Halo Verde Timor
Community Forest Carbon

Project Design Document
2022

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FUNDAÇÃO CARBON OFFSET TIMOR

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Institute for Land, Water and Society
Charles Sturt University

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Contents

Acronyms and Abbreviations

C: Carbon

CBD: Convention on Biological Diversity

CEO: Chief executive officer

cm: centimeters

CO_2: Carbon dioxide

CSR: Corporate social responsibility

CSU: Charles Sturt University

db: Database

dbh: Diameter at breast height

DI: Darwin Initiative

DNAC: National Directorate for Climate Change

ES: Ecosystem services

EU: European Union

FCOTI: Foundation Carbon Offsets Timor

FMNR: Farmer Managed Natural Regeneration

GHG: Greenhouse gases

GIS: Geographic Information System

GoTL: Government of Timor-Leste

GPS: Global Positioning System

GTNT: Group Training Northern Territory

ha: Hectares

HH: Household

HV: Halo Verde

HWPs: Harvested wood products

IPCC: Intergovernmental panel on climate change

MAFF: Ministry of Agriculture, Forestry and Fisheries

masl: meters above sea level

mm: millimeters

MOP: ministry of Public Works

MoU: Memorandum of Understanding

MSE: Mean squared error

NDPA: New Diatuto Protected Area

NGO: Non-Governmental Organisation

PSAF: Partnership for Sustainable Agroforestry

PES: Payment for Ecosystem Services

PSC: Project Steering Committee

PV: Plan Vivo

PVC: Plan Vivo Certificates

RAEBIA: Resilient Agriculture and Economy through Biodiversity in Action

RothC: Rothamsted carbon

SHAMBA: Small-Holder agriculture mitigation and baseline assessment

SOC: Soil organic carbon

t: Tonnes

t CO_2e/ha: tons of carbon dioxide equivalent per hectare

T-L: Timor-Leste

UNFCCC: United Nations Framework Convention on Climate Change

WV-TL: World Vision, Timor-Leste

Glossary

Aldeia: Tetun/Portuguese word meaning hamlet

Holdridge's Life Zones: Global bioclimatic scheme for the classification of lands made by Leslie Holdridge in 1947 and 1967 based on annual rainfall, bio-temperature, and potential evapotranspiration ratios (Holdridge, 1967)

Idaté: Timorese language spoken in the project area

Suco: Tetun/Portuguese word meaning village

Tetun: One of two Timorese official languages; the other language is Portuguese

Title of Project

Halo Verde Timor - Community Forest Carbon.

Executive Summary

The Project Design Document (version 2020) described the Halo Verde Timor Community Forest Carbon project (HV project) developed by GTNT and FCOTI with technical support from CSU and at the time; local Timorese partners WV-TL and RAEBIA. The project, located in the central mountains of Timor-Leste, initiated activities in 2011, conducting reforestation activities with smallholders on their farms. The reforested area has been gradually incremented on a year-by-year basis reflecting availability of resources. To account for expansion of the project, the PDD has been modified to the present version (2022). It now includes new additional areas in the original area of interest (central mountains of Laclubar and Soibada – referred to in the project as Northern region) and a new additional area (southern areas of Manatuto and Viqueque Municipalities - referred to as Southern region). Some of the benefits to farmers participating in the project include income diversification from payments generated by the carbon they will sell, and from improvements on land productivity through agroforestry production and reduction of fertility losses from erosion and water runoff. Reforestation activities have started to show the return of birds, small mammals and reptiles in areas where previously fauna was absent or scarce. The project is empowering the community through creation of farmers groups, environmental educational campaigns and promotion of other livelihood activities that includes a female microfinance initiative and scholarships for secondary and tertiary local students, amongst other initiatives.

The project, under the two combined areas have planted approximately 150 ha in 262 sites, with direct participation of 223 households benefiting more than 1400 individuals. The project is aiming for a total reforested area of approximately 350 ha by the end of 2029. The project interventions consist of ecosystem rehabilitation through reforestation and improved land management through soil management. The project will span 30 years, including trees planted since 2011 and future plantings. A payment period of 10 years of ex-ante credit sales is envisaged. Some of the benefits to farmers participating in the project include income diversification from payments generated by the carbon they will sell, and from improvements on land productivity through agroforestry production and reduction of fertility losses from erosion and water run-off. Reforestation activities have started to show the return of birds, small mammals and reptiles in areas where previously fauna was absent or scarce. The project is empowering the community through creation of farmers groups, environmental educational campaigns and promotion of other livelihood activities that includes a female microfinance initiative and scholarships for secondary and tertiary local students, amongst other initiatives.

The climate benefits of the project were assessed using the Plan Vivo-approved SHAMBA (Small-Holder Agriculture Mitigation Benefit Assessment) model by calculating the changes to biomass and soil pools. The outputs from SHAMBA were also used to calculate carbon stored in harvested wood products. A baseline of 2.86 tCO_2e/ha and 3.05 tCO_2e/ha is estimated for Northern and Southern regions respectively and a 15% risk buffer were applied to the gross estimations, accounting for a net climate benefit average of 230 tCO_2e/ha.

Part A Aims and Objectives

A1 Specific objectives

The HV project aims to rehabilitate areas owned and managed by impoverished local farmers in the central mountains of Timor-Leste. Specific goals of the project are:

1) Reforestation of approximately 350 Hectares by end of 2029 with potential for expansion in area and number of participants beyond that year.
2) Certification of the climate benefits generated by reforestation and soil management activities conducted by farmers since 2011, while improving biodiversity in the area and livelihoods of the community.
3) Marketing of the certified carbon generated by activities initiated in 2011 and staged payment to farmers for their carbon according to a PES agreement, signed between famers and the in-country project coordinator (FCOTI) (hereafter referred to as the project coordinator).

Key specific problems the project is addressing are part of Sustainable Development Goals (SDGs), which correspond to Timor-Leste's agenda on sustainable development (GoTL, 2017) including:

- SDG 1: End of poverty through income generation and community livelihood diversification
- SDG 2: Zero hunger by introducing agroforestry systems (consumption and income) and promotion of organic soil fertility building activities
- SDG 4: Quality education through capacity building of local community members in natural resources management, biodiversity conservation, basic forest inventory and carbon monitoring. It is expected that with higher incomes, parents are likely to be in a better position to afford education for their children
- SDG 5: Gender equality by encouraging female participation and roles in the project, and by supporting the livelihood development of female participants through the "rural women micro grants" scheme
- SDG 13: Climate action by reducing deforestation and associated emissions and by increasing

carbon stocks through reforestation. Project activities will also reduce the impact of droughts and torrential rains

- SDG 15: Life on Land by reversing soil erosion and degradation and reducing deforestation and biodiversity losses.

A2 Retroactive certification

The goal of the project since its inception has been to create carbon certificates, and through sales of the certificates to ensure ongoing financial stability of the project. This was the original goal of the project and we have continued with this objective. To date, the project has not generated carbon certificates and no offsets have been transacted.

The project, initiated in 2011, has been developed with funding from donations made by individuals and not for profit organisations, and since 2013, by the Group Training Northern Territory –GTNT (Darwin, Australia). Up to July 2017, the limited financial resources were used to purchase nursery materials, seeds and agricultural tools, establish nurseries, transport seedlings to planting sites, and actual planting of trees. The remaining funding was used to pay farmers a small incentive to take care of their trees, and to pay the salaries of the local Timorese staff (1 project manager and 5 field staff). Other team members from Australia volunteered their time and expertise on a part time basis.

Since 2011, the project attempted to procure the required finance to enter the certification process with the objective of moving from a donor-based model to a community-driven climate change mitigation business model. Following a number of failed applications for funding to governmental organisations and the private industry, the project established a partnership between GTNT, Charles Sturt University –CSU- (Albury, Australia) and local Timorese organisations Raebia and World Vision Timor-Leste, finally succeeding in receiving a Darwin Initiative (DI) Grant in mid-2017.

Based on the original objectives of the project and our interests in gaining certification for its activities since the beginning, we are seeking retroactive certification of the carbon stored by trees planted since 2011. This is seen as a key financial aspect of the project that will contribute to continuing work with farmers that have been part of the project since the beginning. It will also contribute to expansion of interventions and inclusion of additional households and farmers that have expressed interest in the past in becoming part of the project. A compendium of documents showing the history of the project and early interest in carbon certification is included in Annex A2.

Part B Site Information

B1 Project location

The project is located in Timor-Leste within the Manatuto and Viqueque Municipalities (Figures B1. and

B2). The project comprises two areas: Northern (the original area included in the 2020 PDD) with 74.8 ha and Southern (Annexed to project and PDD in 2022) with 77.4 ha. The combined total area of the project is 152.2 ha. Both areas are detailed in section B2.

Reforestation sites (future and existing Plan Vivos) are located within the coordinates 125.75E – 8.48S and 126.6E – 9.05S. A map of each site is provided to every project farmer in hard copy (example in Figure B3). The spatial data (shapefiles) corresponding to these maps are included in Annex B1. Examples of eligible areas and actual project sites are shown in Figure B4. The process for site selection and land use classification are included in section G2.3.

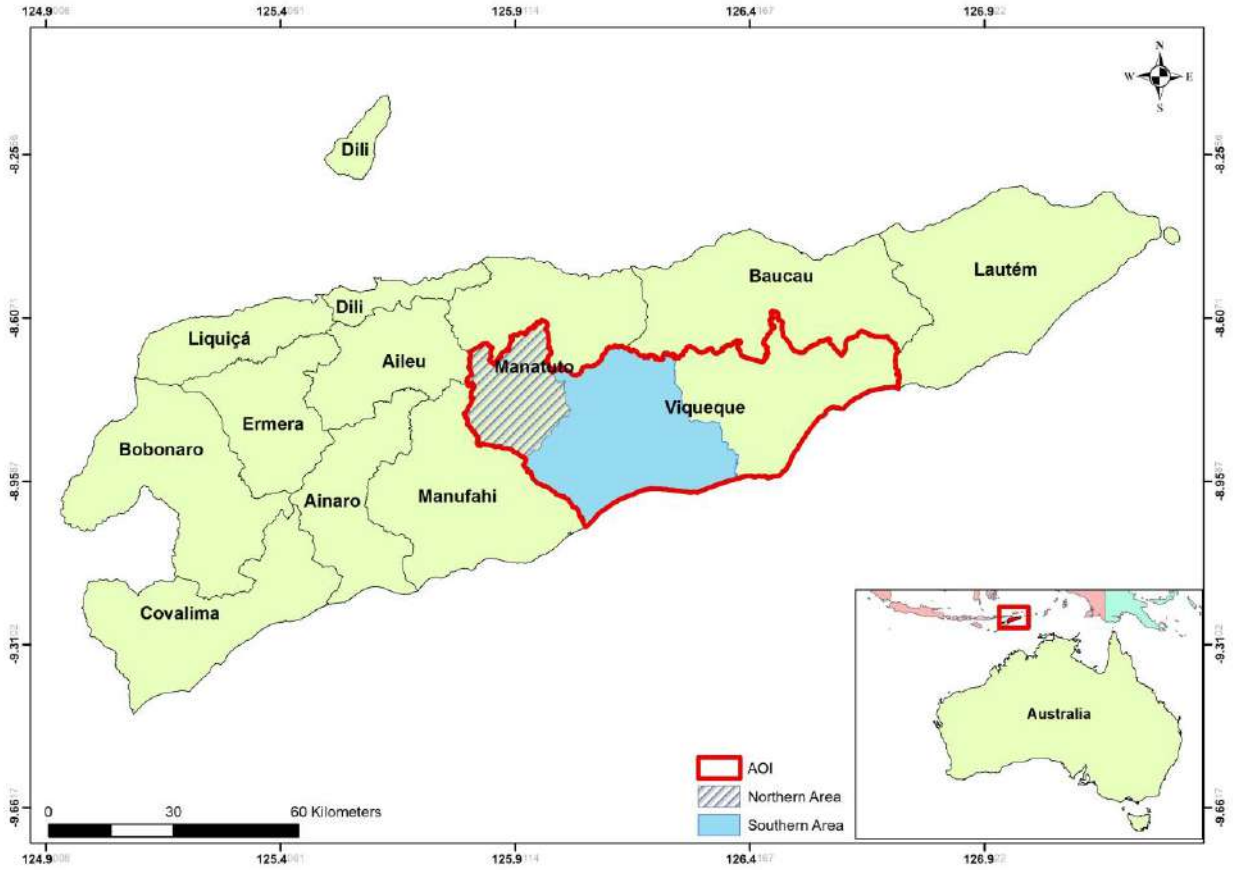

Figure B1: Project Location

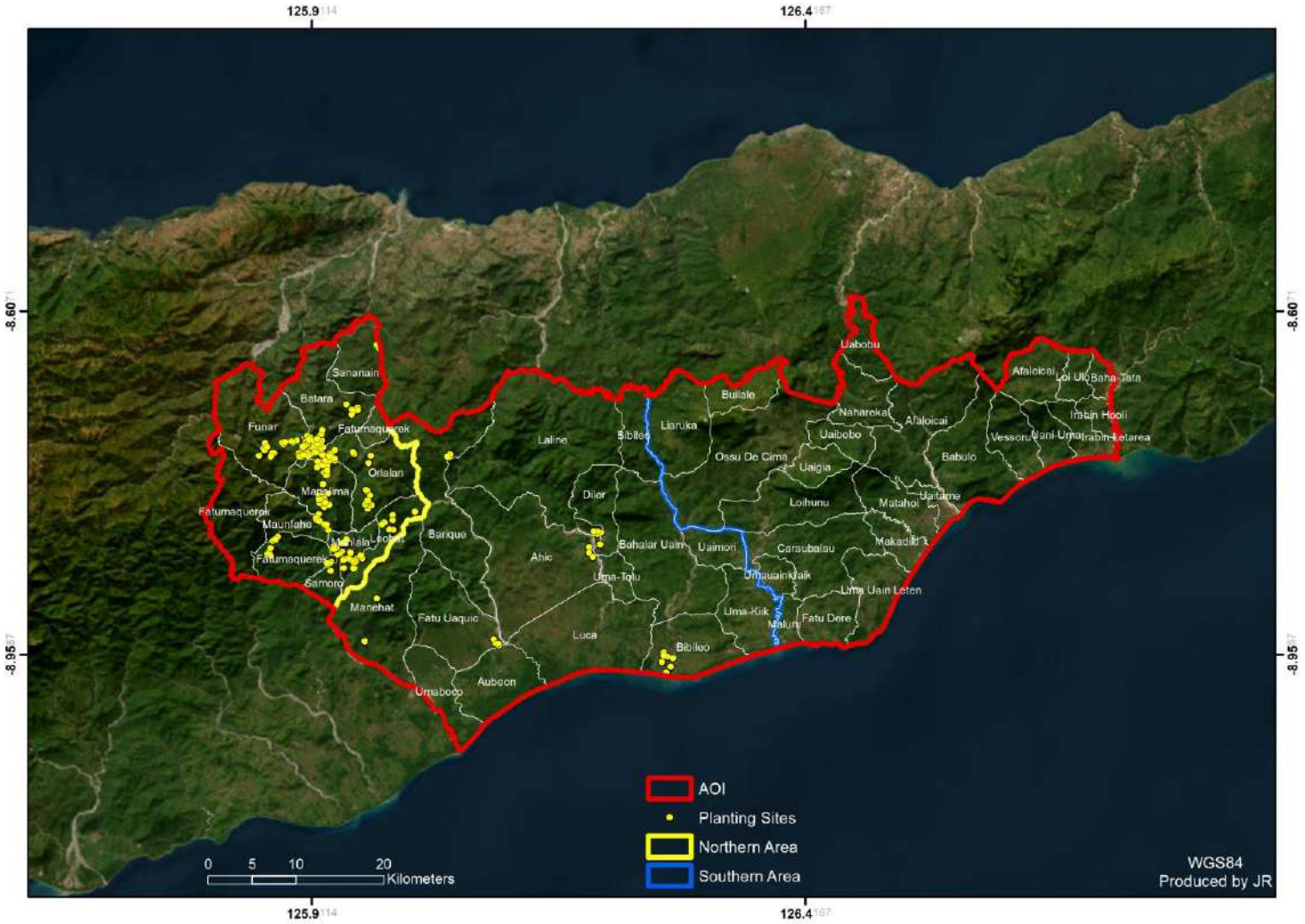

Figure B2: Project Areas and Planting Sites Distribution

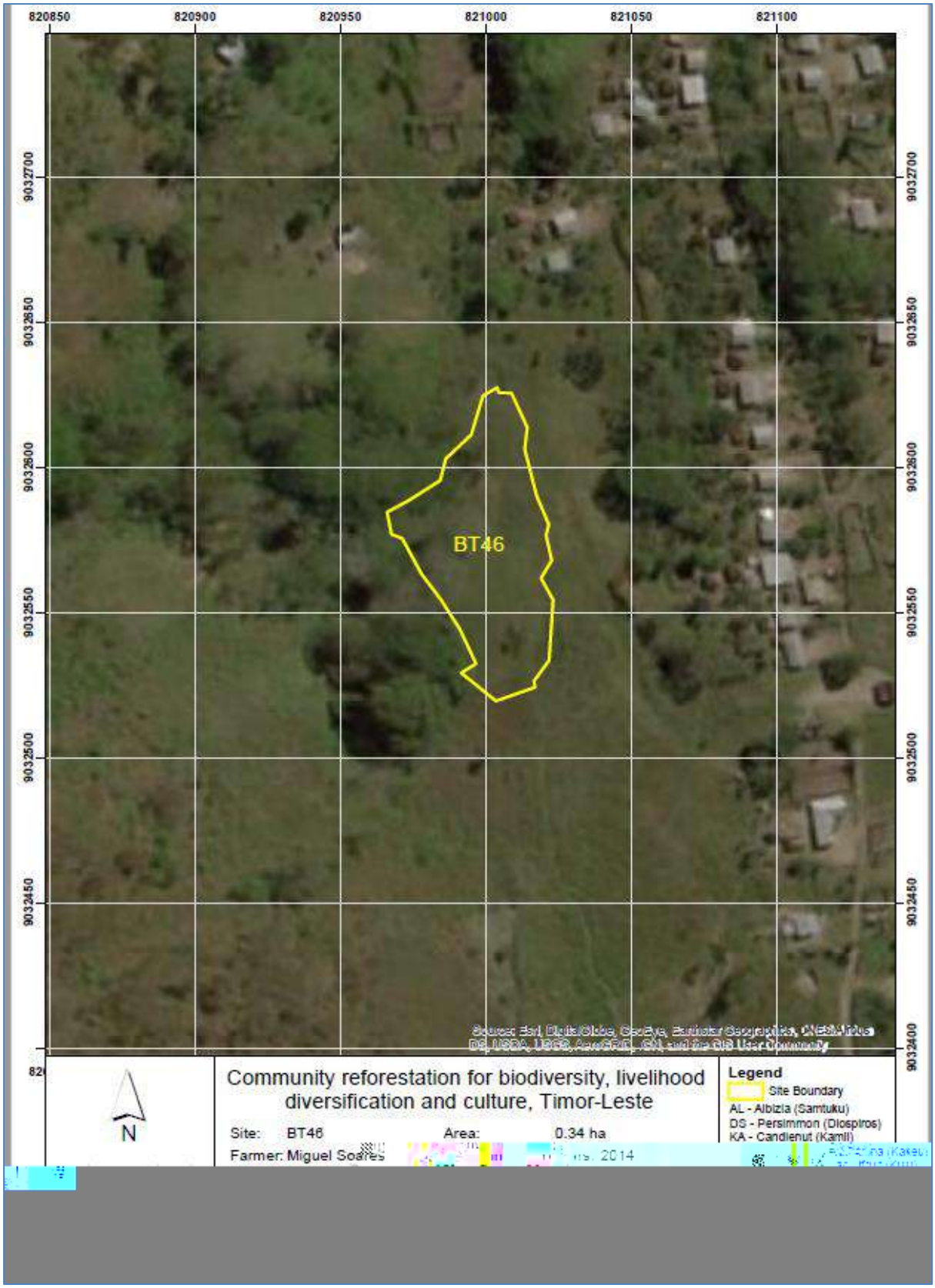

Figure B3 Example of Planting Site in the Project

Figure B4 Examples of pre-reforested sites (top) and project sites post-intervention (bottom) (Laclubar, 2018).

B2 Description of the project area

Northern region: It includes the Manatuto municipality comprised mostly by moist lowland forests (Holdridge's Life Zones) and plantings predominantly in Laclubar and Soibada localities (Postos).

Dominant remnants of vegetation in the region are *Eucalyptus urophylla* and *Eucalyptus alba*. Laclubar has an average precipitation of 2008 mm/year and maximum temperature of 27.7 °C. The average precipitation of Soibada is 1866 mm/year with temperatures of up to 30.7 °C (Seeds of Life, 2015). The topography of the area is predominantly steep, with gradients of up to 40% around Laclubar and Manatuto with slopes of up to 23% in Soibada (project data). Sandy soils are prevalent in Laclubar with some clay and loamy soils in Manelima and Soibada. Manatuto soils are predominantly sandy-loam.

Southern region: An addition to the original AOI; it comprises the Viqueque municipality and southern part of Manatuto municipality. The region comprises lowland forests and dry forest (Holdridge's Life Zones) in areas below 1000 masl. Montane forests and Eucalyptus woodland habitats are found in higher areas (Trainor 2010). The additional project sites (added in 2022/2023) in southern region are located in Barique-

Natarbora, Lacluta and Viqueque Villa (Postos). A summary of the characteristics of both areas follows:

Table B1: Physical characteristics of the project area

Location	Average Precipitation (mm per year)	Temperature (°C) Min.-Max	Altitude (masl range)	Slopes (maximum %)	Predominant Soil Texture	Soil pH range
Northern region (Laclubar/ Soibada	1937	15.2 – 30.7	300-1350	40	Sandy Loam	5.6 - 7.1
Southern region (Manatuto-Viqueque)	1675	19.1 – 34.1	50-1200	35	Sandy Loam, Clay loam	5.0-7.9

The soils of both areas which are typical of Timor-Leste are derived from limestone and metamorphosed marine clay which are low in fertility. The steep slopes are mainly covered only with thin soils which have low organic matter and water holding capacity (FAO, 2008).

There are 3 major types of soils found in Timor-Leste: cambisols, vertisols and fluvisols, of which, cambisols are generally found in the project region. This type of soils is relatively low in fertility and prone to erosion (FAO, 2008).

Water is in surplus during the wet season with unreliable supply during the dry season. The main river in Laclubar is the Wer Urun, which is a no-perennial water course and the Mota Sahen River in Soibada which is perennial. The main rivers in Manatuto are the Lauclo and Caraulun (Project information 2020).

Some of the project sites are located nearby the New Diatuto Protected Area (NDPA) along the South West area of the project. The NDPA has been classified by Birdlife International as an Important Bird Area (IBA) as it provides habitat to endangered and near threatened species of birds including the Yellow Crested Cockatoo (*Cacatua sulphurea*), Timor Green Pigeon (*Treron psittaceus*) and Timor Imperial Pigeon (*Ducula cineracea*) among others (Birdlife International, 2018). The Black-banded Flycatcher (*Ficedula timorensis*), which is also a near threatened species of birds (IUCN, 2019), has been reported by farmers in planting sites located in Laclubar. The sighting of this bird was confirmed during a biodiversity pilot (see Annex B2) and a capacity building exercise in 3 planting areas during 2018; conducted by the project in collaboration with Conservation International TL. Depending on availability of financial resources a biodiversity baseline will be conducted across project sites, degraded areas, and forested land (details in Section K3.2) aiming to enhance the project's information on biodiversity.

B3 Recent changes in land-use and environment conditions

In 2016, 67% of the population of Timor-Leste (T-L) was rural, with an annual population growth rate of 1.3% (World Bank, 2017). This high population growth has increased demand for agricultural land, energy and wood, leading to annual deforestation rates of 2.18% (T-L, UNCFCC, 2014). The population relies heavily on firewood for cooking and timber for fencing and construction. Extraction of non-timber forest products, such as palm wine and honey, are important livelihood streams for the community. Coffee is grown in association with shade trees such as Albizia, while other crops, like cassava, corn and pineapples, are grown as single crops or mixed with trees.

B4 Drivers of degradation

Key causes of degradation and deforestation in the project area include population growth, demand for agricultural land and harvesting of timber for construction, cooking needs and fencing. Wildfire and overgrazing are also contributing factors to increased degradation (Bond and Millar, 2018).

Common to the project area is the use of slash and burning activities to prepare the land for annual crop planting. This takes place between September and October, prior to the intense November-March wet season. Combined with increased deforestation, this makes the land vulnerable to landslides, soil fertility losses and erosion. During the dry season strong winds are also contributing to erosion processes, specially where ground cover is poor, while high temperatures impact soil structure affecting the ability of the soil to absorb water (FAO, 2008). The issue of poor water infiltration has already impacted some parts of the country, where spring-waters, which are the major water sources for most households, are reported to have dried up in upland areas (FAO, 2008).

Other signs of degradation visible in the project region, are river bank erosion and evidence of weed infestation by *Lantana camara* and siam weed (*Chromolaena odorata*) at elevations below 1000 meters. Besides suppressing other vegetation such as *E. alba*, siam weed contributes to intense fires during the dry season (Day et al. 2010).

Construction of a new road from Dili to the South coast will facilitate access to the region and mobility of people. This could become a contributing factor to additional deforestation and degradation in the area.

Part C Community and Livelihoods Information

C1 Participating communities/groups

The participating communities are in the Administrative Posts of Laclubar, Barique-Natarbora and Soibada in the Municipality of Manatuto and the Administrative Posts of Lacluta and Viqueque Vila in the Municipality of Viqueque. According to the 2015 census data, Laclubar and Soibada Administrative Posts have populations of 12,050 and 3,294, respectively (DGE 2015). Meanwhile the new additional sites of Barique Natarbora has a total population of 5,438 based on the same 2015 population data. Lacluta and

Viqueque Villa in the Municiplaity of Viqueque have populations of 6,808 and 25,755 respectively. The current five participating farmer groups represent Soibada, Batara, Funar, Orlalan, Manelima and Sananain villages within Laclubar and Soibada Administrative Posts, with a total estimated population of 11,000. Within the expanded site to the south of Manatuto and Viqueque, there will be at least one more farmers' group that will be established to cater for new project participants.

- Cultural, ethnic and social groups

The main language of Laclubar Administrative Post is Idaté, a close relative of Tetun, one of the national languages (Bovensiepen 2011). There is no ethnic variation amongst the participating communities. The main language of the expanded sites across Barique-Natarbora, Viqueque Villa,and Lacluta Administrative Posts is Tetun-terik with slight variation between Tetun terik spoken in Barique-Natarbora and Tetun Terik spoken in Lacluta and Viqueque Villa . The population of southern region of Barique-Natarbora, Lacluta and Viqueque Villa are mostly farming communities in rice field cultivation and agroforestry and livestock. Most of these communities are difficult to access specially during wet season. Majority if not all community members in this region are catholic but do celebrate traditional rituals through the offering of animal blood specially during harvesting of crops, funeral and inauguration of traditional sacred houses and other form of rituals. There has been a precedence of local institutions in the fields of crop production, sewing, and savings groups. While some groups have folded due to loss of resources or mismanagement, others, such as the coffee group and community savings schemes, remain strong. The Maubere Mountain Coffee is an example of well-structured and executed local capacity. The Alola Foundation has established, and continues to support, women's savings groups in Soibada and Funar.

- Gender and age equity

The 2015 national census reports gender ratios (number of males per 100 females) in Laclubar and Soibada as 100.2 and 102.2 respectively (DGE 2015). Meanwhile, gender ratios for Barique-Natarbora has a sex ratio of 113.25. Lacluta and Viqueque Villa have sex ratios of 107.06 and 103.02 respectively (DGE 2015). The household survey conducted in 2017 showed average family size of seven members (Bond and Millar 2018 – see Annex C1), similar to the Municipality average of 6.8 (DGE 2015). Household heads were reported as mostly middle-aged males. The traditional gendered-division of labour is consistent within households in the project area, where women take greater responsibility for caring and domestic duties while men spend more time in outside activities and decision-making (Bond and Millar 2018). The Timor-Leste Constitution states that males and females are to be treated equally and provides protection from discrimination based on gender (DFAT 2018).

C2 Socio-economic context

C2.1 Livelihood activities including access to land, natural resources and energy

The majority of participants are farmers producing subsistence and cash crops. The 2017 household survey (Bond and Millar 2018), found that the average land area available to households for cropping was 2.3ha (ranging from 0.5 to 8.0ha), while the average land area available for natural forest products was 1.8ha (range 0.25 to 6.0ha) and an average of 1.5ha (range 0.5 to 4.0ha) for livestock. Ninety-five percent of households own their traditional land and five percent of households use communal land. Twenty types of food crops were grown including taro, cassava, potato, yam, corn, banana, arrowroot, candlenut, avocado, pineapple, mango, orange, breadfruit, jackfruit, pomelo, lime, coffee, bean, betel nut and coconut. Forty-eight per cent of households interviewed consume only their produce and 53% of households both consume and sell their produce. One third of households surveyed (33%) raise livestock. Of those that keep livestock, the most common species are cows/buffaloes (85%), pigs (77%), horses (69%), goats (54%) and chickens (46%).

Eleven timber varieties were grown including mahogany, casuarina, albizia, teak, black eucalyptus, palm, gamal, bamboo, and banyan. Thirty-five percent of households interviewed grow mahogany, while other common trees grown are albizia (38%), black eucalyptus (28%) and gum tree (23%). Eighty per cent of respondents claimed to grow crops under the trees within their plantation.

All Sucos have electricity but most households use firewood for cooking. Timber is harvested for firewood and fence posts generally from neighboring forest remnants. Some households sell timber for housing and furniture. Traditional medicine and honey are commonly sold whilst fruits, nuts and tubers are important for consumption with 30% of households also selling them. Water shortage is common during the dry season for both human and livestock consumption and is a major limitation for establishing tree plantations.

C2.2 Cultural and religious context

The population is Catholic with strong connections to their diocese and churches. Most families attend church services on Sundays and throughout the week. However, traditional customs are still practiced. The main cultural system in Timor-Leste is *Lulik*. *Lulik* refers to a family's connection to ancestral leadership. *Lulik* determines family status, marriage exchange, gender roles and social exclusion (Brogan and Mepham 2017; Molnar 2010). Tara -bandu is a traditional Timorese custom of relying on social agreement to determine community law and social norms for social cohesion and conflict management (The Asia Foundation 2013). This custom is the process through which the relationship between humans and the environment is normalised (Soares 2012).

C2.3 Assets and incomes/poverty status

The communities where the project is located are categorised as poor households when compared to the national per capita income. The household survey conducted in 2017, found the average household annual income to be US$938, equivalent to US$2.6/day (Bond and Millar 2018 – see Annex C1). By contrast, Timor-Leste's annual per capita income is US$5,371 largely due to urban income in the national capital, Dili. A few survey respondents had off-farm employment in the public sector, for example as a school teacher or administration assistant. In terms of average annual income, palm wine is the most lucrative ($526), followed by non-farm jobs ($493), forest products ($450), coffee ($307) and livestock ($278). There is less income from fruit crops ($67), field crops ($35), and firewood ($34).

Most people own their own homes in both Soibada and Laclubar. Very few participants have cars. Traders own trucks and most families have a motorbike. People travel to Dili and other Municipalities by public bus. There are health clinics in almost each suco, however most are under-resourced. The same description also applies to new additional areas of Barique-Natarbora, Lacluta and Viqueque Villa. However, it is worth noted here that as of late 2022 the main road from Dili, the Capital of Timor-Leste to Natarbora has been mostly paved with asphalt. The road from Natarbora connecting Lacluta and Viqueque Villa however is still very dilapidated and the lack of bridges make the road impassable during wet season which is normally occurs from December to June.

C3 Land tenure & ownership of carbon rights

Land tenure in the project area, as in most parts of rural T-L, is based on customary land rights. In the context of T-L, the core principles of customary land are origin (first possessors of areas of land) and alliances resulting from kinship (blood relations and marriage) (Fitzpatrick *et al*. 2008). Among farmers participating in the project and the community at large, there is a common understanding relating to land ownership (who owns what) and the boundaries of properties.

Land tenure status has been corroborated by the project through local stakeholder consultations, conducted since 2010, prior to project commencement. During stakeholder consultation sessions that took place in September 2017 and September 2018, land tenure was once again discussed. The consensus among farmers and government stakeholders is that land tenure conflicts in the region are uncommon. The stakeholder consultation also included the National Directorate for Climate Change (DNAC), Ministry of Agriculture, Forestry and Fisheries (MAFF) and local authorities (Administrative Posts) as well as Sucos' leaders who have endorsed the project. The project has, and currently is, implementing activities on land owned by smallholders where no land disputes are occurring and where disputes are unlikely to occur. The Government is implementing a Land Law Tenure framework that came into force in April 2017 aiming to formalize land tenure. For reasons aforementioned, it is expected that land tenure of project participants

will not be negatively impacted by this law.

Following due diligence by the project; only sites owned by farmers who are not involved in land tenure issues are selected by the project. To reduce and mitigate the risk of land disputes, project participants have agreed to provide land ownership declarations. These are signed by each farmer and formally recognised / witnessed by the local community leader, neighbors and the Administrative Post authority. A sample is included in Annex C2.

Part D Project Interventions & Activities

D1 Summary of project Interventions

Key project interventions we intend to get Plan Vivo (PV) certification for are: Ecosystem rehabilitation (reforestation) and improved land management (soil management). Ecosystem restoration via farmer managed natural regeneration (FMNR) is another intervention we are implementing although at this stage not selected by the project for PV certification.

D1.1 Ecosystem rehabilitation

The project has and will continue reforesting privately owned degraded and ex-farming lands. These areas are mostly located in steep terrain with some sites showing little ground cover.

The main trees planted to date are *Casuarina sp*, *Swietenia macrohpylla* (mahogany) and *Gmelina arborea (*gmelina */ gamhar).* Other species that have been planted in smaller quantities are *Tectona grandis* (black teak), *Paraserianthes falcataria* (Albizia) and *Gliricidia sepium* (gamal). An addition to the project in 2022 is *Toona sureni* (red cedar). Casuarina, red cedar and albizia are native to Timor. The other trees are naturalised species to the region (Figure D1). Tree nursery production is managed by farmers with full technical support from FCOTI. Every year different farmers are given the opportunity to manage nurseries in their lands and to join the project.

Figure D1: Example of project area reforested with mahogany (Lacublar)

The selection of species is based on farmers' preferences and suitability of trees to the physical conditions of the project sites, which often include areas with challenging soil conditions (Figure D2).

A planting assessment procedure is in place to facilitate site selection and participation of farmers. Farmers have received training on tree planting, basic soil tests, contour planting and farm land-use planning, complemented with technical assistance provided every year during the planting seasons by the field team.

Figure D2: Example of area to be reforested (Laclubar)

As of May 2019, there are 115 households directly participating in the project, which equates to roughly 800 individuals. They have planted 151 sites totaling 74.8 ha. The area of the sites included in the project ranges from 0.02 ha to 3.6 ha (average of 0.5 ha), while the size of farms ranges from 0.5 ha to 8 ha.

D1.2 Improved land management

Farmers from Soibada and Laclubar are receiving training on soil management through ground cover promotion, fire exclusion and terracing techniques (Figure D3). Farmers are instructed about the use of compost and mulch to nurture food crops, such as sweet potato, cassava, beans and other vegetables as well as seed saving techniques. We are taking this activity one step forward by ensuring implementation and permanency of this intervention through PV certification and on-going monitoring.

Figure D3: Farmers receiving training on terracing techniques

D1.3 Ecosystem restoration

Through a partnership with World Vision Timor-Leste (WV-TL) and farmers; the project is implementing natural forest regeneration activities, currently under trial on 7 ha of farmers' land. This was initiated in December 2017 with demonstration sites established to create awareness of the activity and its benefits among local farmers.

The Farmer Managed Natural Regeneration (FMNR) conducted by project participants includes isolation of some of their areas within their farms to encourage natural seedling propagation, harvesting of defective stems for firewood and preservation of straight stems for future harvesting of high value timber (Figure D4). The species managed are native eucalyptus trees that otherwise would be harvested. Through sustainable harvesting of timber and coppicing practices, the activity reduces deforestation. FMNR also encourages sapling growth, reduces erosion and soil nutrient losses, and improves water retention. Subject to future FMNR area increments and increased farmers' participation in this activity, the project will consider its inclusion in the HV project with the goal of claiming climate benefits under PV.

Figure D4: Farmer conducting FMNR activities on his land (Laclubar)

D2 Summary of project activities for each intervention

Table D1: Description of activities

Intervention type	Project Activity	Description	Target group	Eligible for PV accreditation
Ecosystem rehabilitation	Reforestation	Planting of trees as woodlots (single tree plantings), agroforestry systems and living fences.	Smallholder farmers	Yes
Improved land management	Soil management	Increased ground cover, fire exclusion and awareness creation of benefits from soil management activities	Smallholder farmers	Yes
Ecosystem Restoration	Farmer managed natural regeneration (FMNR)	Sustainable management of native forests using pruning and coppicing techniques and promotion of	Smallholder farmers	PV certification not sought at this stage

		natural regeneration		

D3 Effects of activities on biodiversity and the environment

We expect that the interventions summarised in Section D2 will have a positive impact on biodiversity through habitat creation for local fauna. During a community participative mapping exercise in late 2018, farmers mentioned that birds and reptiles were returning to areas where tree planting was taking place as compared to deforested neighboring areas. In 2018, Conservation International conducted a wildlife monitoring training exercise with FCOTI staff in Laclubar, during which they found 21 bird species, 5 reptile species and 2 small rodent species (Conservation International 2018). Some of these species are also found in the Mt Diatuto Protected Area which also has endangered bird species (Birdlife International 2018; Trainer et al. 2007). A more comprehensive biodiversity baseline study may be undertaken , subject to availability of financial resources todetermine species distribution and composition across five habitat types (4 remnant native forests, and the agroforestry plantation sites) details are included in section "K3.2 Biodiversity Indicators". This study will set the baseline for on-going monitoring of biodiversity in the PV project sites.

With regards to environmental impacts, during the history of the project, a reduction in the incidence of wildfires has been observed. The Administrator from Laclubar (Administrative Post) has reported that the number of wildfire incidents reported in the region has gone down from 59 in 2010 to about 7 in 2018. He attributed part of this change to awareness generated by the project among community members (Project coordinator pers. communication, April 2019).

We are introducing measures to monitor any potential negative impacts on the environment generated by the project.

Although not observed during the history of the project, and overall, in TL, we are vigilant to uncontrolled growth of native and naturalized trees outside project sites. Control measures include monitoring of neighbouring areas by the field team and communication with farmers and farmers groups, asking them to alert the project in the event of natural regeneration of these trees outside project areas to then introduce early eradication actions if needed.

Reasons why we believe uncontrolled regeneration outside project areas by our trees are not a concern include: a) The relatively small number of trees planted, especially of species that in other countries might be regarded as invasive (i.e. *Gliricidia* and *Gmelina*) b) No evidence or reports of any of the species planted by the project showing signs of being invasive around the project area or elsewhere in TL

c) Soil fertility is not conducive for easy propagation or invasion of the trees planted d) Any wild trees

growing outside project areas are likely to be harvested by the community e) The IUCN[1] database "*invasive species specialist group"* (ISSG) which identifies invasive species in TL, does not include any of the species planted by the project nor has the GoTL identified them as invasive.

We are also searching for options to reduce the use of seedlings' poly-bags and re-use where possible. Chemicals are not used by the project and measures are taken during the planting season to avoid soil degradation, including small swells for each tree planted and the use of a wooden "A" frame for marking contours and facilitating planting in slopes. Details of measures to reduce erosion from planting activities are included in annex G1 Plantation management. It describes site preparation recommendations such as ways to dig planting holes, mounding and how to plant in sites prone to drought or inundation. Sections D, G and K describe activities aiming to reducing overall soil erosion through ground cover promotion and fire exclusion.

Part E Community Participation

E1 Participatory project design

The project started in 2010; since then, regular consultation with the community and project participants has taken place. The project identified, together with the community, that food security and land degradation were interlinked and the interest of the community was to address these issues through tree planting and improvements in crop production in marginal areas. This was later validated through the project's social survey (See Annex C1). Recent consultation milestones of the project in Laclubar and Soibada involving farmers and community in general are:

- September 2017, a meeting to set up the basis for project governance and to improve tree survival tree propagation and distribution of materials. The project continued facilitating discussions between farmers to identify aspects where the project could improve its activities and technical specifications as articulated by farmers themselves. Key outputs of these discussions included modification to tree nursery production, improvement of planting plans and community planting options. A summary of directions given by farmers during these discussions are included in Annex E1 documents " Input to project tech specifications by farmers " and "Farmers input LSC" documents.
- September 2018, a consultation took place to receive feedback from farmers on conservation areas, biodiversity observations and risk and to inform farmers about the introduction of the PV model and the process to design their own Plan Vivos. This was also an opportunity to explain the objectives of PV agreements, inform and consult aspects where the project could improve with special focus on species

[1] http://issg.org/database/species/search.asp?st=sss&sn=&rn=Timor-Leste%20(East%20Timor)&ri=18888&hci=-1&ei=-1&fr=1&sts=&lang=EN

matching site conditions and tree planting in slopes.

- This was followed by a consultation meeting in early 2019; where the basis of a Payment for Ecosystem Services (PES) contract, creation of farmers groups and a common fund was discussed and approved by project participants (minutes of meetings and signed attendance samples are included in Annex E1).

The involvement of community members has been and will continue to be achieved through:

- Regular community consultation meetings with the project coordinator
- Participation of farmers on farmers groups and Project Steering Committee (PSC)
- Training and capacity building sessions
- Dissemination of project information through brochures distribution and talks during Sunday Church Masses and community markets.

The design of PVs in the project takes into consideration the following aspects:

a) Livelihoods: During the participatory process, it has been collectively agreed by the community that this project enhances the participants' livelihoods and considers their local needs. The social survey conducted in 2017 (see Annex C1) indicates increased income by around US$480 on average. Agroforestry systems also promoted by the project will continue contributing to income and livelihood diversification, as well as improving food security.

b) Enhanced biodiversity: As mentioned in Section D3, farmers have seen a positive increment on the presence of birds and reptiles across planting sites when compared to degraded adjacent areas. The project is actively promoting and encouraging planting of additional native species. However, it will continue to use naturalized species, where appropriate, taking into consideration that some of these species might be better suited to poorer soils than native trees.

c) Local customs: A key element of success in natural resources management in the project area is the implementation of a *Tara Bandu* ceremony (see Section C); which is a respected custom law in rural Timor-Leste. During several consultations with participants, one of the key aspects that was identified as a potential issue related to animal grazing. The community agreed that the most effective solution would be to perform a *Tara Bandu* ceremony in which it becomes custom law the exclusion of animals and protection of the trees planted. When farmers disrespect this law, they will be fined based on a common agreement reached at the ceremony. The conditions of the law and its application is 100% a community affair, but one that the project supports and respect.

d) Land availability and tenure: The project is implementing activities in areas where: 1) There is not risk of displacing agricultural activities and/or firewood collection and 2) where there is not known land tenure issues. To further reinforce land tenure, a land ownership declaration was signed by farmers with approval and endorsement of local leaders and neighbors as witnesses. Farmers who plant trees but do not own the

land signed a separate agreement with the land owner of those sites. Samples of these agreements are presented in Annex C2.

E.1.1 Target groups and governance

The target groups are the rural communities of Laclubar and Soibada, comprising nine villages -Sucos-, (see Section C1). Participation of farmers from these Sucos in Plan Vivo design and project management is channelled through five farmer groups and PSC. Details of governance are in Section I.

E.1.2 Barriers to community participation

This project aligns with Timor-Leste's gender equality framework through project activities which simultaneously acknowledge traditional gender roles while promoting women's empowerment. There is room for institutional capacity development, particularly in relation to providing opportunities and support for women to move into decision-making roles. This is achieved through a gradual increase in women's empowerment from a starting point of inclusion and participation, such as in training and capacity building activities, being promoted further to leadership roles with greater decision-making responsibilities. Steps which the project are taking towards gender equity are the inclusion of females in field monitoring activities and provision of scholarships for girls and boys to attend the local school in Lacublar and Universities in Dili.

In addition to women, the project also acknowledges and includes other marginalized groups (such as landless households, older citizens and veterans), through nursery operations and other project-related activities, such as training days and membership at the PSC. The project also has an environmental education program aimed at primary and secondary students, benefiting approximately 90 students. The project is further developing communication channels through an input-and-grievance mechanism, not only for the participants, but also for other community members keen to express their opinions.

The project is further strengthening local organisational capacity by facilitating the creation of Plan Vivo farmer groups and a PSC (see Section I).

E2 Community-led implementation

E.2.1 Preparation and registration requirements for plan vivos or management plans

In September 2018, there was a 3-day introduction to the PV process and training delivered by CSU, which involved all participants as well as the field team. Mock PVs were prepared by groups of farmers with assistance from the field team; followed by site visits to farmers who needed assistance with their PVs (Figure E1).

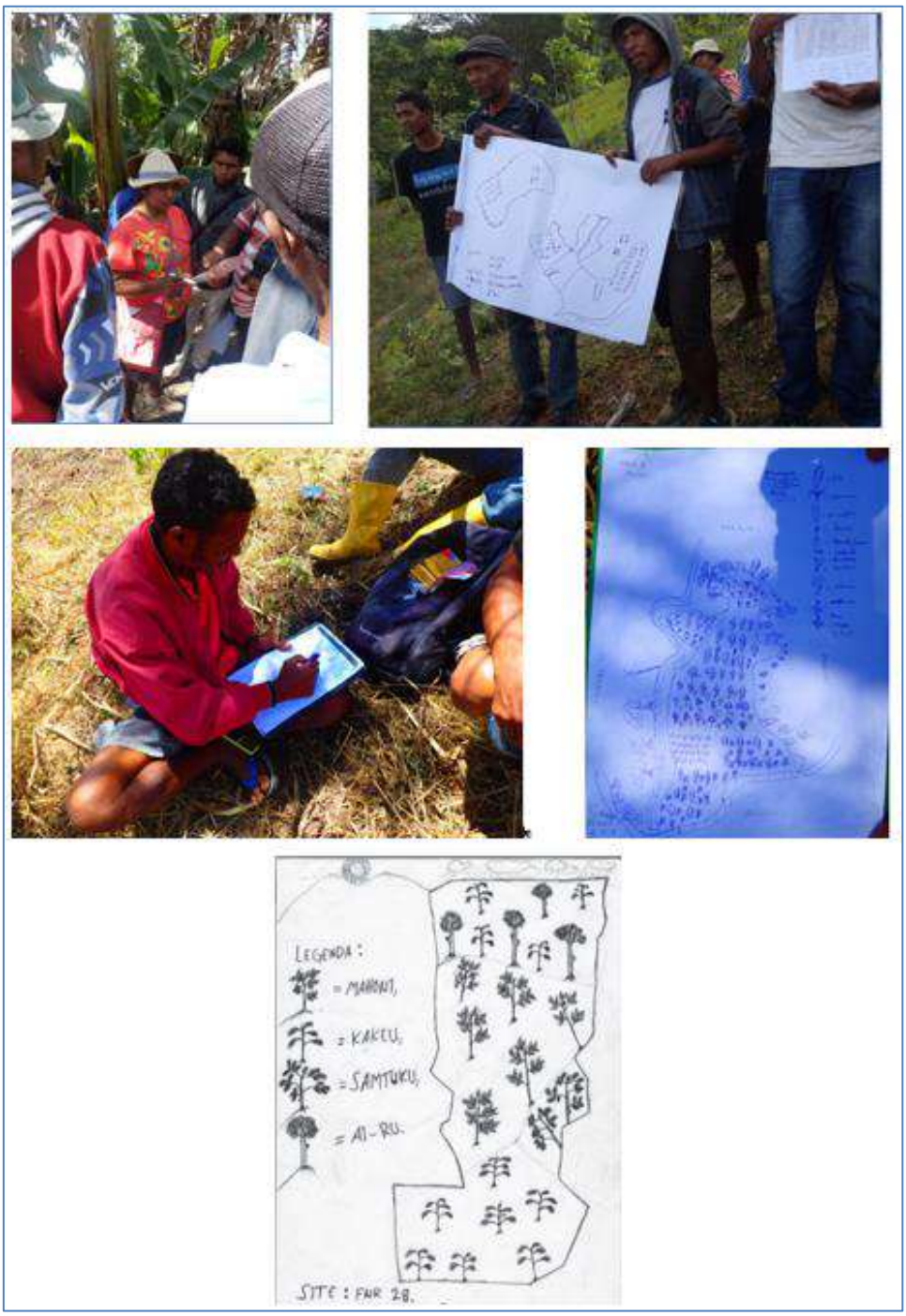

Figure E1. Training of Farmers on Plan Vivo Design

The field team has also been trained on Global Positioning System (GPS) use and ways to assist the farmers in the preparation of the PVs. Induction and training on preparation of PVs similar to the one described above will be delivered every year to new participants.

E.2.2 Mapping, recording and storage of plan vivos

The initial step is for the field team to conduct an assessment of a potential project site based on land tenure, physiographic characteristics and capacity of the participant to be part of the project. This is carried out using the Plantation Management Procedure (Annex G1). If the assessment is positive and the farmer agrees to key conditions that are part of the project; then the field team will map the site using a GPS device. This information is processed, included in a Geographic Information System (GIS) and stored in a spatial database. A hardcopy map of the perimeter of the site is given to farmers, to facilitate visualization of their sites and inclusion of land-use features to produce their PV. At the site, the field team will explain to the farmer the objectives of the PV and links between the PV and the PES agreement. This is also an opportunity to address questions the farmer might have. The farmers are then provided with paper and stationary to draw their PV map with a similar shape to the perimeter of the GPS map. If needed, the field team provides some assistance with the drawing exercise. The field team, together with the farmer, will inspect the site so the farmer can sketch his/her land-management vision.

E.2.3 Assessment system for plan vivos

During the production of the PV, the field team re-confirms that there are no potential land conflicts between the participant and neighbours or internal family disagreements pertaining to land tenure or land use. Once the PV has been completed, an initial assessment of the PV is carried out at the site by the field team. The goal is to verify that the type of species that the farmer is intending to plant are in line with the project objectives, that they are suitable for the site and that the land-use proposed does not include harvesting of existing trees or potential damage to high conservation values (cultural or natural). The field team also confirms that information regarding water bodies, fences, legend of the PV sketch and other relevant details are provided.

A scanned version of the PV is then sent to the project coordinator, who reviews the document, cross-checking it with PV requirements, and project requirements (Planting Procedures for instance). The farmers keep the original copy of their PV.

Following this step, and if approved, a copy of the document is made for storage in electronic and hard copy formats. Any matters that need to be clarified during the process of preparation in the field is communicated to the project coordinator with support by the field team as required. Samples of PVs already completed are included in Annex E2.

E3 Community-level project governance

The key community governance elements and related forums are the farmers groups and the PSC (described in Section I). The in-country project coordinator who has extensive experience with the project and the region, will be the focal point between the different groups.

With regards to grievance, the project has developed a procedure which details the process to lodge a comment or complain and the process to achieve a resolution within an allocated period of time. This process is open to all stakeholders, including non-project participants. Channels to express grievances include verbal and written communication (complaints box) and electronic means. This mechanism, together with the internal regulation of the farmers groups and guidelines of the PSC are presented in Annex E3. The project has two log books located in Laclubar and Soibada respectively to register feedback, complaints and comments (verbal but also written i.e from the complaints wooden box available to the public) and to record our corresponding responses and resolution actions. All this information is stored in a central access database to facilitate tracking of actions. It includes dates, details of comments and or grievances, who presented the grievance, responsible person resolving and/ or addressing the complaint as well as target dates for resolution.

Part F Ecosystem Services & Other Project Benefits

F1 Carbon benefits

The climate benefits by species planted and with regards to the interventions described in Part D are summarised in Table F1. All results are in tons of Carbon Dioxide equivalent per hectare (t CO_2e/ha), estimated as an average at conclusion of the crediting period (year 30). Full details, references, growth curves and model fit details are available in the Excel database submitted with this document (Annex F1).

The calculations are included in workbook "_Results" for each one of the species in Annex "F1 Climate benefits (SHAMBA model inputs and outputs)". The calculations are based on parameters included in Table G8 and species-specific equations summarised in Table G10.

Table F1
Carbon benefits per intervention (per ha) Northern Region.

***Casuarina angustifolia* (woodlots)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP[2]	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	2.86	241.92	6.25	0.00	36.80	208.51
Soil management	-70.72	-3.12	0.00	0.00	10.14	57.46
Total	-	-	-	-	-	265.98

***Casuarina angustifolia* (agroforestry)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	2.86	218.01	5.73	0.00	33.13	187.75
Soil management	-70.72	-4.24	0.00	0.00	9.97	56.51
Total	-	-	-	-	-	244.26

***Sweitenia macrophylla* (woodlots)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	2.86	231.20	5.94	0.00	35.14	199.14
Soil management	-70.72	-2.20	0.00	0.00	10.28	58.24
Total	-	-	-	-	-	257.38

[2] HWP: Harvested wood products

***Sweitenia macrophylla* (agroforestry)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	2.86	205.04	5.33	0.00	31.13	176.38
Soil management	-70.72	-3.61	0.00	0.00	10.07	57.05
Total	-	-	-	-	-	233.43

***Gmelina arborea* (woodlots)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	2.86	212.61	6.50	0.00	32.44	183.81
Soil management	-70.06	-4.20	0.00	0.00	9.88	55.98
Total	-	-	-	-	-	239.79

***Gmelina arborea* (agroforestry)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	2.86	186.32	5.78	0.00	28.39	160.85
Soil management	-70.06	-5.78	0.00	0.00	9.64	54.64
Total	-	-	-	-	-	215.49

Living fences *(Gliricidia sepium)*	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	2.86	192.46	0.00	0.00	28.44	161.16
Soil management	-42.76	-29.63	0.00	0.00	1.97	11.16
Total	-	-	-	-	-	172.32

***Tectona grandis* (woodlots)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	2.86	104.65	2.96	0.00	15.71	89.04
Soil management	-70.72	-13.29	0.00	0.00	8.61	48.81
Total	-	-	-	-	-	137.85

***Paraserianthes falcataria* (agroforestry)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	2.86	278.38	0.00	0.00	41.33	234.20
Soil management	-70.72	-2.54	0.00	0.00	10.23	57.95
Total	-	-	-	-	-	292.15

***Toona sureni* (Woodlots)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	2.86	197.51	4.82	0.00	29.92	169.55
Soil management	-70.72	-6.69	0.00	0.00	9.60	54.43
Total	-	-	-	-	39.52	223.97

***Toona sureni* (Agroforestry)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	2.86	176.10	4.33	0.00	26.64	150.94
Soil management	-70.72	-7.97	0.00	0.00	9.41	53.33
Total	-	-	-	-	36.05	204.27

Table F2. Carbon benefits per intervention (per ha) Southern Region.

***Casuarina angustifolia* (woodlots)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	3.05	241.92	6.25	0.00	36.80	208.51
Soil management	-109.84	-28.39	0.00	0.00	12.22	69.23
Total	-	-	-	-	49.02	277.75

***Casuarina angustifolia* (agroforestry)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	3.05	218.01	5.73	0.00	33.13	187.75
Soil management	-109.84	-29.47	0.00	0.00	12.05	68.31
Total	-	-	-	-	45.18	256.06

***Sweitenia macrophylla* (woodlots)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit

Reforestation	3.05	231.20	5.94	0.00	35.14	199.14
Soil management	-109.84	-27.52	0.00	0.00	12.35	69.97
Total	-	-	-	-	47.49	269.11

***Sweitenia macrophylla* (agroforestry)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	3.05	205.04	5.33	0.00	31.13	176.38
Soil management	-109.84	-28.88	0.00	0.00	12.14	68.81
Total	-	-	-	-	43.27	245.20

***Gmelina arborea* (woodlots)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	3.05	212.61	6.50	0.00	32.44	183.81
Soil management	-109.20	-29.45	0.00	0.00	11.96	67.79
Total	-	-	-	-	44.40	251.60

***Gmelina arborea* (agroforestry)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	3.05	186.32	5.78	0.00	28.39	160.85
Soil management	-109.20	-30.98	0.00	0.00	11.73	66.49
Total	-	-	-	-	40.12	227.34

Living fences *(Gliricidia sepium)*	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake /	Carbon uptake/emissions	HWP	Expected losses from leakage	Deduction of risk buffer	Net carbon benefit

	emissions	reductions with project			(15%)	
Reforestation	3.05	192.46	0.00	0.00	28.44	161.16
Soil management	-66.82	-54.10	0.00	0.00	1.91	10.81
Total	-	-	-	-	30.35	171.97

***Tectona grandis* (woodlots)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	2.91	104.97	2.96	0.00	15.75	89.26
Soil management	-109.84	-38.21	0.00	0.00	10.74	60.88
Total	-	-	-	-	26.50	150.15

***Toona sureni* (Woodlots)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	3.05	197.51	4.82	0.00	29.92	169.55
Soil management	-109.84	-31.85	0.00	0.00	11.70	66.29
Total	-	-	-	-	41.62	235.83

***Toona sureni* (Agroforestry)**	**1**	**2**	**3**	**4**	(2+3-4-1)*15%	(2+3-4-1)*85%
Intervention type	Baseline carbon uptake / emissions	Carbon uptake/emissions reductions with project	HWP	Expected losses from leakage	Deduction of risk buffer (15%)	Net carbon benefit
Reforestation	3.05	176.10	4.33	0.00	26.64	150.94
Soil management	-109.84	-33.10	0.00	0.00	11.51	65.23
Total	-	-	-	-	38.15	216.16

F2 Livelihoods benefits

Key indicators of the project's socio-economic baseline include an average income (U$2.6/day/HH), strong interest in tree planting and crop expansion but a lack of resources or technical assistance and incentives for tree permanence.

In addition to technical assistance, for our project tree permanence is strengthened by linking tree planting with other livelihood benefits. An example of this is coffee production which requires tree shade from Casuarina. Another example is the implementation of agroforestry systems, which has been successful and will continue to be implemented where soil conditions are, or become, appropriate.

In July 2019, in line with the goals of the project, although not as part of the HV initiative or PES agreement, GTNT and FCOTI initiated a program called "Rural Women Micro Grants" that provides loans to women in Soibada and Laclubar. As part of this program, women are receiving training in micro-business development to market homemade marmalade, candies, sauces and scented bar soaps produced from local products such as papaya, banana, sweet potatoes and lemon grass, which are cultivated in some of the reforested sites (but not exclusively). Initially eight women have been selected to receive a loan of U$500 each. The loan will then be repaid with zero interest rates and then passed on to other beneficiaries in a revolving funding mechanism.

An initial proposal to continue promoting and linking tree planting with livelihood activities has been developed from feedback from the baseline socioeconomic survey, and subsequent discussions amongst project staff. These activities focus on:

a. Maximising the value of HV carbon credits by promoting the HV project with organisations needing to address their corporate social responsibility (CSR) requirements and by making the project "visible" via website development
b. Certifying, or at least receiving recognition and compensation for, other ecosystem service benefits generated by the project (e.g. biodiversity)
c. Development of forest enterprises for non-timber forest products and sustainable agriculture as per the women's micro-finance program aforementioned.
d. Value adding to timber products through sustainable harvesting cycles following conclusion of the PV project and thinning activities that are part of the project.
e. Community-based ecotourism and homestays in the project area. The initiative seeks to use the project itself and its activities as a "show case" or model for sustainable natural resource management in Timor-Leste; attractive to both domestic and foreign visitors. The Diatuto Protected Area has also been

identified as a potential destination for ecotourism.

In this context, activities that are likely to provide benefits to groups that might be under-represented in the project, such as women and landless farmers, will be prioritized (refer to list of activities/ benefits to under-represented groups below).

The next step will be for FCOTI to co-design a full proposal with participating communities, and to identify support from government and potential development partners, independently of the introduction of co-benefits and additional activities.

In addition to potential positive effects from the existing activities planned under the Halo Verde project, we envisage for the carbon component to be part of a broader sustainable livelihood's initiative in the region. The intention is that the carbon project, and the institutions developed initially for this purpose and which include participants and non-participants (HV farmers groups and project steering committee respectively), will provide coordination and impetus for a wider range of activities in partnership with the broader community, government and other development partners and donors.

The potential positive effects to livelihoods for non-project participants are:

1. Participation in field trainings to learn about tree and land management, sustainable agriculture and diversifying enterprises
2. Invitation to plant trees and become a participant and/or run a tree nursery
3. Support for labour and materials
4. Opportunity to rent or use another person's land
5. Parents learning from children via school education program on the project (benefits of trees/carbon, biodiversity, etc)
6. Replication of the project in more remote areas of the Manatuto Municipality
7. Direct or indirect financial benefits from livelihood initiatives develop by the project through carbon or other livelihood initiatives strategized by project partners (see points a to c above).

Parallel livelihood and capacity development activities that the project coordinator intends to continue implementing such as scholarships, the rural women micro-grants and micro-business program, training for non-HV participants, farmers managed natural regeneration, etc, will be funded externally and not from carbon sales. The Project coordinator will strive to mobilize separate donor funding to continue those parallel activities.

To date, no negative effects have been detected among non-participating communities. Interviews with non-participating households in 2018 did not uncover any negative impacts on them from not being involved. Most people had heard about the Project but didn't have knowledge about what it was. Those who did, were interested in becoming involved. Meetings with communities and local authorities also confirm to date, that no negative effects resulting from the project are evident and no complaints have

been made. This is also confirmed by the project's field staff who are based in the project area and who have regular communication and interaction with non-participants and project participants alike. Despite this, the project will continue to monitor and evaluate potential negative impacts. The project has considered the potential negative effects to non-participants that could arise from the project activities, and will implement mitigation measures to minimise the likelihood of any such negative effects arising. These mitigation activities are described in Table F2. In addition to this, the project has also considered any potential negative effects for participants, and will likewise implement mitigation measures to minimise the likelihood of any such events arising. These are described in Table F3.

Table F2: Potential negative effects to livelihoods of non-project participants

Potential Negative effects	Mitigation
Trees encroaching on their land through suckering or seed dispersal	Early intervention through monitoring (see Section K3)
Increased fire hazards resulting from the project	Awareness campaigns and exclusion of slash and burning activities in project sites and surrounding areas.
Lack of resources to include other community members interested in participating in the project, which results in conflicts between project participants and non-participants	• Development of additional livelihood initiatives (see page 27) to reduce exclusive reliance on carbon payments and to create direct or indirect opportunities for non-participants • Opportunities are given to farmers without enough land to participate in the project by paying them to operate tree nurseries, to collect, treat seeds and operate tree nurseries. Funding for these activities will be generated by carbon sales and payment done through farmers groups or individual farmers participating in the project. • Another opportunity for landless farmers is the option of renting land to plant trees as part of the HV project. The tree planters (farmers renting the land) will sign a PES like any other project participant, with the same rights and obligations. A separate agreement will be signed between the land owner and the farmer renting the land (i.e. the tree planter) using a template designed by the project (see Annex C2). This document will be filed together with the PES and the PV (land use plan). • The introduction of the Rural Women Micro Grant/Loan program funding outside the HV project, but still managed by FCOTI.
Non-participants' animals being killed or confiscated by entering participants' tree plantations	Prevention through implementation of *Tara Bandu* law and establishment of living fences

Table F3: Potential negative effects to livelihoods of project participants

Potential negative effects	Mitigation
Increased workload for farmers	Use funds from the farmers groups to pay for labour for those families lacking labour availability if agreed by the farmer's groups. Encourage sharing of labour within farmers groups. The introduction of project benefits from carbon could compensate for additional work load.
Food security threat from converting agricultural land to reforestation	The project interventions are conducted on marginally productive sites. One of the project interventions is expansion of agroforestry activities, which should result in increased food production and/or income generation.
Land tenure disputes	Land ownership certificates are being drafted to prevent or reduce the risk of land tenure conflicts. The document is signed by the local authority and neighbours surrounding the land. The project will ask the farmer declaring ownership, to include a brief history of tenure as far as possible in the past and provide any other documents that could substantiate this. These documents will be stored by the project in electronic format together with the land declaration.
Females are not included in decision making processes that might affect them directly	Opportunities for female input on decision making process are given through the farmers groups, which comprise equal number of males and females in its management. The input and grievance mechanism is open to all farmers. The project has and will continue encouraging female participation in educational and training activities.
Exclusion of landless farmers	• Development of additional livelihood initiatives (see beginning of section F2) to reduce exclusive reliance on carbon payments and to create direct or indirect opportunities for non-participants. • Opportunities are given to farmers without enough land to participate in the project by paying them to collect, treat seeds and operate tree nurseries. Funding for these activities will be generated by carbon sales and payment done through farmers groups or individual farmers participating in the project. • Landless farmers will have the option of renting land to plant trees as part of the HV project. The tree planters will sign a PES like any other project participant, with the same rights and obligations. A separate agreement will be signed between the land owner and the tree planter using a template designed by the project (see Annex C2). This document will be filed together with the PES and the PV (land use plan).

Since 2011, the project has generated employment opportunities and income diversification in addition to environmental and biodiversity gains, which impact positively the whole community. Although difficult to measure, satisfaction and pride are other benefits generated by the project. A summary of these livelihood benefits, and others described earlier in this section, are presented in Table F4.

Table F4: Livelihoods benefits for Participating Groups

Food and agricultural production	Financial assets and incomes	Environ-mental services (water, soil, etc.)	Energy	Timber & non-timber forest products (incl. forest food)	Land & tenure security	Use-rights to natural resources	Social and cultural assets
Increase in area suitable for coffee production using shade canopy trees	• Income from carbon credits and nursery sales • Increased value of the land	Reduced landslides and soil erosion impacting on agriculture and roads		Increase in quality timber for building houses and furniture, and for sale	Re-enforcement of land tenure through activity implementation		Protection of important cultural sites within tree plantations
More diverse food crops grown within tree plantations	Increase in timber assets for sale from harvesting as per thinning and harvesting schedules	Better soil and water quality for household and livestock use		Increase in quality timber for building houses and furniture, and for sale			Increase investment in children's education and health
Increase in food security and potential cash income from agroforestry	Financial growth from investing in savings schemes	Better pollination of crops and fruit trees					Increase organizational capacity of farmers groups
Expansion of organic and conservation farming practices	Increase in physical assets investment, such as housing and transport	Increase in birds, reptiles and insects to reduce pest invasion and diseases					Establishment of women's small enterprises to add value to food or forest and non – forest products
Improved soil quality from mulching,		Improved nutrient recycling from					Opportunities for group assistance to conduct activities requiring

terracing and composting		reforestation					additional labour through farmers groups input and/or neighbours' cooperation
Increased water conservation and reduction of soil erosion and nutrient losses as a result of FMNR activities	Reduction of degradation and deforestation in native forest remnants	Reduction of deforestation and related carbon emissions. Soil erosion control, reduction of landslides	Sustainable harvesting of fire wood from pruning activities	Increase in available timber for construction and fence posts		Reduction of conflicts between farmers, as there is a lesser need for farmers to enter other neighbour's land for timber collection	
Increased forage for animals from Gliricidia (living fences)	Increased value of animals	Reduction of soil compaction		Use of some of the timber for domestic use		Reduction of conflicts as there is a lesser need for farmers to take animals to other neighbour's land for grazing	

F3 Ecosystem & biodiversity benefits

Reforestation and soil management (PV certification sought for both interventions) will contribute to habitat creation, water conservation and reduction of the need to clear remnants of native forests for agriculture (as detailed in Table F5).

Table F5: Ecosystem impacts

Intervention type (technical specification)	Biodiversity impacts	Water/watershed impacts	Soil productivity/ conservation impacts	Other impacts
Reforestation	• Habitat creation for birds, small mammals, reptiles, amphibians, butterflies, insects and pollinators • Encourages natural pest control in crops • Creates linkages with corridors to remnant native forest areas and Mt Diatuto protected area • Reduction of weed infestation	• Water flow regulation • Slows the runoff of water in steep slopes during the wet season • Water turbidity reduction • Improvement in water quality • Reduction in landslides, sheet erosion and gully erosion.	• Fixation of nitrogen in the soil by trees' root system. • Addition of organic matter to the soil • Reduction of evapotranspiration through shade and cooling provided by organic matter • Reduction of erosion	Reduction of deforestation and degradation of native forests
Soil management	• Increased micro-organism activity in the soil and soil habitat creation • Increased ground cover will reduce heat	• Water flow regulation and water infiltration • Slows the runoff of water in steep slopes during the wet season • Water turbidity reduction • Water quality improvement	• Addition of organic matter to the soil • Improved soil texture condition • Improved nutrient breakdown and nutrient cycling • Reduction of soil compaction • Reduction of evapotranspiration through cooling provided by organic matter and micro-organisms activity • Water storage	Reduction of smoke and dust

Part G Technical Specifications

G1 Project intervention and activities

Interventions that form part of the project are in line with PV's approved activities and include:

a) Ecosystem rehabilitation through reforestation by planting trees in agroforestry systems, woodlots and live tree fencing

b) Improved land management through soil management by promoting fire exclusion, ground cover improvement and awareness-creation activities.

G1.1. Applicability conditions

The project is implemented on ex-farm land - sites that have limited agricultural productivity potential and areas that have never been cultivated or have not been cultivated for years due to not being suitable for agricultural purposes. Sites with suitable soil conditions are used to establish agroforestry systems, while sites with poorer soils are initially selected for single tree plantings (woodlots) only. It is anticipated that soil conditions of some of the poorer sites where woodlots are established might improve with time; allowing introduction of crops to create agroforestry systems during the life of the project.

The criteria that have been applied selecting current sites is listed below, these are also the conditions that must be met by new candidate sites for inclusion in the project:

a) Areas located within the Manatuto and Viqueque Municipalities .
b) Altitudes ranging from 300 to 1500 masl
c) Sites that match the requirements of the species included in table G3
d) Where farmers can demonstrate there are not land tenure issues
e) Owned or rented by farmers willing to sign a commitment document to comply with basic requirements for tree establishment and tree care leading to a PES
f) Sites located in relative proximity to water sources
g) Sites that are reasonably accessible and where planted areas are unlikely to be impacted by future infrastructure development such as road expansions
h) Deforested, degraded or unproductive sites where current activities (if any) will not be displaced elsewhere

We have found these conditions to be appropriate to the project's activities. They have been established through community consultations, trialling of species and project calibration, and will

continue to underpin the expansion of the project.

The project conducted a land classification analysis using satellite imagery and found about 2000 ha of land to be degraded and relatively accessible. Some of the data available from the project Seeds of Life[3] (2016) has given us valuable information regarding general soil conditions for planting including pH and soil texture. Specific soil tests are now undertaken by the project to improve species and site matching. If the site is considered suitable, the farmer's Plan Vivos (PVs) are then developed to implement the activity. The project provides training to farmers on how to develop their land use plans (Plan Vivos) with support on site to assist with the PV development. Mixing of tree species is not excluded from the project but this is also dependent on site *versus* specie requirements and farmers preference.

G1.2 Suitability of Project Interventions

The project interventions are conducted in areas identified by project participants as marginal and where biophysical site conditions match tree growth requirements as described in Table G1. No vegetation clearing will occur within the project sites or adjacent areas to project sites. This is a condition for farmers participating in the project, included in the farmers PES agreements (see Annex J1).

[3] *Seeds of Life* was an agricultural development program funded and implemented by the MAFF and the Australian Centre for International Agricultural Research (ACIAR) between 2000 and 2016. It aimed to improve crop yields and food security across 7 Municipalities of TL.

Table G1: Description of activities' inputs and applicability to local geophysical conditions

Intervention type	Project Activity	Input	Applicability
Ecosystem rehabilitation	Reforestation	• Planting of trees as woodlots • agroforestry systems (Intercropping naturalized trees with crops) • Living fences.	• Mixing trees with crops in low productivity agricultural land and degraded land to improve agricultural yields • Creating a forest cover (shade) for future coffee plantations • Recovery of sites impacted by erosion • Protection of planted trees and crops inside PV sites by establishing live fences to act as windbreaks and barriers to prevent damage by livestock
Improved land management	Soil management	• Introduction of management actions that prevent soil degradation and promote soil organic matter additions • Activities to create awareness • Increased ground cover through mulching and permanent soil cover • Contour planting and terracing	• Avoidance of residual crop burning inside planting sites • Exclusion of livestock to prevent soil compaction • Prevention of hill erosion

G1.3 Reforestation

a) Species

Early in the project we trialed different species of native trees, which with the exception of *Casuarina sp*. and *Paraserianthes falcataria* (Albizia), showed very low survival rates most likely due to the marginal soil conditions of eligible planting sites. Thus, the project selected naturalised species over natives, based on the need to plant trees that could grow in poor soils and trees that were valued by farmers. The latter was a decisive factor when selecting the species to plant, which in addition to the two native trees mentioned include:

Swietenia macrohpylla (mahogany): Highly preferred by project farmers because of its potential wood value and adaptability to a wide range of site conditions.

Gmelina arborea (white Teak): which has shown to be highly adaptable to the conditions of the

southern part of the project area, especially around Soibada.

Gliricidia sepium (gamal): Already being planted in the region and identified by project staff and farmers as a good alternative for live fencing.

Tectona grandis (black teak): Although of interest to farmers, this specie has been planted in very small numbers as it only grows well in very specific sites within the project area.

Toona sureni (red cedar): A native sp. added to the project in 2022. Like mahogany, it is preferred by farmers because of its potential wood value and adaptability to a wide range of site conditions.

From this list, the project advises farmers on what trees are likely to match their site conditions. The project promotes where technically feasible, the planting of mixed species but farmers decide whether to plant mixed or single species to suit their interest, land availability and long-term objectives. This is reflected in their PVs design.

These species and their requirements are summarised in Tables G2 and G3 respectively.

Table G2: Species planted by the project

Species	Present status in project	Additional future plantings?	Type
Casuarina (*Casuarina sp*) Kakeu	Already planted in 2019	Yes	Native
Mahogany *(Swietenia macrophylla*) Mahoni	Already planted in 2019	Yes	Naturalised
Gamal (*Gliricidia sepium*) Gamal	First planted in 2020	Yes	Naturalised
White Teak (*Gmelina arborea*) Teka mutin	Already planted in 2019	Yes	Naturalised
Black Teak (*Tectona grandis*) Teka metan	Already planted in 2019	Limited numbers	Naturalised
Albizia *(Paraserianthes falcataria)* Samntuku	Already planted in 2019	Limited numbers	Native
Red cedar *(Toona sureni)* Ai Saria	First planted in 2022	Yes	Native

b) Plantation management activities

Key management activities include:

1. Seed collection: The bulk of mahogany, red cedar, white/black teaks, albizia seeds are mostly collected in Laclubar by the field team. Where required, they are sourced from farmers located in neighboring Administrative Posts, like Natarbora, who sell seeds to the project.
2. Tree nursery production: Managed by farmers with full technical and financial support from the project. Every year, different farmers are given the opportunity to manage nurseries in their lands and to join the project through this activity as an entry point.

3. Site preparation, site selection and planting specifications as per Table G3.
4. Pruning: Recommended for gamal, gmelina and mahogany trees during the first 3 to 8 years, or for gmelina, red cedar and mahogany when trees have reached approximately 5 meters in height.
5. Thinning: The recommend thinning regime is included in Section G5.7. Overall, the project will aim for light thinning interventions to prevent wind damage to non-harvested trees and to achieve the desired estimated final stocking by factoring annual mortality rates.
6. Pest Control: No pests have been reported for trees planted in the project except for mahogany and red cedar which are susceptible to *Hypsipyla grandella* (a borer). Prevention is achieved by promoting fast tree growing, pruning, use of quality seeds and where possible by mixing these trees with other species.

A plantation management document describing the activities listed above in detail is available in Annex G1.

Table G3: Planting Requirements

Species	pH	Soil type	Slope	Planting Density	Soil drainage	Light / Shade	Minimum height of seedling at planting
Casuarina (*Casuarina sp*)	Less than 6.5 Slightly acid	Sandy	Tolerant to steep slopes	3m x 3m (1111 trees /Ha)	Well drained	Light demanding	>40 cm
Mahogany *(Swietenia macrophylla*)	6.5 – 7,5 Slightly acid to Alkaline	Clay	Ok. In moderate slopes	3m x 3 m (1111 trees /Ha)	Well drained	Requires plenty of sun light	>40 cm
Gamal (*Gliricidia sepium*) Living fence	5-8 acid to alkaline	Sandy or clay	Tolerant to steep slopes	Every 1m in fences	Ok. In moderately inundated soils	Ok. in moderate light shade	Cuttings Length => 50 cm and 1 -2 cm minimum diameter.
White Teak/ Teka Filipina (*Gmelina arborea*)	6 – 8	Sandy, fertile	Ok. In moderate slopes	3m x 3m (1111 trees / Ha)	Well drained	Light demanding	>40 cm
Black Teak (*Tectona grandis*)	6.5 - 8 Slightly acid to Alkaline	Sandy, fertile	Ok. In moderate slopes	3m x 3m (1111 trees /Ha)	Well drained	Light demanding	>40 cm
Albizia *(Paraserianthes falcataria)*	Wide range	Wide range	Ok. In moderate slopes	12 m x 12 m (69 trees /Ha)	Wide range	Light demanding	>40 cm

Red cedar (*Toona sureni*)	4-8	Loamy, fertile	Ok. In moderate slopes	3m x 3m (1111 trees / Ha)	Well drained	Light demanding	>40 cm

The maps below (Figures G.a and G.b) show the location of sites and soil types found in the project area (adopted from Seeds of Life, 2016):

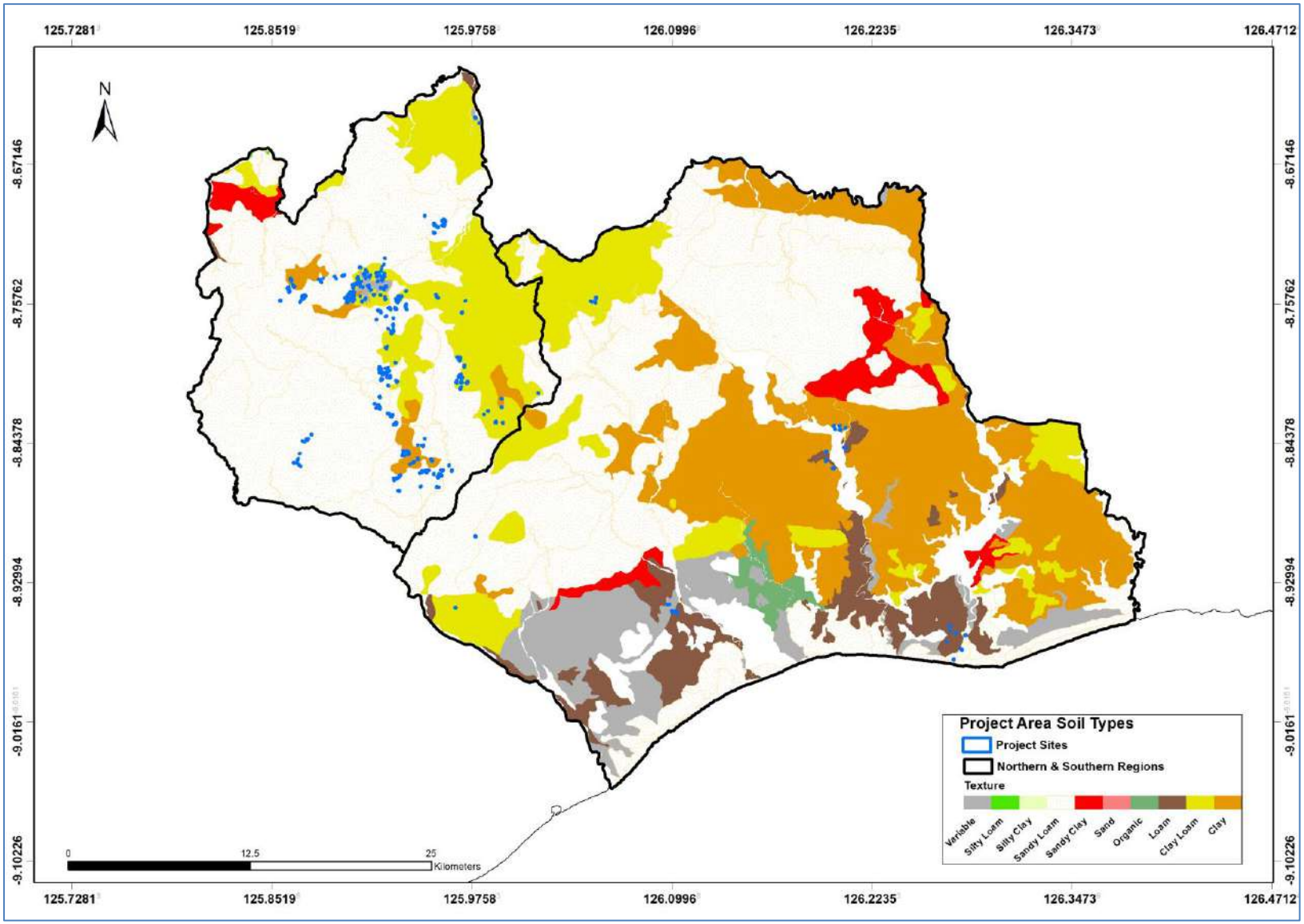

Figure G.a Soils Texture

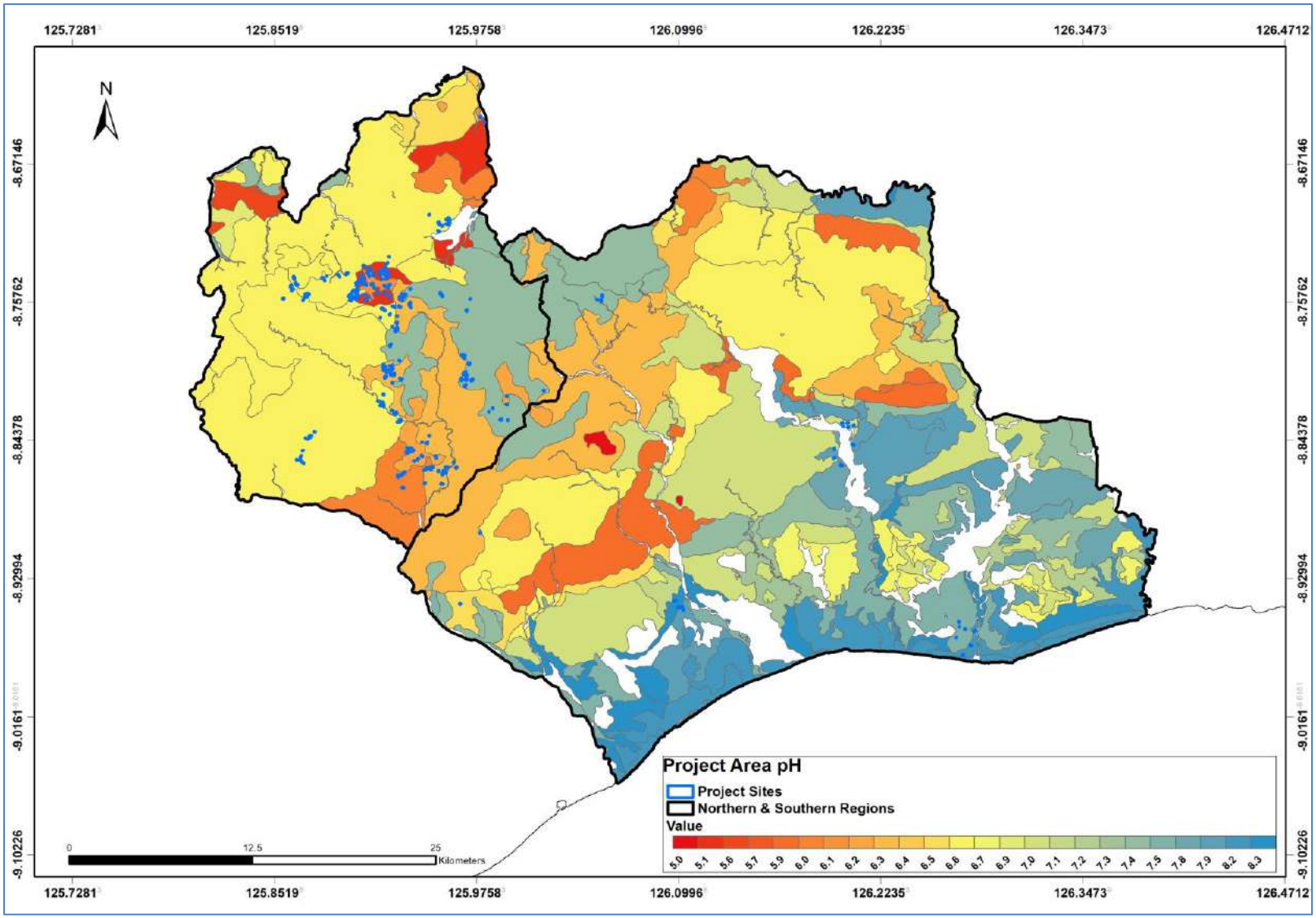

Figure G.b Soils pH

G1.4 Soil management

Although soil management activities have been promoted by the project, some project farmers have not or only partially implemented the activity in their sites. In most cases, this is due to lack of resources (time mainly) and incentives to continue increasing organic matter returns to the soil and improving ground cover (live or dead plant material). The literature consulted suggests that there is a direct relation between soil carbon volumes and soil organic matter; the latter comprised by about 85% of dead plant material, 10% of plant roots and 5% micro-organisms (Crawford *et al.* 2009). It is fair then to assume that improvements on soil management, such as increased ground cover, will result in lesser soil degradation and therefore reduced carbon losses. We are applying, in this intervention, the project's multi-level adaptive learning and management principles described in Annex G2; in this case as an element of project adjustment and monitoring at farm and project scales.

The actions that will underpin soil management in project sites are:

- Fire exclusion and elimination of burning of crop residues and/or remnants of vegetation prior to crop establishment;
- Promotion of permanent ground cover and addition of crop residues, or other organic materials, to serve as mulch and, where suitable, contour terracing and construction of small swales around trees (described in Annex G1)
- Increased awareness of soil management actions among project and non-project participants through show-and-tell field days with champion farmers.

G2 Additionality and Environmental Integrity

G2.1 Relevant laws and regulations for forest and land management

The project proponent identified the General Forest Regime (Law 14/2017 GoTL) as the main legislation relevant to our project. This law does not require farmers or individuals to engage in reforestation, agroforestry activities, climate mitigation activities or any of the project interventions the project is conducting. The project therefore demonstrates that it goes beyond the Timorese regulatory framework with regards to land-use and land management in the country.

G2.2 Additionality

Reforestation and permanency of the activity in the region would not be possible without incentives to maintain trees on the ground, or for farmers to initiate planting or conservation activities without technical and financial support. Tree planting outside the project is not commonly practiced by farmers in the region due to lack of resources to implement the activity on a voluntary basis.

The project demonstrates it is additional by overcoming this and other barriers to its implementation (Table G4).

Table G4: Additionality analysis

Barrier	Description	Overcoming the barrier
Lack of finance	Landholders lack financial resources to propagate and plant trees	The project has always aimed to enter carbon finance to ensure project implementation and long-term permanency of reforestation efforts. Without carbon payments, farmers would not have the financial capacity to plant or look after planted trees. Farmers are unlikely to continue the project on their own without technical and financial support.
Lack of technical expertise	Silvicultural management is not common practice in Timor-Leste, nor is forest carbon and related activities, including carbon monitoring and forest inventories. This project is the first of its kind in the region, therefore technical capacity for these types of activities is low or non-existent.	Training of field staff has been provided by the project and will continue to be provided as required. Essential tools have been acquired enabling project implementation. Procedures for mapping and monitoring in the local language have been produced.
Local ecological conditions	The project areas are highly degraded and/or relatively unproductive (ex-farm lands).	This barrier is overcome by introducing resilient species and activities that prevent soil erosion.

Social conditions	There is increased pressure on natural resources in the region resulting from population growth and lack of awareness among farmers on implementation of tree growing practices.	Field days showing how to match tree species to site conditions and introduction of FMNR to reduce deforestation are addressing this barrier. Farmers groups (PV Farmers) have been formed to facilitate farmers' involvement in tree planting.

The previous explanation and barriers are also relevant to new additional areas (southern areas of Manatuto and Viqueque Municipalities where lack of resources and technical support resulted in heavy tree mortality, estimated at 70% from the total trees planted under GIZ Ai Ba Futuru Project) in absence of the project. Based on the experience of FCOTI, survival rates greatly increase when socialization of activities and time and resources are allocated, which becomes possible if payments for carbon (future or present) are part of the tree life cycle.

G2.3 Land-use classification and site selection

Reforestation activities are conducted in areas that have been identified as degraded and/or deforested, most of them in farms located near small villages (Sucos). FMNR areas include pruning of trees, exclusion of sites to protect standing trees and to encourage regeneration. Both interventions do not result in native tree remnants being harvested. The project verifies that areas are not negatively impacted prior the intervention. A systematic approach of land-use identification that eliminates the risk of land clearing is in place. This process consists of preliminary identification of land-use through a spatial data set analysis using Planet imagery (Dove constellation, 5 m resolution), acquired in October 2017 and processed in early 2018, from where eligible sites (degraded, pastures, agricultural land) can be identified (Figure G1.1).

Once an eligible site is identified, a physical site assessment conducted by the field team confirms land-use condition prior project interventions, eliminating the risk of adverse or unintended modifications to sites prior start of activities. The basic criteria used to identify eligible project sites is farmers interest in planting and preserving trees and evidence of land degradation. For practical reasons; and taking into consideration the challenging topography of the region, site accessibility and a reasonable distance of potential planting sites to roads or tracks is also assessed. From 2011 to date, the sites have

been selected relying on site visits conducted by the field team. It has been a condition of the individual agreements between farmers and the HV project that tree remnants inside project sites and existing vegetation are conserved. Another requirement is that the activities implemented by the project are not displacing agricultural activities (in the case of woodlots).

To the best of our knowledge, this is the only climate mitigation project in the project area (Municipality of Manatuto and Viqueque).

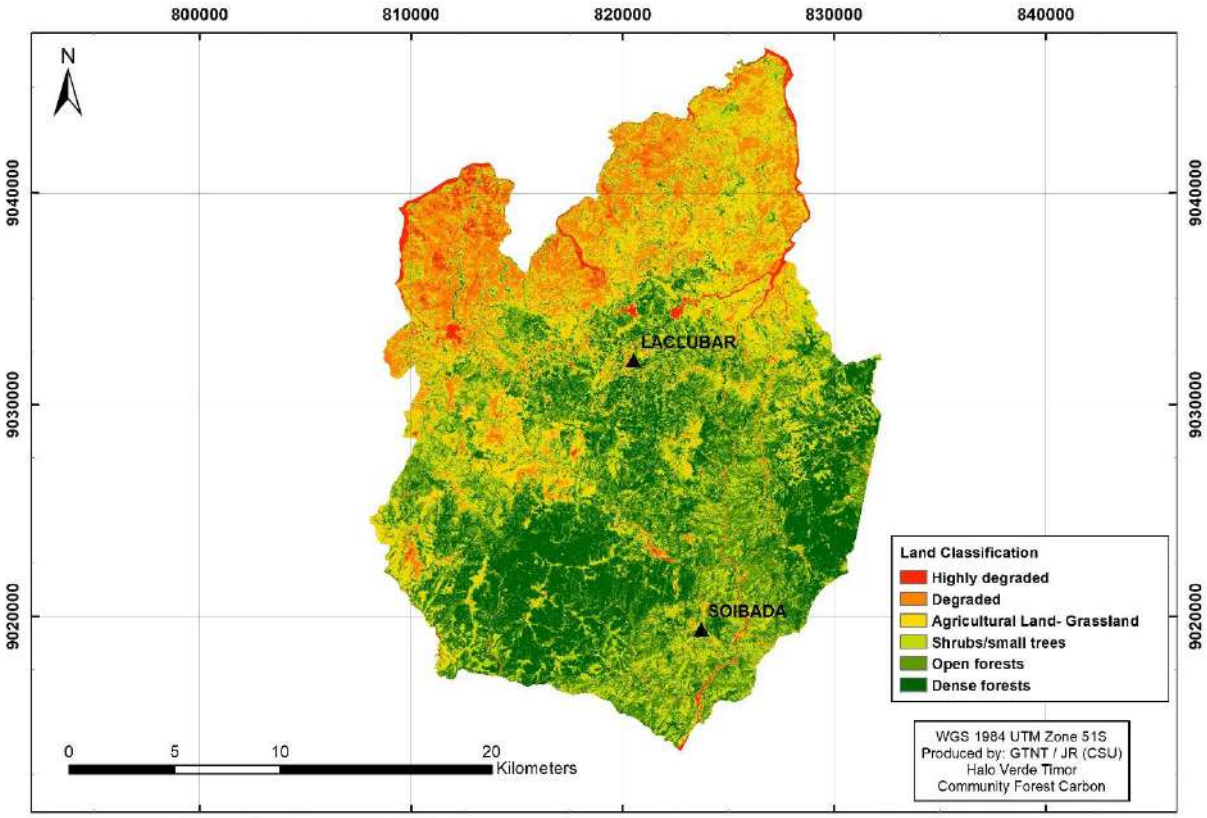

Figure G1.1: Land classification Northern region

The land classification for the Southern region (Figure G1.2), was obtained from Sentinel-2 L2A imagery at 10 m resolution, captured in 2021, produced by Impact Observatory, Microsoft, and Esri and licenced under Creative Commons BY-4.0[4].

[4] Creative Commons BY-4.0: This dataset is based on the dataset produced for the Dynamic World Project by National Geographic Society in partnership with Google and the World Resources Institute The corresponding metadata can be explored in:
https://ic.imagery1.arcgis.com/arcgis/rest/services/Sentinel2_10m_LandCover/ImageServer

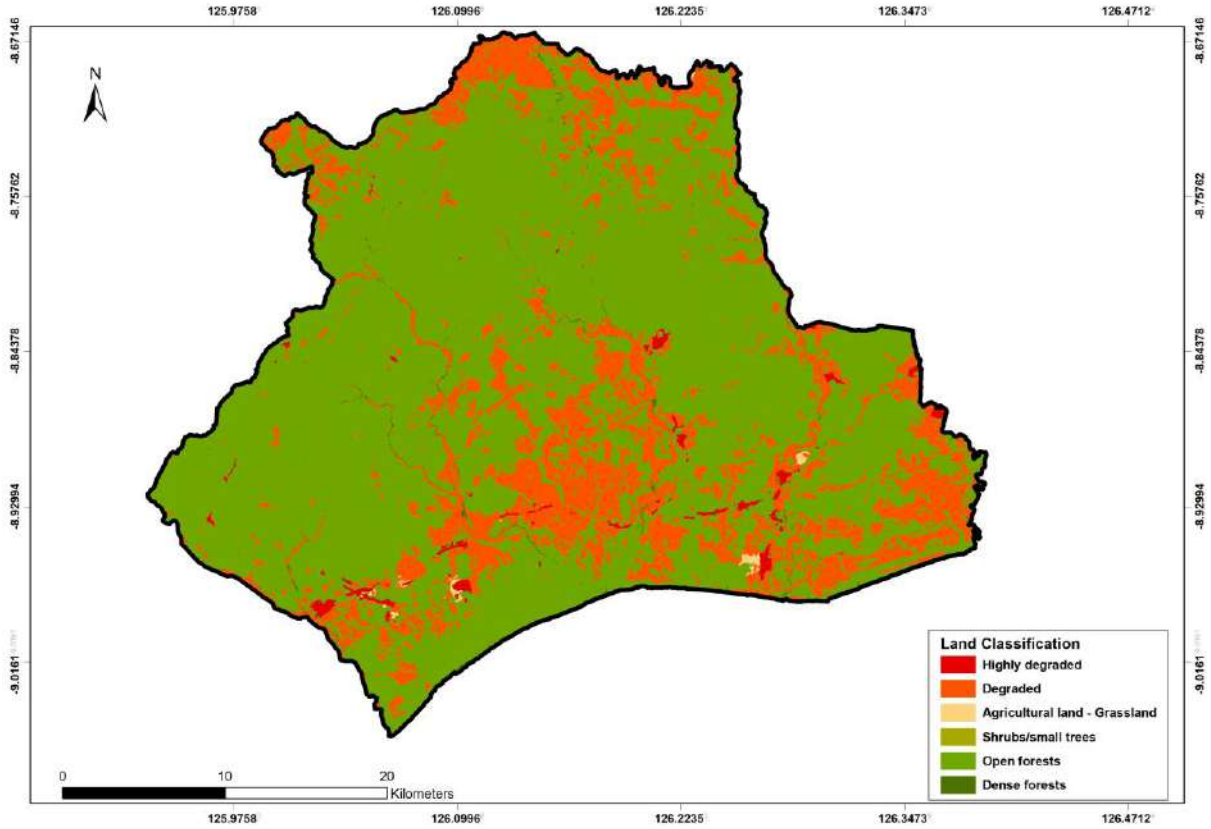

Figure G1.2: Land classification Southern region

G3 Project period

The climate benefits of the project are estimated over 30 years (crediting period) and the payment period will be 10 years. This relatively short payment period, is intended to give farmers an opportunity to have access to a larger sum of money to help them establishing their land management activities, and/or expand their existing project interventions.

This payment arrangement will apply to all project participants. As an example, for sites planted in 2020 the crediting period will conclude in 2050, for trees planted in 2011 the crediting period will end in 2041. The project aims to generate Plan Vivo Certificates (PVC) for project activities started in 2011 and subsequent planting years. The crediting period reflects the approximate life span of the trees planted and the long-term goals of the participants beyond the 10 year payment period which include timber production and increased agricultural production in marginal lands. Plan Vivos received reflect the interest of farmers, suggesting that most of them intend to establish tree shade coffee crops using project planted within the project. Tree permanency is further strengthened through the PES agreement with a commitment enforceable via the farmers

groups. These groups are expected to continue operating on conclusion of the payment period as a result of additional economic activities linked to tree planting that the project will be generating. Additional details are included in sections F2 and J1.

G4 Baseline scenario

The baseline is defined as the scenario without project interventions ("business as usual"). The community in the project area relies heavily on firewood for cooking and timber for fencing and construction. The annual deforestation rate for Timor-Leste is estimated to be 2.18% (T-L, UNCFCC, 2014). The land where the project is taking place corresponds to sites identified as deforested during the land use analysis conducted by the project in 2018 (details in section G2.3). These are mostly areas that are marginally cultivated or not being cultivating at all due to their relatively low productive capacity. This is the baseline scenario of the project and also the project's area of interest: areas devoid of trees or with scarce vegetation which applies to both Northern and Southern regions. Table G5 summarises the carbon pools in the baseline. Details of the soil carbon pool in the baseline are included in Section G4.7.

Table G5: Carbon pools and emissions in the baseline

Carbon pool	Included	Justification
Above ground biomass for trees with diameter at breast height equal or greater than five centimeters (5 cm at dbh)	Yes	Used to estimate the net project's climate benefits
Below ground biomass for trees equal or greater than 5 cm at dbh	Yes	Used to estimate the net project's climate benefits
Tree litter	Yes	Used to estimate climate benefits.
Dead wood	No	Not considered significant in the baseline (eligible sites) as dead wood is usually collected for cooking or burned during the yearly slash and burn season.
Soil organic carbon	Yes	Used to estimate the net project's climate benefits
Long lived harvested products	No	The baseline areas are deforested sites, therefore excluded as the number of trees that could be harvested and specifically the number of trees that could yield timber products are negligible. This was corroborated during the project's baseline sampling.

Emission sources	Included	Justification
Organic fertilisers	No	Very little agricultural activity in the baseline, fertilizers are not applied by farmers in the region
Synthetic fertilisers	No	Very little agricultural activity in the baseline, fertilizers are not applied by farmers in the region.
Biomass burning	Yes	Included as an emissions flux for SOC and the estimation of climate benefits.

G4.1 Methodology for tree biomass sampling in the baseline and planted areas

There was no recent information available from other similar projects that could inform the carbon baseline, thus the project defined its own by sampling areas that satisfy the criteria the project uses for selection of tree planting sites (i.e. eligible sites). The baseline therefore consisted of areas mostly denuded of trees that are accessible by roads or tracks.

Key steps used during the determination of number of plots required and carbon estimations included:

a) Creation of a land-use cover in shapefile format (see point c) below) identifying the area of interest to the HV project (i.e. eligible areas for planting).
b) The shape file identifies degraded and grasslands/agricultural lands relatively close to roads or tracks. Those two classes were used as the strata for biomass sampling.
c) A pilot inventory was conducted using the tool *create random points* (ESRI, ArcGIS) over the land-use shapefile to determine the number of plots required to estimate carbon in the baseline. A total of 29 plots were measured. The size of the plots was 7.5 m in radius circular (equivalent to 176 m^2 in area) with correction of radius to a horizontal plane where slopes were greater than 10 degrees. Only trees equal or greater than 5 cm in diameter were measured. Field data was collected using the project's protocol for inventory developed by the project (Annex G3). A description of the parameters used are included in Section K (monitoring biomass).
d) The stocking and carbon per plot were estimated using the general equation for biomass aboveground in moist tropical forests developed by Chave et al. 2005.

$$\boldsymbol{Biomass\ (kg) = p * e^{(-1.499+2.148ln(dbh)+0.207ln(dbh)\text{^}2-0.0281\ln(dbh)\text{^}3))}}$$

Where:

kg: kilograms

p: wood density
ln: log natural
dbh: diameter at breast height

e) The required number of plots was estimated using Equations 1 and 2 with results summarised in Table G6:

Equation 1: Used to estimate number of plots (n)

$$n = \frac{((N_1 \times s_1) + (N_2 \times s_2))^2}{\frac{N^2 \times E^2}{t^2} + N_1 \times s_1 + N_2 \times s_2^2}$$

Equation 2: Used to calculate the distribution of plots in each stratum (n_h)

$$n_h = n \times \frac{N_h \times s_h}{\sum_{h=1}^{L} N_h \times s_h}$$

Where:
n = the total number of plots,
n_h = the number of plots in stratum h,
N = the number of sampling units in the population,
N_h = the number of sampling units in stratum h,
s = the standard deviation,
s_h = the standard deviation in stratum h.

Table G6.1: Summary of values used in the calculation and results from pilot inventory (Northern region)

Values	Strat1 (Ex-agriculture)	Strat2 (Degraded)	Total
Area (Ha)	1440	530	1970
Mean tCO_2e/ha	0.0	2.98	2.98
S: Standard deviation tCO_2e/ha	0.0	4.95	-
Plot size (ha)	0.0176	0.0176	0.0176
E: Error	-	-	0.3
t: t-student value for a 90% confidence Level	-	-	1.645
Precision	-	-	20%
Confidence Level	-	-	90%
n (total number of plots) required per strata	10	54	64

An additional 9 plots were installed for strata 1; the total number assessed was 73 plots (this data is

included in Annex G4).

Table G6.2: Summary of values used in the calculation and results from pilot inventory (Southern region)

Values	Strat1 (Ex-agriculture)	Strat2 (Degraded)	Total
Area (Ha)	1079	7785	8864.0
Mean tCO_2e/ha	4.3	1.8	6.1
S: Standard deviation tCO_2e/ha	8.4	3.3	-
Plot size (ha)	0.0176	0.0176	0.0176
E: Error	-	-	0.17
t: t-student value for a 90% confidence Level	-	-	1.645
Precision	-	-	20%
Confidence Level	-	-	90%
n (total number of plots) required per strata	29	82	111

G4.2 Spatial distribution of plots for the baseline

The land cover classification and spatial distribution of plots is shown in Figures G2 and G3.

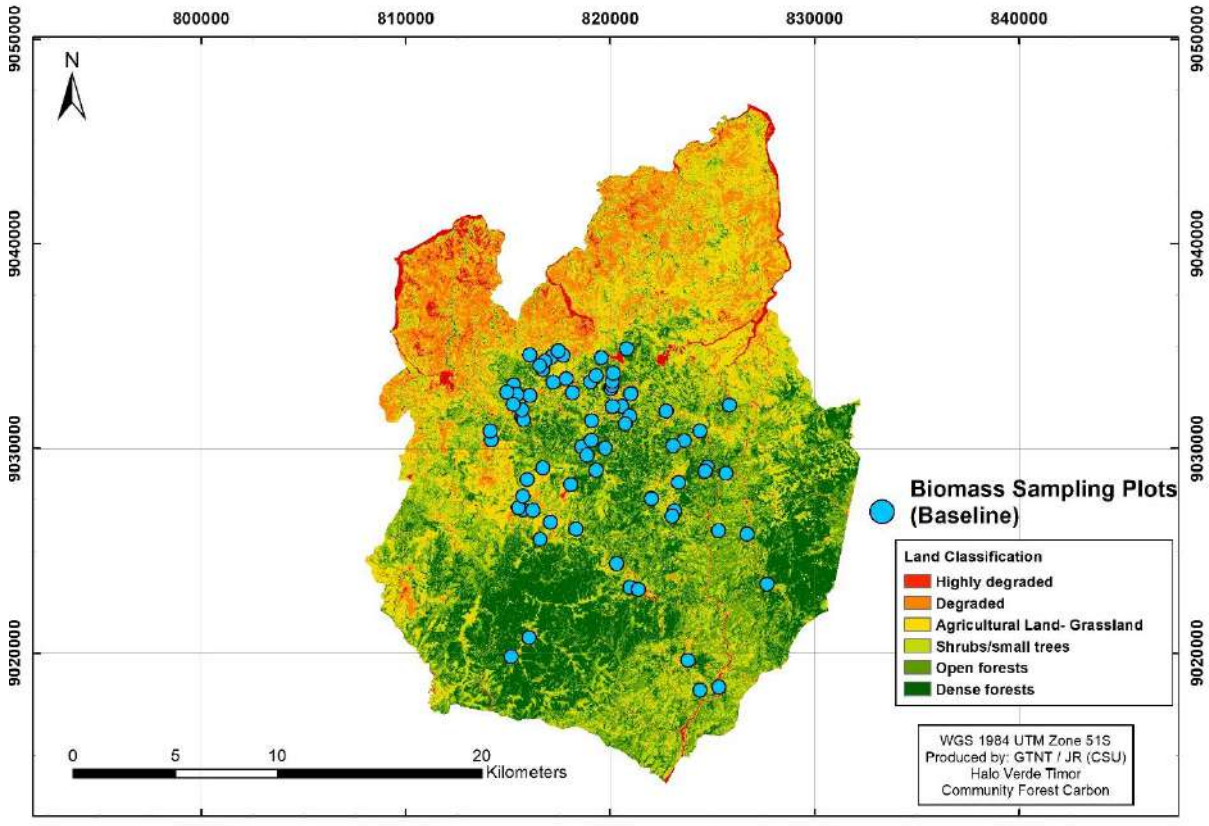

Figure G2: Plot distribution for baseline sampling (Northern region)

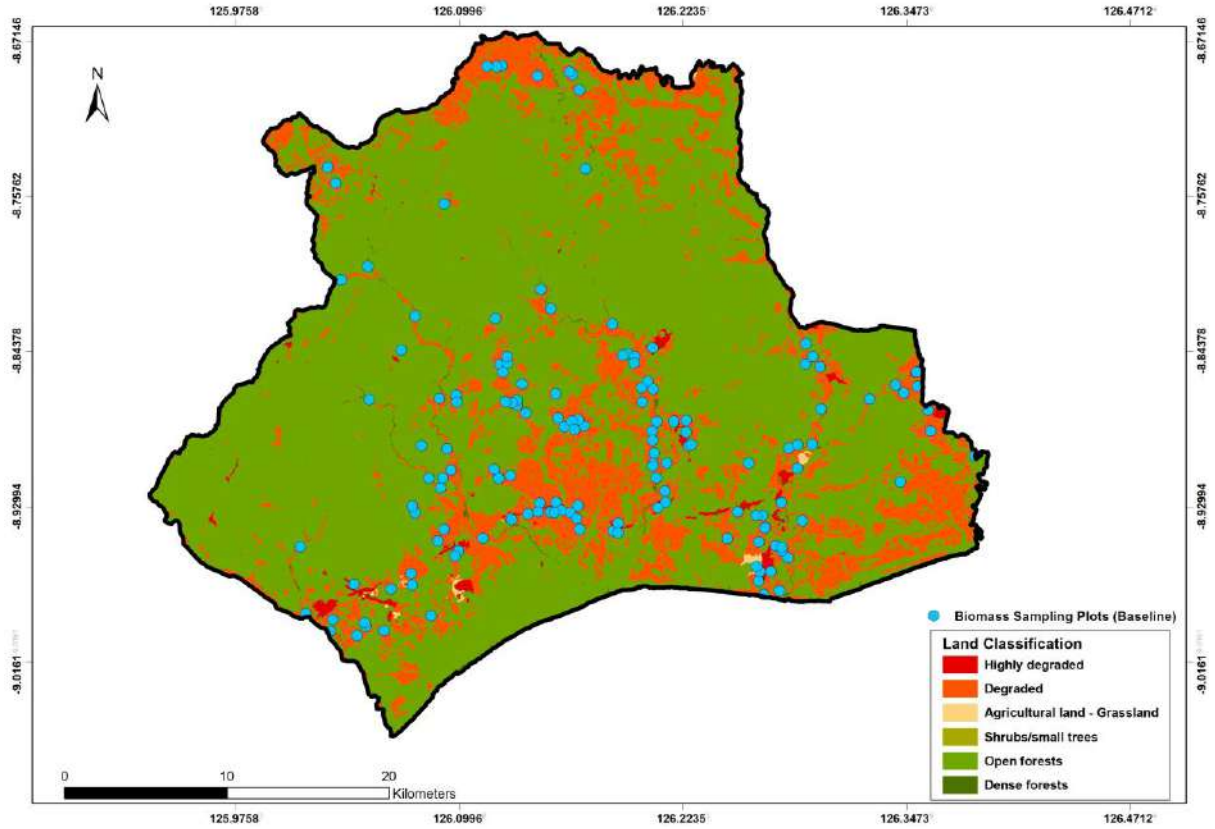

Figure G3: Plot distribution for baseline sampling (Southern region)

G4.3 Biomass baseline sampling results

The biomass carbon stocks in the baseline (above and below ground) are included in Table G7. Conservatively, the project assumes that the baseline will remain constant during the crediting period of the project.

Table G7: Results of biomass assessment in the baseline

Region	Strata	tC/ha	tCO_2e/ha	Average tCO_2e/ha
Northern	Degraded	1.4	5.23	2.86
	Grassland -Agricultural land	0.13	0.49	
Southern	Degraded	0.5	1.8	3.05
	Grassland -Agricultural land	1.2	4.3	

G4.4 Data sources

The key data sources and factors used to estimate the biomass baseline include:

- Field data collected by the project from the baseline survey
- Land-use classification developed by the project (shapefiles) - see Section G2.3
- The equation for biomass in moist forests developed Chave et. al 2005

- Protocols for biomass sampling and plot navigation developed by the project (see Annex G3)
- IPCC (2006) Volume 4, Chapter 4, Table 4.4 for Root to shoot ratio (0.2)
- LULUCF IPCC for the Carbon fraction of species (0.49) and the universal ratio of molecular weights of Carbon and CO_2 (44/12).
- Wood density: Average for tropical Asian species sourced from Brown, S. 1997.

G4.5 Soil organic carbon baseline

We use a soil organic carbon (SOC) baseline derived from estimates in the Plan Vivo approved SHAMBA (small-holder agriculture mitigation and baseline assessment) model (for more details see Section G5). This modelling approach, which does not require soil sampling, improves upon similar approaches used in other existing carbon forestry projects approved by the VCS (Vi Agroforestry 2012), by not only calculating an existing SOC state but also the year zero of the baseline, project scenarios and also calculating the expected flux of SOC in each year of the baseline. The model does this through implementation of the Intergovernmental panel on climate change (IPCC)'s RothC approach (Rothamsted carbon model[5]), where the model assumes that SOC is already in disequilibrium (i.e. losing or gaining carbon) due to pre-existing degradation. SHAMBA then uses parameters from the Harmonised World Soil Database (Fischer *et al*. 2008) to 'wind up' RothC and estimate the existing state of SOC at the site in year zero, and the ongoing flux from disequilibrium. In the case of the project, SHAMBA estimated a starting soil baseline of 143 tCO_2e/ha (39 tC/ha)$^{-}$at 30cm soil depth, which is comparable to the 139 tCO_2e/ha (38 tC/ha) estimated by ISRIC SoilGrids machine learning analyses (Hengl *et al.* 2017). All soil parameters estimated by Hengle *et al.* (2017), including SOC, can be interactively explored in a web browser at https://tinyurl.com/y4zbwkaz. Further, SHAMBA estimated that soils were in disequilibrium and losing SOC in each year of the baseline. Full soil baseline fluxed can be viewed for the baseline scenarios at charts/tables on cumulative benefits and average carbon value in results worksheet, Annex F1.

[5] Details in SHAMBA v 1.1 Methodology https://shambatool.wordpress.com/outputs/

G4.6 Overall carbon content in the baseline

Table G8 summarises the average carbon in the baseline during the accounting period for both biomass and soil organic carbon.

Table G8. Baseline average carbon content

Region	Biomass (AGB+BGB) average tCO_2e/ha	SOC average tCO_2e/ha
Northern	2.86	71
Southern	3.05	109

G5 Ecosystem service benefits

G5.1 Climate benefits methodology and calculations

The climate benefits of the project were assessed using the Plan Vivo-approved SHAMBA (Small-Holder Agriculture Mitigation Benefit Assessment) model (Woollen *et al.* 2017). The full model accounts for greenhouse gases (GHG) benefits from changes in biomass, soil management, crops and fertiliser use. In this project, we only use SHAMBA to calculate the changes to biomass and soil pools. We also use the outputs from SHAMBA to calculate carbon stored in harvested wood products (HWPs) from light thinning and tree harvesting at end of the crediting period (Table G9). In our analysis of the SHAMBA outputs, positive numbers represent GHG removals.

Table G9: Carbon pools and emissions in the estimation of the project's climate benefits

Carbon pool	**Included**	**Justification**
Tree biomass (above and below ground)	Yes	A significant carbon pool resulting from trees planted by the project
Soil organic carbon	Yes	Changes in soil management are increasing SOC
Long lived harvested products	Yes	The project will increase the stock of wood products when compared to the baseline
Tree litter	Yes	The model assumes that tree litter will remain on the ground due to fire suppression.
Dead wood	Yes	The model assumes that all C in tree deadwood will be removed from the system for firewood.
Emission sources	**Included**	**Justification**
Organic fertilisers	No	Not applied by farmers
Synthetic fertilisers	No	Not applied by farmers
Biomass burning	Yes	Included as an emissions flux for SOC and the estimation of

		climate benefits.

Below follows an outline of the overall modelling approach, and a brief description of the assumptions and calculations made for calculating each of the carbon pools. For further details on the SHAMBA model, please refer to the SHAMBA methodology (https://shambatool.wordpress.com/outputs/). In addition to the species, stocking densities, growth rates and soil management activities specified elsewhere in this document, the full SHAMBA input values used to estimate the climate benefit for each intervention are documented and referenced in a separate Excel database for each intervention (Annex F1).

G5.2 Overall modelling approach

We employ an average carbon accounting approach to calculate the benefit from carbon in biomass, HWPs and soils over the project period. First, we use the outputs of SHAMBA to calculate the net GHG benefit across pools (i.e. biomass, HWPs and soils) in each year over the project period, relative to the baseline for each pool. We then average this over the project period to give an average GHG benefit to tCO_2e/ha.

For the baseline scenario, GHG emissions or removals per hectare in year *y* are calculated as:

$$BE_y = BE_{SOy} + BE_{WBy} + BE_{HWPy}$$

Where:

BE_y is the GHG emissions under the baseline scenario for year *y* (tCO_2e/ha);

BE_{SOy} is the emissions from change in soil organic carbon stocks in year *y* of the baseline scenario (tCO_2e/ha);

BE_{WBy} is the emissions from change in woody biomass of trees planted through scenario activities in year *y* of the of the baseline scenario (tCO_2e/ha); and

BE_{HWPy} is the emissions from change in harvested wood products of trees planted through scenario activities in year *y* of the of the baseline scenario (tCO_2e/ha).

For the intervention scenario, the calculation is identical:

$$PE_y = PE_{SOy} + PE_{WBy} + PE_{HWPy}$$

Where:

PE_y is the GHG emissions under the intervention for year *y* (tCO_2e/ha);

PE_{SOy} is the emissions from change in soil organic carbon stocks in year *y* of the intervention (tCO_2e/ha);

PE_{WBy} is the emissions from change in woody biomass of trees planted through scenario activities in year *y* of the intervention (tCO_2e/ha); and

PE_{HWPy} is the emissions from change in harvested wood products of trees planted through scenario activities in year *y* of the intervention (tCO_2e/ha).

The average net climate benefit for a project period is given by first adding the cumulative benefit from the difference between the intervention and the baseline over the years *y* = 1 to *y* = *d,* then averaging this over *d*:

$$CBd = \frac{\sum_{y=1}^{d}(PEy - BEy)}{d}$$

Where:

CBd is the average net climate benefit over the accounting period

PEy is project emissions in year y (tCO_2e/ha) over the accounting period

BEy is baseline emissions in year y (tCO_2e/ha) over the accounting period

d is the accounting period

G5.3 Biomass calculations

Biomass calculations relied on growth rates from a field inventory of existing project sites and on values from the literature. Full details, references, growth curves and model fit details are available in the Excel database for each technical specification (Annex F1). Biomass was estimated for all species using species specific equations, (details in Table G10). Growth curves were based on the annual dbh increments specified in Table G8. The growth model was selected by SHAMBA from a variety of options (linear, exponential, hyperbolic and logistic) based on the model with the lowest mean squared error (MSE). For each of these species in these technical specifications, the logistic curve provided the best fit. The amount of carbon from the baseline assessment was also included in the project scenario because any existing trees will remain in the project scenario and would otherwise be cleared (see Section G2.3). Subject to soil conditions, the project will include agricultural activities in most tree planting sites to form agroforestry systems. Areas with poorer soils will be initially established as woodlots (trees only) with scope for introducing crops once the soil conditions of some of these sites become suitable for agroforestry (see Section G1.1).

Some farmers have indicated that they intend to increase crop activities at a later stage in the project; hence greater thinning intensity in the component identified as agroforestry. Conservatively, the same crop assumptions are used in the model for both woodlots and agroforestry.

G5.4 Soil calculations

Soils in the baseline and changes to soil organic carbon (SOC) were calculated in SHAMBA using its 'wind up' RothC feature, where the model assumes that, in year zero of the project, SOC is already in disequilibrium (i.e. losing or gaining carbon) due to pre-existing degradation (see Section G4.7). Changes to SOC in a given year under the project scenario are assessed against the expected flux in the baseline scenario. In the cases of the technical specifications in the interventions under this project, soils remain a GHG source in the project, but less so than in the baseline scenario, due to the project's enhanced soil management and fire management activities (see charts on cumulative and average climate benefits in *results* worksheet, Annex F1). We use best practices in activity-based monitoring to verify the modelled climate benefits from changes to SOC under each intervention (Plan Vivo 2017; FAO 2011; VCS 2012). See Part K on monitoring for more details.

G5.5 HWP calculations

A proportion of tree stems removed from the system during thinning and harvesting will be processed into HWPs (Table G9 and *HWP* and *results* worksheets, Annex F1), which will form a pool of stored wood-based carbon separate from the biomass and soil pools modelled in SHAMBA. During community consultations, farmers' have expressed interest in using timber from 2nd thinnings for other than woodfire or fence post use as they see more value if they use it for furniture or construction or as an opportunity to sell it to other farmers for this use. Conservatively only timber from 2nd thinnings will be considered as part of the HWP calculations. Although thinned, HWP from *Gliricidia sepium* is not included in the carbon estimations while *Paraserianthes* is not thinned at all and therefore not included.

We calculated HWP for each of the interventions (with the exclusions mentioned) in this project using an IPCC Tier 1 approach (IPCC 2006), as follows:

$$C_{HWP} = k \times (C_{harv} - C_{discard})$$

Where:

C_{HWP} is carbon in harvested wood products (HWPs)

K is decay rate of carbon HWPs, based on default value of 0.023% per year in IPCC (2006), which appears conservative relative to similar analyses in the tropics and elsewhere (Kürsten *et al*. 1993)

C_{harv} is amount of carbon in total harvested timber, from intermediary SHAMBA outputs on the biomass of stems per ha in each year of the project scenario, and information on thinning and harvesting regimes

$C_{discard}$ is amount of carbon in timber discarder during processing of timber, using value of 0.4 of C_{harv} based on conservative estimates from Ximenes *et al*. (2008), and similar to other smallholder systems (de Jong *et al.* 1996)

G5.6 Growth parameters

The estimation of the carbon pools is based on dbh growth rates, thinning regime and initial stocking. The dbh growth rate was derived for most species from a random stratified inventory conducted by the project in 2018 and 2019. The average dbh results of trees that were 5 years or older were then compared with growth rates of global projects and studies (Table G10); with the lowest of the two values used conservatively in the model calculations. Details of the parameters are included in Annex F1. Should specific allometrics equations be developed for TL and with regards to the species of the project; these equations will be considered for use in the model. The monitoring schedule will inform calibration of growth inputs at year 5. This will occur prior third-party verification of the project which also will take place every 5 years in accordance with PV's guidelines.

Table G10: Growth inputs in the model

<table>
<tr><th>Species</th><th>Annual increment of diameter at breast height (cm/year) used in the model</th><th>Age and dbh average (from project data)</th><th>Sources of information for annual dbh increment and stand tree density from global studies</th><th>Age and dbh applied in the model (based on annual increment)</th><th>Trees per hectare (initial planting density)</th><th>Activity</th></tr>
<tr><td>Mahogany
(Swietenia macrophylla)</td><td>0.98</td><td><table><tr><th>Age (years)</th><th>dbh average (cm)</th><th>Height average (m)</th></tr><tr><td>6</td><td>7.1</td><td>-</td></tr><tr><td>7</td><td>7.4</td><td>-</td></tr><tr><td>8</td><td>7.7</td><td>7.5</td></tr></table></td><td>Sampling of 133 trees planted by the project (aged 4 to 8). Other studies: 1.25 cm / year annual dbh growth and average height of 9.6 m for trees less than 10 years old (Krisnawati et al. 2011); reported for Indonesia. Perez et al. 2012, reported for Mexico an</td><td><table><tr><th>Age (years)</th><th>dbh (cm)</th></tr><tr><td>6</td><td>5.9</td></tr><tr><td>12</td><td>11.8</td></tr><tr><td>18</td><td>17.6</td></tr><tr><td>24</td><td>23.5</td></tr><tr><td>30</td><td>29.4</td></tr></table></td><td>1111</td><td>Woodlots and Agroforestry</td></tr>
</table>

<table>
<tr>
<td></td>
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<td></td>
<td>average height of 13 m and dbh of 14 cm (annual growth of 1.07 cm) for 14 years old stands with densities of 800 TPH[6] and 13 m height and 15 cm dbh (annual growth of 1.66 cm) for 9 years old, with densities of 944 TPH.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Casuarina sp</td>
<td>1.17</td>
<td>
<table>
<tr><th>Age (years)</th><th>dbh average (cm)</th></tr>
<tr><td>5</td><td>7.6</td></tr>
<tr><td>6</td><td>8.0</td></tr>
<tr><td>8</td><td>9.3</td></tr>
</table>
</td>
<td>Sampling of 281 trees planted by the project. Other studies: 1.36 cm/ year with initial stocking/ha of up to 2500 trees (Rana et al. 2001 and Ugalde & Perez 2001) for Asian conditions. Goel et al. 2005, reported for India an average dbh of 8.59 ± 1.99 cm for stand densities of 3331 TPH (8 year old stands, annual dbh growth of between 0.87 and 1.32 cm) while Wang et al. 2013,</td>
<td>
<table>
<tr><th>Age (years)</th><th>dbh (cm)</th></tr>
<tr><td>6</td><td>7.0</td></tr>
<tr><td>12</td><td>14.0</td></tr>
<tr><td>18</td><td>21.1</td></tr>
<tr><td>24</td><td>28.1</td></tr>
<tr><td>30</td><td>35.1</td></tr>
</table>
</td>
<td>1111</td>
<td>Woodlots and Agroforestry</td>
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</table>

[6] TPH: trees per hectare

<table>
<tr>
<td></td>
<td></td>
<td></td>
<td>reported for China, average dbh of 19.35 ± 0.9 for densities of 975 TPH (18 years old, annual dbh growth of between 1.02 and 1.25cm).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gamal (Gliricidia sepium)</td>
<td>1.55</td>
<td>Planting started in 2019- early 2020, therefore input data from other studies is used.</td>
<td>Linear model derived from literature review on species analysis worksheet. (Baker, K. 2012.; And Getahun, A. and Jama, B. 1989.)</td>
<td>
<table>
<tr><th>Age (years)</th><th>dbh (cm)</th></tr>
<tr><td>6</td><td>9.3</td></tr>
<tr><td>12</td><td>18.6</td></tr>
<tr><td>18</td><td>27.9</td></tr>
<tr><td>24</td><td>30.0</td></tr>
<tr><td>30</td><td>33.6</td></tr>
</table>
Asymptote at 30cm at age 24 in line with literature and slight dbh increment from age 24-30, resulting from increased growth from mortality of other trees.
</td>
<td>400 (1 m between trees along perimeter of 1 ha)</td>
<td>Living Fences</td>
</tr>
<tr>
<td>Teka filipina/ White teak (Gmelina arborea)</td>
<td>1.67</td>
<td>
<table>
<tr><th>Age (years)</th><th>dbh average (cm)</th><th>Height average (m)</th></tr>
<tr><td>3</td><td>8.8</td><td>6.2</td></tr>
<tr><td>4</td><td>14.6</td><td>10.1</td></tr>
</table>
</td>
<td>Sampling of 44 trees in the project indicated annual dbh increments of 3.4 cm. Conservatively, the diameter growth in the model was sourced from other studies, while heights obtained from the project were used to generate a height model. Roshetko et al. (2004) reported</td>
<td>
<table>
<tr><th>Age (years)</th><th>dbh (cm)</th></tr>
<tr><td>6</td><td>10.0</td></tr>
<tr><td>12</td><td>20.0</td></tr>
<tr><td>18</td><td>26.7</td></tr>
<tr><td>24</td><td>40.1</td></tr>
<tr><td>30</td><td>50.1</td></tr>
</table>
</td>
<td>1111</td>
<td>Woodlots and Agroforestry</td>
</tr>
</table>

			for Indonesia average heights of 4.25 m for trees less than 2-years old. Swammy et al. 2003, reported for India an average dbh of 15.1 cm for densities of 734 TPH (6 years old, annual dbh growth of 2.51 cm) and Onyekwelu *et al*. 2003, who reported for Nigeria an average height of 16.4 m and dbh of 15.6 cm for stand densities of 1291 TPH (6 years old, annual dbh growth of 2.6 cm).			

<table>
<tr>
<td>Teka, black teak (Tectona grandis)</td>
<td>1.15</td>
<td>
<table>
<tr><th>Age (years)</th><th>dbh average (cm)</th></tr>
<tr><td>5</td><td>7.5</td></tr>
<tr><td>6</td><td>8.2</td></tr>
</table>
</td>
<td>Sampling of 36 trees planted by the project (aged 5 to 8). Other studies: 1.9 cm / year increment (Monteuuis et al. 2011). Siregar (2011) who reported for Indonesia an average of 26.2 cm dbh for 556 TPH (15 years old, annual growth of 1.7 cm).</td>
<td>
<table>
<tr><th>Age (years)</th><th>dbh (cm)</th></tr>
<tr><td>6</td><td>6.9</td></tr>
<tr><td>12</td><td>13.8</td></tr>
<tr><td>18</td><td>20.7</td></tr>
<tr><td>24</td><td>27.6</td></tr>
<tr><td>30</td><td>34.5</td></tr>
</table>
</td>
<td>1111</td>
<td>Woodlots</td>
</tr>
<tr>
<td>Albizia (Paraserianthes falcataria)</td>
<td>2.85</td>
<td>
<table>
<tr><th>Age (years)</th><th>dbh average (cm)</th></tr>
<tr><td>8</td><td>22.8</td></tr>
</table>
</td>
<td>Small number of trees planted in the project. Limited data from field sites on growth measured at year 8 gives increments of 2.85cm/ year. This seems conservative compared to the literature with initial growth rates in Indonesia of over 4 cm/ year (Krisnawati et al. 2011) and of similar species (Toky et al. 1996 and Parrotta et al. 2006).</td>
<td>
<table>
<tr><th>Age (years)</th><th>dbh (cm)</th></tr>
<tr><td>6</td><td>17.1</td></tr>
<tr><td>12</td><td>34.2</td></tr>
<tr><td>18</td><td>43.8</td></tr>
<tr><td>24</td><td>43.8</td></tr>
<tr><td>30</td><td>43.8</td></tr>
</table>
dbh conservatively caped at 43.8 cm in line with the allometric equation by Rusolono (2006) applied in the model.
</td>
<td>69</td>
<td>Agroforestry</td>
</tr>
<tr>
<td>Red cedar / Ai saria (Toona</td>
<td>1.3</td>
<td>Planting started in 2020, therefore input data from other studies and sites are used.</td>
<td>Data sourced from 50 trees planted in the AOI (not part</td>
<td></td>
<td>1111</td>
<td>Woodlots and Agroforestry</td>
</tr>
</table>

sureni)			of the HV project) gives increments of 1.3 cm / year. By comparison, other studies reported dbh increments of 1.8 cm/year in Indonesia (Latifah et al. 2018) while Balducci et al. 2009 reported average increments of 4.2 cm /year.	<table><tr><th>Age (years)</th><th>dbh (cm)</th></tr><tr><td>6</td><td>7.8</td></tr><tr><td>12</td><td>15.6</td></tr><tr><td>18</td><td>23.4</td></tr><tr><td>24</td><td>31.2</td></tr><tr><td>30</td><td>39</td></tr></table>			

G5.7 Tree survival rates and thinning regimes

The project is aiming for a 90% survival rate during the first year and a 1% mortality / year thereafter for the duration of the project. Ongoing tree counts and monitoring will allow updating of these rates as required. There are provisions in place under the PES agreement and monitoring to re-stock sites as needed as a result of mortality.

Farmers will remove suppressed trees (thinning from below) using the harvesting proportions included in Table G11. The project will apply a light thinning approach to prevent potential windthrow impact and account for the significant slope gradient of the terrain in most sites, while still encouraging growth of best trees. When combining the annual mortality rate applied and thinning prescribed; the final stocking at the end of the rotation is comparable to the recommended stockings for specific species made by other studies (Krisnawati *et al.* 2011, Onyekwelu *et al*. 2003, Urueña 2004).

Table G11: Thinning regimes

Species	Year	Woodlots % of trees removed	Agroforestry % of trees removed	Live Fence % of trees removed
Mahogany *(Swietenia macrophylla) and Casuarina sp*	8	10	20	-
	13	10	10	-
Gamal *(Gliricidia sepium)*	8	-	-	10
	13	-	-	10
Teka filipina *(Gmelina arborea)*	5	20	30	-
	11	20	20	-
Black teak *(Tectona grandis)*	5	20	20	-
	11	20	20	-
Albizia *(Paraserianthes falcataria)*	-	-	-	-
Red cedar/ Ai saria (*Toona sureni*)	4	10	20	-
	9	10	10	-

G.5.8 Tree growth equations used in the model

There are not allometric equations specifically developed for the species planted by the project in TL, therefore most of the equations used in the model are reported for Indonesia, a neighboring country with similar physiographic conditions to TL. The key criteria selecting the equations was conservativeness in the results obtained from the model. Details of the equations are summarised in Table G12.

Table G12: Equations used in the model.

Specie	Biomass Equation	Height equation	Source and Justification
Casuarina angustifolia	$AGB = 0.1168 * dbh^{2.523}$	-	Dudley, N., S. and Fownes, J., H. 1992., reported for Hawaii. The results are conservative when compared with Goel, V. L.& Behl, H.M. 2005, reported for India showing a potential overestimation of ~ 10%.
			Indonesian Forest Department

Swietenia macrophylla	$AGB = 0.903 * (dbh^2 * h)^{0.684}$	$h = 0.6488 * dbh + 1.7084$	(2009), referenced by Krisnawati et al. 2012, reported for Indonesia. Other equation reported for Indonesia (Adinugroho and Sidiyasa, 2006), referenced by Krisnawati et al. 2012, showed a potential overestimation of more than 40%. Height equation from linear model by measuring 46 trees that are part of the project.
Gmelina arborea	$AGB = 0.06 * (dbh^2 * h)^{0.88}$	$h = 0.4629 * dbh + 2.7775$	Agus (2002), referenced by Krisnawati et al. 2012. Only equation found for the region. Comparable with results from the equation by Batanicla et al. 2007, reported for the Philippines, albeit sourced from only 7 trees. Height equation from linear model by measuring 44 trees that are part of the project.
Gliricidia sepium	$AGB = 0.294 * dbh^{2.269}$	-	Smiley and Kroscher 2008. Reported for Indonesia. This is the only equation found for the region.
Paraserianthes falcataria	$logAGB = -1.239 + 2.561 \log dbh$	-	Rusolono (2006), referenced by Krisnawati et al. 2012. The upper dbh in the equation is 43.8 cm, also applied in the model from age 18 onwards. This dbh ceiling gives a conservative estimation when applying the model's estimated annual growth rate. Some trees at age 8 in the project are already measuring 24 cm in dbh while other trees that are not part of the project can measure more than 80 cm in dbh (age unknown). Other equations by Siregar (2007) and Siringoringo and Siregar (2006) reported for Indonesia by Krisnawati et al. 2012, are limited to 2-30 cm and 16.6-31.2 cm in dbh respectively.

Tectona grandis	$AGB = 0.0548 dbh^{2.579}$	-	Siregar 2011, reported for Indonesia and conservatively selected. Other equation found for Indonesia (Aminudin 2008 reported by Krisnawati) showed a potential overestimation of ~ 28%.
Toona sureni	$AGB = 0.00013 * dbh^{2.502} * wd * BEF$ *Where:* *Wood density (wd) = 0.375 g/cm3 and Biomass Expansion factor (BEF) = 1.5*	-	A volume equation referenced by Krisnawati et al. 2012 for Indonesia is conservatively applied. By comparison results from equations by Chaturvedi et al. 1971 for India and Leech et al. 1990 for Myanmar were 11% and 67% respectively higher.

dbh: diameter at breast height, h: height, *AGB*: above ground biomass.

G5.8 Estimated tree growth

Growth of each specie included in the project is included in Tables G13, G14 and G15 for woodlots, agroforestry and live fence respectively. The estimation is based on the estimated tree dbh growth rate, stocking and corresponding allometric equation.

Table G13: Basal area (m^2/ha) and estimated tree biomass (tCO_2e/ha) per specie for woodlots

Age (years)	*Casuarina angustifolia*					*Swietenia macrophylla*					*Gmelina arborea*					*Tectona grandis*				
	Tree dbh (cm)	Trees/ha	Basal area (m^2/ha)	Tree Biomass tCO_2e/ha	Average tree biomass for duration of the project tCO_2e/ha	Tree dbh (cm)	Trees/ha	Basal area (m^2/ha)	Tree Biomass tCO_2e/ha	Average tree biomass for duration of the project tCO_2e/ha	Tree dbh (cm)	Trees/ha	Basal area (m^2/ha)	Tree Biomass tCO_2e/ha	Average tree biomass for duration of the project tCO_2e/ha	Tree dbh (cm)	Trees /ha	Basal area (m^2/ha)	Tree Biomass tCO_2e/ha	Average tree biomass for duration of the project tCO_2e/ha
1	1.17	1000	0.1	1.8	239	0.98	1000	0	1.95	228	1.67	1000	0.22	1.99	210	1.15	1000	0.1	0.9	102
2	2.34	990	0.4	5.6	239	1.96	990	0	7.01	228	3.34	990	0.87	6.41	210	4	990	1.2	2.9	102
3	3.51	980	0.9	10.6	239	2.94	980	1	13.60	228	5.01	980	1.93	12.14	210	6.85	980	3.6	5.5	102
4	4.68	970	1.7	16.6	239	3.92	970	1	21.34	228	6.68	970	3.40	18.94	210	9.7	970	7.2	8.6	102
5	5.85	960	2.6	23.5	239	4.9	960	2	30.19	228	8.35	768	4.21	16.08	210	12.55	768	9.5	7.5	102
6	7.02	951	3.7	31.4	239	5.88	951	3	40.23	228	10.02	761	6.00	23.55	210	15.4	761	14.2	11.0	102
7	8.19	941	5.0	40.6	239	6.86	941	3	51.56	228	11.69	753	8.08	32.15	210	18.25	753	19.7	14.9	102
8	9.36	839	5.8	44.1	239	7.84	839	4	54.52	228	13.36	746	10.45	41.98	210	21.1	746	26.1	19.5	102
9	10.53	830	7.2	55.2	239	8.82	830	5	67.55	228	15.03	738	13.10	53.21	210	23.95	738	33.3	24.7	102
10	11.7	822	8.8	67.8	239	9.8	822	6	82.16	228	16.7	731	16.01	66.03	210	26.8	731	41.2	22.8	102
11	12.87	814	10.6	82.2	239	10.78	814	7	98.49	228	18.37	579	15.34	60.42	210	29.65	579	40.0	28.5	102
12	14.04	806	12.5	98.7	239	11.76	806	9	116.69	228	20.04	573	18.07	74.07	210	32.5	573	47.5	35.0	102
13	15.21	718	13.0	104.6	239	12.74	718	9	120.58	228	21.71	567	21.00	89.59	210	35.35	567	55.7	42.4	102
14	16.38	711	15.0	124.0	239	13.72	711	11	140.93	228	23.38	562	24.11	107.17	210	38.2	562	64.4	50.8	102
15	17.55	704	17.0	146.0	239	14.7	704	12	163.41	228	25.05	556	27.40	127.01	210	41.05	556	73.6	60.4	102
16	18.72	697	19.2	170.9	239	15.68	697	13	188.09	228	26.72	550	30.86	149.34	210	41.12	550	73.1	71.2	102
17	19.89	690	21.4	198.9	239	16.66	690	15	215.07	228	28.39	545	34.49	174.39	210	41.19	545	72.6	83.4	102
18	21.06	683	23.8	230.2	239	17.64	683	17	244.42	228	30.06	539	38.28	202.37	210	41.26	539	72.1	97.1	102
19	22.23	676	26.2	265.2	239	18.62	676	18	276.13	228	31.73	534	42.23	233.48	210	41.33	534	71.6	112.4	102
20	23.4	669	28.8	303.9	239	19.6	669	20	310.20	228	33.4	529	46.32	267.92	210	41.4	529	71.2	129.4	102
21	24.57	662	31.4	346.7	239	20.58	662	22	346.52	228	35.07	523	50.56	305.79	210	41.47	523	70.7	148.1	102
22	25.74	656	34.1	393.5	239	21.56	656	24	384.94	228	36.74	518	54.93	347.19	210	41.54	518	70.2	168.7	102
23	26.91	649	36.9	444.4	239	22.54	649	26	425.24	228	38.41	513	59.44	392.11	210	41.61	513	69.8	191.1	102
24	28.08	643	39.8	499.3	239	23.52	643	28	467.12	228	40.08	508	64.08	440.46	210	41.68	508	69.3	215.2	102
25	29.25	636	42.8	557.8	239	24.5	636	30	510.20	228	41.75	503	68.83	492.03	210	41.75	503	68.8	241.0	102

26	30.42	630	45.8	619.6	239	25.48	630	32	554.06	228	43.42	498	73.70	546.50	210	41.82	498	68.4	268.3	102
27	31.59	624	48.9	684.2	239	26.46	624	34	598.21	228	45.09	493	78.69	603.41	210	41.89	493	67.9	296.7	102
28	32.76	617	52.0	750.7	239	27.44	617	37	642.12	228	46.76	488	83.78	662.18	210	41.96	488	67.5	326.1	102
29	33.93	611	55.3	818.4	239	28.42	611	39	685.25	228	48.43	483	88.97	722.11	210	42.03	483	67.0	356.0	102
30	35.1	605	58.6	35.4	239	29.4	605	41	-7.57	228	50.1	478	94.26	22.46	210	42.1	478	66.6	13.5	102

Age (years)	***Toona sureni***				
	Tree dbh (cm)	Trees/ha	Basal area (m^2/ha)	Tree Biomass tCO_2e/ha	Average tree biomass for duration of the project tCO_2e/ha
1	1.3	1000	0.13	1.48	195
2	2.6	990	0.53	4.68	195
3	3.9	980	1.17	8.82	195
4	5.2	970	2.06	10.42	195
5	6.5	960	3.19	15.65	195
6	7.8	951	4.54	21.68	195
7	9.1	941	6.12	28.62	195
8	10.4	839	7.13	36.58	195
9	11.7	830	8.93	39.59	195
10	13	822	10.91	49.10	195
11	14.3	814	13.07	59.97	195
12	15.6	806	15.40	72.37	195
13	16.9	718	16.10	86.48	195
14	18.2	711	18.49	102.48	195
15	19.5	704	21.01	120.60	195
16	20.8	697	23.67	141.04	195
17	22.1	690	26.45	164.02	195
18	23.4	683	29.36	189.74	195
19	24.7	676	32.39	218.39	195
20	26	669	35.53	250.15	195
21	27.3	662	38.78	285.12	195
22	28.6	656	42.13	323.38	195
23	29.9	649	45.59	364.90	195
24	31.2	643	49.14	409.59	195
25	32.5	636	52.79	457.22	195
26	33.8	630	56.53	507.46	195
27	35.1	624	60.35	559.84	195

28	36.4	617	64.25	613.79	195
29	37.7	611	68.23	668.61	195
30	39.0	605	72.29	27.83	195

Table G14: Basal area (m^2/ha) and estimated tree biomass (tCO_2e/ha) per specie for Agroforestry

Age (years	*Casuarina angustifolia*					*Swietenia macrophylla*					*Gmelina arborea*					*Paraserianthes falcataria*				
	Tree dbh (cm)	Trees/ha	Basal area (m^2/ ha)	Tree Biomass tCO_2e/ha	Average tree biomass for duration of the project tCO_2e/ha	Tree dbh (cm)	Trees/ha	Basal area (m^2/ ha)	Tree Biomass tCO_2e/ha	Average tree biomass for duration of the project tCO_2e/ha	Tree dbh (cm)	Trees/ha	Basal area (m^2/ ha)	Tree Biomass tCO_2e/ha	Average tree biomass for duration of the project tCO_2e/ha	Tree dbh (cm)	Trees /ha	Basal area (m^2/ ha)	Tree Biomass tCO_2e/ha	Average tree biomass for duration of the project tCO_2e/ha
1	1.17	1000	0.11	1.79	215	0.98	1000	0.08	1.95	202	1.7	1000	0.22	1.99	183	2.9	62	0.04	1.06	276
2	2.34	990	0.43	5.64	215	1.96	990	0.30	7.01	202	3.3	990	0.87	6.41	183	5.7	61	0.16	2.78	276
3	3.51	980	0.95	10.63	215	2.94	980	0.67	13.60	202	5.0	980	1.93	12.14	183	8.6	61	0.35	5.30	276
4	4.68	970	1.67	16.57	215	3.92	970	1.17	21.34	202	6.7	970	3.40	18.94	183	11.4	60	0.62	8.95	276
5	5.85	960	2.58	23.47	215	4.9	960	1.81	30.19	202	8.4	672	3.68	10.70	183	14.3	60	0.95	14.19	276
6	7.02	951	3.68	31.43	215	5.88	951	2.58	40.23	202	10.0	666	5.25	17.38	183	17.1	59	1.36	21.67	276
7	8.19	941	4.96	40.61	215	6.86	941	3.48	51.56	202	11.7	659	7.07	25.06	183	20.0	58	1.83	32.26	276
8	9.36	746	5.13	44.15	215	7.84	746	3.60	44.73	202	13.4	652	9.15	33.85	183	22.8	58	2.36	47.12	276
9	10.53	738	6.43	55.16	215	8.82	738	4.51	56.46	202	15.0	646	11.46	43.89	183	25.7	57	2.96	67.66	276
10	11.7	731	7.86	67.79	215	9.8	731	5.51	69.64	202	16.7	639	14.01	55.35	183	28.5	57	3.62	95.49	276
11	12.87	723	9.41	82.22	215	10.78	723	6.60	84.36	202	18.4	506	13.42	50.32	183	31.4	56	4.34	132.1	276
12	14.04	716	11.09	98.69	215	11.76	716	7.78	100.8	202	20.0	501	15.81	62.50	183	34.2	56	5.11	178.3	276
13	15.21	638	11.59	91.80	215	12.74	638	8.13	104.2	202	21.7	496	18.37	76.36	183	37.1	55	5.93	233.4	276
14	16.38	632	13.31	109.3	215	13.72	632	9.34	122.6	202	23.4	491	21.10	92.04	183	39.9	54	6.81	294.3	276
15	17.55	625	15.13	129.2	215	14.7	625	10.61	142.8	202	25.1	486	23.97	109.7	183	42.8	54	7.74	355.4	276
16	18.72	619	17.04	151.6	215	15.68	619	11.96	165.0	202	26.7	482	27.00	129.6	183	42.8	53	7.69	409.9	276
17	19.89	613	19.05	176.8	215	16.66	613	13.36	189.2	202	28.4	477	30.18	152.0	183	42.9	53	7.64	452.1	276
18	21.06	607	21.14	205.1	215	17.64	607	14.83	215.6	202	30.1	472	33.50	176.9	183	43.0	52	7.59	480.3	276
19	22.23	601	23.32	236.6	215	18.62	601	16.36	244.1	202	31.7	467	36.95	204.5	183	43.0	52	7.54	496.3	276
20	23.4	595	25.58	271.5	215	19.6	595	17.95	274.6	202	33.4	463	40.53	235.2	183	43.1	51	7.49	503.6	276

21	24.57	589	27.92	310.0	215	20.58	589	19.59	307.1	202	35.1	458	44.24	268.8	183	43.2	51	7.43	505.6	276
22	25.74	583	30.33	352.1	215	21.56	583	21.28	341.5	202	36.7	453	48.07	305.5	183	43.2	50	7.38	504.6	276
23	26.91	577	32.82	397.8	215	22.54	577	23.03	377.5	202	38.4	449	52.01	345.3	183	43.3	50	7.33	502.1	276
24	28.08	571	35.38	446.9	215	23.52	571	24.82	414.9	202	40.1	444	56.07	388.1	183	43.4	49	7.28	498.8	276
25	29.25	566	38.01	499.3	215	24.5	566	26.67	453.3	202	41.8	440	60.23	433.6	183	43.5	49	7.23	495.2	276
26	30.42	560	40.70	554.6	215	25.48	560	28.55	492.3	202	43.4	436	64.49	481.6	183	43.5	48	7.19	491.3	276
27	31.59	554	43.45	612.3	215	26.46	554	30.48	531.6	202	45.1	431	68.85	531.7	183	43.6	48	7.14	487.4	276
28	32.76	549	46.26	671.6	215	27.44	549	32.46	570.5	202	46.8	427	73.31	583.3	183	43.7	47	7.09	483.4	276
29	33.93	543	49.13	731.9	215	28.42	543	34.47	608.8	202	48.4	423	77.85	635.9	183	43.7	47	7.04	479.4	276
30	35.1	538	52.05	28.1	215	29.4	538	36.52	-12.1	202	50.1	418	82.48	15.2	183	43.8	46	6.99	-13.9	276

Age (years)	*Toona sureni*				
	Tree dbh (cm)	Trees/ha	Basal area (m^2/ha)	Tree Biomass tCO_2e/ha	Average tree biomass for duration of the project tCO_2e/ha
1	1.3	1000	0.13	1.48	173
2	2.6	990	0.53	4.68	173
3	3.9	980	1.17	8.82	173
4	5.2	970	2.06	7.10	173
5	6.5	960	3.19	11.83	173
6	7.8	951	4.54	17.29	173
7	9.1	941	6.12	23.56	173
8	10.4	746	6.33	30.76	173
9	11.7	738	7.94	33.48	173
10	13	731	9.70	42.08	173
11	14.3	723	11.62	51.91	173
12	15.6	716	13.69	63.11	173
13	16.9	638	14.31	75.85	173
14	18.2	632	16.44	90.31	173
15	19.5	625	18.68	106.66	173
16	20.8	619	21.04	125.11	173
17	22.1	613	23.51	145.83	173
18	23.4	607	26.10	169.01	173
19	24.7	601	28.79	194.83	173
20	26	595	31.58	223.41	173
21	27.3	589	34.47	254.86	173
22	28.6	583	37.45	289.24	173
23	29.9	577	40.52	326.51	173
24	31.2	571	43.68	366.57	173
25	32.5	566	46.92	409.22	173
26	33.8	560	50.24	454.14	173
27	35.1	554	53.64	500.90	173
28	36.4	549	57.11	548.98	173
29	37.7	543	60.65	597.76	173
30	39.0	538	64.26	21.94	173

Table G15: Basal area (m^2/ha) and estimated tree biomass (tCO_2e/ha) for *Gliricidia sepium* (live fence)

Age (Years)	Tree dbh (cm)	Trees/ha (with mortality)	Basal area ($m^2/\ ha$)	Tree Biomass (tCO_2e/ha)	Average tree biomass for duration of the project tCO_2e/ha
1	1.6	360	0.07	1.90	190
2	3.2	356	0.28	5.09	190
3	4.7	353	0.62	9.24	190
4	6.3	349	1.10	14.33	190
5	7.9	311	1.53	20.48	190
6	9.5	308	2.17	27.85	190
7	11.1	305	2.93	36.63	190
8	12.6	302	3.79	41.81	190
9	14.2	299	4.75	52.94	190
10	15.8	296	5.80	65.94	190
11	17.4	293	6.95	80.9	190
12	19.0	290	8.19	98.0	190
13	20.5	258	8.56	117.2	190
14	22.1	256	9.83	138.4	190
15	23.7	253	11.18	161.4	190
16	25.3	251	12.59	185.7	190
17	26.9	248	14.07	211.0	190
18	28.4	246	15.61	236.5	190
19	30.0	243	17.22	261.5	190
20	30.3	241	17.41	285.2	190
21	30.7	239	17.60	307.1	190

22	31.0	236	17.79	326.6	190
23	31.3	234	17.97	343.4	190
24	31.6	231	18.15	357.4	190
25	31.9	229	18.33	368.6	190
26	32.2	227	18.51	377.3	190
27	32.6	225	18.69	383.7	190
28	32.9	222	18.86	388.2	190
29	33.2	220	19.03	391.0	190
30	33.5	218	19.20	392.6	190

G5.9 Total climate benefits summary

The normalised number of live trees / species / years planted and corresponding area is included in Table G16.

Table G16: Summary of live trees per year (2011-2019)

Planted Year	*Casuarina angustifolia*	*Casuarina angustifolia (ha)*	*Swietenia macrophylla*	*Swietenia macrophylla (ha)*	*Gmelina arborea*	*Gmelina arborea (ha)*	*Tectona grandis*	*Tectona grandis (ha)*	*Paraserianthes falcataria*	*Paraserianthes falcataria (ha)*	*Gliricidia sepium*	*Gliricidia sepium (ha)*
2011	*4002*	4.8	*3774*	4.5	*0*	0.00	*274*	0.3	*25*	0.4	*0*	0.00
2012	*2302*	2.4	*625*	0.7	*0*	0.00	*0*	0.0	*23*	0.4	*0*	0.00
2013	*2099*	2.2	*774*	0.8	*0*	0.00	*0*	0.0	*11*	0.2	*0*	0.00
2014	*3925*	4.1	*1580*	1.6	*0*	0.00	*0*	0.0	*168*	2.8	*0*	0.00
2015	*3044*	3.1	*1510*	1.6	*406*	0.42	*0*	0.0	*10*	0.22	*0*	0.00
2016	*2335*	2.4	*193*	0.2	*400*	0.41	*256*	0.31	*0*	0.00	*0*	0.00
2017	*2392*	2.4	*2465*	2.5	*1996*	2.02	*730*	0.7	*0*	0.00	*0*	0.00
2018	*3312*	3.3	*2556*	2.6	*1451*	1.45	*760*	0.8	*0*	0.00	*0*	0.00
2019	*7702*	6.9	*12092*	10.9	*6129*	5.52	*621*	0.6	*0*	0.00	*540*	1.4

The climate benefit per year was calculated using the area distribution (%) included in Table G17.

Table G17.1: Area distribution (ha) by specie and tree planting arrangement (2020)

	Casuarina angustifolia		*Swietenia macrophylla*		*Gmelina arborea*		*Tectona grandis*		*Paraserianthes falcataria*		*Gliricidia sepium*	
	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
Agroforestry	6.2	19	11.8	46	5.6	57	-		4.0	100	-	-
Woodlots	25.5	81	13.5	54	4.2	43	2.6	100	-	-	-	-
Live Fence	-	-	-	-	-	-	-	-	-	-	1.3	100
Planted area (ha)	31.7		25.3		9.8		2.6		4.0		1.3	

Total area: 74.8 ha

This area distribution is based on a full project tree counting that was part of the project's monitoring activities in 2019. Wood products from first thinnings are conservatively excluded from the estimations. The climate benefit of areas already planted for the 30-year cycle is 18508.1 tCO2 for 74.8 ha. Table G17.2 shows the hectares for both North Northern and Southern regions combined that are added to the project in 2022. The climate benefit of this new area is 17830 tCO2, corresponding to a total 77.4 ha. The results for both new and old areas are summarised as a weighted average of the interventions per year in Tables G18.1 to G19.2

Table G17.2 Area distribution (ha) by species and tree planting arrangement (2022 additions)

	Casuarina angustifolia		*Swietenia macrophylla*		*Gmelina arborea*		*Tectona grandis*		*Paraserianthes falcataria*		*Gliricidia sepium*		*Toona sureni*	
	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
Agroforestry	8.54	50.78	27.98	65.82	3.45	73.36	5.21	51.30	-	-	-	-	1.67	71.60
Woodlots	8.28	49.22	14.53	34.18	1.25	26.64	4.94	48.70	-	-	-	-	0.66	28.40
Live Fence	-	-	-	-	-	-	-	-	-	-	0.88	100.00		
Planted area (ha)	16.82		42.51		4.71		10.15		0.00		0.88		2.34	

Total area: 77.4 ha

Table G18.1: Summary of climate benefits claimed in 2020 (Northern region)

Age (Years)	Woodlots (average / ha)			Agroforestry (average / ha)			Live Fence (average / ha)			Leakage	Risk buffer (15%)	Net Benefit tCO2 average all species / ha	Total benefit tCO2 (74.8 ha)
	Biomass minus Baseline	HWP	SOC minus Baseline	Biomass minus Baseline	HWP	SOC minus Baseline	Biomass minus Baseline	HWP	SOC minus Baseline				
1	1.11	0.00	5.05	0.66	0.00	3.02	0.03	0.00	0.00	0.0	1.5	8.4	627.7
2	2.38	0.00	7.81	1.43	0.00	4.68	0.06	0.00	0.01	0.0	2.5	13.9	1040.8
3	3.91	0.00	10.51	2.36	0.00	6.30	0.10	0.00	0.01	0.0	3.5	19.7	1474.0
4	5.65	0.00	12.89	3.42	0.00	7.72	0.14	0.00	0.02	0.0	4.5	25.4	1897.8
5	7.45	0.00	15.03	4.39	0.00	9.01	0.18	0.00	0.02	0.0	5.4	30.7	2294.4
6	9.50	0.00	17.01	5.55	0.00	10.21	0.24	0.00	0.03	0.0	6.4	36.1	2703.8
7	11.79	0.00	18.84	6.91	0.00	11.31	0.30	0.00	0.03	0.0	7.4	41.8	3126.3
8	13.81	0.00	20.56	8.01	0.00	12.34	0.35	0.00	0.03	0.0	8.3	46.8	3504.0
9	16.15	0.00	22.24	9.38	0.00	13.37	0.42	0.00	0.04	0.0	9.2	52.4	3916.4
10	18.79	0.00	23.81	11.03	0.00	14.32	0.50	0.00	0.04	0.0	10.3	58.2	4354.5
11	21.65	0.02	25.05	12.83	0.02	15.06	0.58	0.00	0.05	0.0	11.3	64.0	4785.9
12	24.86	0.04	26.10	14.95	0.04	15.71	0.68	0.00	0.05	0.0	12.4	70.1	5241.5
13	27.88	0.15	27.04	17.04	0.10	16.28	0.79	0.00	0.06	0.0	13.4	75.9	5680.8
14	31.29	0.25	27.96	19.46	0.15	16.85	0.91	0.00	0.07	0.0	14.5	82.4	6163.6
15	35.12	0.33	28.80	22.19	0.19	17.38	1.05	0.00	0.08	0.0	15.8	89.4	6684.3
16	39.37	0.40	29.60	25.18	0.23	17.89	1.19	0.00	0.08	0.0	17.1	96.9	7245.0
17	44.09	0.46	30.38	28.40	0.26	18.39	1.34	0.00	0.09	0.0	18.5	104.9	7846.4
18	49.28	0.51	31.14	31.81	0.29	18.88	1.50	0.00	0.10	0.0	20.0	113.5	8489.0
19	54.98	0.55	31.90	35.39	0.31	19.36	1.67	0.00	0.11	0.0	21.6	122.6	9173.4
20	61.21	0.59	32.66	39.13	0.33	19.84	1.85	0.00	0.12	0.0	23.4	132.4	9901.1
21	67.98	0.62	33.44	43.03	0.34	20.31	2.02	0.00	0.14	0.0	25.2	142.7	10674.0
22	75.32	0.65	34.22	47.11	0.36	20.78	2.20	0.00	0.15	0.0	27.1	153.7	11493.8
23	83.23	0.67	35.02	51.36	0.37	21.25	2.37	0.00	0.16	0.0	29.2	165.3	12362.1
24	91.73	0.69	35.84	55.80	0.38	21.71	2.54	0.00	0.17	0.0	31.3	177.5	13279.8
25	100.82	0.71	36.68	60.43	0.39	22.17	2.70	0.00	0.18	0.0	33.6	190.5	14247.2

26	110.47	0.73	37.54	65.24	0.40	22.64	2.86	0.00	0.20	0.0	36.0	204.1	15263.6
27	120.68	0.74	38.42	70.24	0.41	23.10	3.01	0.00	0.21	0.0	38.5	218.3	16327.4
28	131.41	0.75	39.32	75.40	0.41	23.57	3.15	0.00	0.22	0.0	41.1	233.1	17435.8
29	142.61	0.76	40.25	80.71	0.42	24.04	3.29	0.00	0.23	0.0	43.8	248.5	18585.1
30	138.28	3.68	41.19	78.05	1.74	24.51	3.41	0.00	0.24	0.0	43.7	247.4	18508.1

Table G18.2: Summary of climate benefits 2022 (Northern region Additions)

Age (Years)	Woodlots (average / ha)			Agroforestry (average / ha)			Live Fence (average / ha)			Leakage	Risk buffer (15%)	Net Benefit tCO2 average all species / ha	Total benefit tCO2 (61.6 ha)
	Biomass minus Baseline	HWP	SOC minus Baseline	Biomass minus Baseline	HWP	SOC minus Baseline	Biomass minus Baseline	HWP	SOC minus Baseline				
1	0.73	0.00	3.45	1.09	0.00	4.71	0.02	0.00	0.00	0	1	8	523
2	1.61	0.00	5.37	2.41	0.00	7.41	0.03	0.00	0.00	0	3	14	881
3	2.67	0.00	7.22	4.01	0.00	9.99	0.05	0.00	0.01	0	4	20	1253
4	3.86	0.00	8.86	5.79	0.00	12.25	0.06	0.00	0.01	0	5	26	1614
5	5.14	0.00	10.33	7.63	0.00	14.28	0.09	0.00	0.01	0	6	32	1961
6	6.57	0.00	11.68	9.72	0.00	16.14	0.11	0.00	0.01	0	7	38	2315
7	8.16	0.00	12.93	12.06	0.00	17.87	0.14	0.00	0.01	0	8	43	2678
8	9.54	0.00	14.10	13.64	0.00	19.49	0.17	0.00	0.02	0	9	48	2980
9	11.13	0.00	15.25	15.57	0.00	21.12	0.20	0.00	0.02	0	9	54	3312
10	12.88	0.00	16.33	17.84	0.00	22.62	0.24	0.00	0.02	0	10	59	3660
11	14.85	0.01	17.18	20.36	0.02	23.79	0.28	0.00	0.02	0	11	65	4004
12	17.04	0.02	17.90	23.22	0.03	24.78	0.32	0.00	0.03	0	13	71	4361
13	19.07	0.10	18.53	25.74	0.14	25.65	0.37	0.00	0.03	0	13	76	4690
14	21.36	0.16	19.16	28.63	0.23	26.52	0.43	0.00	0.03	0	14	82	5050
15	23.91	0.21	19.73	31.88	0.30	27.30	0.49	0.00	0.04	0	16	88	5436
16	26.74	0.26	20.28	35.51	0.37	28.04	0.56	0.00	0.04	0	17	95	5850

17	29.85	0.30	20.80	39.53	0.42	28.75	0.64	0.00	0.04	0	18	102	6297
18	33.27	0.33	21.32	43.95	0.47	29.45	0.71	0.00	0.05	0	19	110	6779
19	36.99	0.36	21.83	48.77	0.51	30.13	0.79	0.00	0.05	0	21	119	7297
20	41.04	0.39	22.34	54.02	0.55	30.82	0.87	0.00	0.06	0	23	128	7854
21	45.43	0.41	22.86	59.69	0.58	31.50	0.96	0.00	0.06	0	24	137	8451
22	50.15	0.43	23.38	65.80	0.60	32.19	1.04	0.00	0.07	0	26	148	9088
23	55.21	0.44	23.91	72.34	0.63	32.89	1.12	0.00	0.08	0	28	159	9766
24	60.62	0.46	24.45	79.31	0.65	33.60	1.20	0.00	0.08	0	30	170	10485
25	66.36	0.47	25.00	86.69	0.66	34.33	1.28	0.00	0.09	0	32	183	11245
26	72.43	0.48	25.56	94.48	0.68	35.06	1.35	0.00	0.09	0	35	196	12043
27	78.81	0.49	26.13	102.64	0.69	35.80	1.42	0.00	0.10	0	37	209	12878
28	85.48	0.50	26.71	111.15	0.70	36.56	1.49	0.00	0.10	0	39	223	13746
29	92.40	0.50	27.30	119.96	0.71	37.32	1.55	0.00	0.11	0	42	238	14645
30	89.47	2.35	27.90	115.98	3.11	38.10	1.61	0.00	0.11	0	42	237	14581

Table G18.3: Summary of climate benefits 2022 (Southern region Additions)

Age (Years)	Woodlots (average / ha)			Agroforestry (average / ha)			Live Fence (average / ha)			Leakage	Risk buffer (15%)	Net Benefit tCO2 average all species / ha	Total benefit tCO2 (15.8 ha)
	Biomass minus Baseline	HWP	SOC minus Baseline	Biomass minus Baseline	HWP	SOC minus Baseline	Biomass minus Baseline	HWP	SOC minus Baseline				
1	0.70	0.00	6.76	0.78	0.00	4.77	0.04	0.00	0.00	0	2	11	176
2	1.49	0.00	9.63	1.77	0.00	7.09	0.08	0.00	0.01	0	3	17	270
3	2.43	0.00	12.45	2.97	0.00	9.23	0.12	0.00	0.02	0	4	23	366
4	3.51	0.00	14.96	4.29	0.00	11.10	0.17	0.00	0.02	0	5	29	458
5	4.20	0.00	17.24	5.70	0.00	12.78	0.23	0.00	0.03	0	6	34	541

6	5.13	0.00	19.39	7.28	0.00	14.33	0.30	0.00	0.03	0	7	39	625
7	6.25	0.00	21.37	9.03	0.00	15.77	0.37	0.00	0.03	0	8	45	711
8	7.45	0.00	23.21	10.09	0.00	17.13	0.44	0.00	0.04	0	9	50	786
9	8.83	0.00	24.97	11.42	0.00	18.50	0.53	0.00	0.05	0	10	55	865
10	10.40	0.00	26.63	12.99	0.00	19.76	0.62	0.00	0.05	0	11	60	948
11	11.71	0.07	27.96	14.77	0.01	20.77	0.73	0.00	0.06	0	11	65	1024
12	13.23	0.13	29.15	16.78	0.02	21.64	0.85	0.00	0.07	0	12	70	1102
13	14.86	0.19	30.19	18.63	0.10	22.42	0.99	0.00	0.07	0	13	74	1177
14	16.72	0.25	31.14	20.73	0.16	23.18	1.14	0.00	0.08	0	14	79	1257
15	18.82	0.30	32.03	23.09	0.22	23.88	1.31	0.00	0.09	0	15	85	1342
16	21.17	0.34	32.86	25.71	0.26	24.54	1.49	0.00	0.10	0	16	90	1433
17	23.78	0.37	33.65	28.58	0.30	25.17	1.68	0.00	0.11	0	17	97	1530
18	26.67	0.40	34.41	31.73	0.34	25.78	1.88	0.00	0.13	0	18	103	1633
19	29.84	0.43	35.14	35.14	0.37	26.37	2.10	0.00	0.14	0	19	110	1743
20	33.32	0.45	35.86	38.83	0.39	26.96	2.31	0.00	0.15	0	21	118	1861
21	37.11	0.47	36.56	42.79	0.41	27.53	2.53	0.00	0.17	0	22	125	1986
22	41.22	0.48	37.25	47.03	0.43	28.10	2.75	0.00	0.18	0	24	134	2119
23	45.66	0.49	37.92	51.53	0.45	28.67	2.97	0.00	0.20	0	25	143	2260
24	50.44	0.51	38.60	56.30	0.46	29.23	3.18	0.00	0.21	0	27	152	2408
25	55.56	0.52	39.26	61.32	0.48	29.79	3.38	0.00	0.22	0	29	162	2564
26	61.01	0.53	39.92	66.58	0.49	30.35	3.58	0.00	0.24	0	30	172	2728
27	66.77	0.53	40.58	72.05	0.50	30.91	3.77	0.00	0.25	0	32	183	2898
28	72.84	0.54	41.24	77.70	0.51	31.46	3.95	0.00	0.26	0	34	194	3075
29	79.18	0.54	41.89	83.53	0.51	32.01	4.11	0.00	0.28	0	36	206	3258
30	76.75	2.19	42.55	80.63	2.15	32.56	4.27	0.00	0.29	0	36	205	3249

A summary of the net average tCO2/Ha and total climate benefit for all interventions in the project is included in Tables G19.1 and G19.2

Table G19.1: Summary climate benefits by intervention 2020 (Northern region)

Intervention type (technical specification)	Net average tCO2/Ha	Total area (ha) All Sites	Net tCO_2e
Tree plantings	191.4	74.8	14315.5
Soil management	56.1	74.8	4192.6
Total	247.4	74.8	18508.1

Table G19.1: Summary climate benefits by intervention 2022 (Northern region)

Intervention type (technical specification)	Net average tCO2/Ha	Total area (ha) All Sites	Net tCO_2e
Tree plantings	180.6	61.6	11122
Soil management	56.2	61.6	3459
Total	236.8	61.6	14581

Table G19.1: Summary climate benefits by intervention 2022 (Southern region)

Intervention type (technical specification)	Net average tCO2/Ha	Total area (ha) All Sites	Net tCO_2e
Tree plantings	141.1	15.8	2234
Soil management	64.1	15.8	1015
Total	205.2	15.8	3249

The project is expected to expand activities for at least the next 7 years and add to the 74.8 ha included in 2020 and the 77.4 ha presented in 2022. The goal is for an additional 197 ha (Table G20), for a total area of approximately 350 ha. The climate benefit of the additional future area is included in Table G21. It compares results from woodlots and agroforestry as a 100% area for each type of land use. The actual climate benefit will depend on what proportion of the area farmers decide to use for either woodlots and agroforestry.

Table G20: Future Area (ha).

	Year						
Species and area (ha)	2023	2024	2025	2026	2027	2028	2029
Swietenia macrophylla	9	12	12	13	14	18	17
Gmelina arborea	5	5	5	5	5	5	5
Casuarina angustifolia	4	5	5	5	5	5	5
Gliricidia sepium	3	3	4	4	4	4	4
Toona sureni	1	1	1	1	1	1	1
Total (ha)	197						

Table G21: Estimated net climate benefits from future plantings

Species	Total future area by sp. (ha)	Average tCO2e /ha/sp Woodlots	Average tCO2e/ha/sp Agroforestry	tCO2e Woodlots^^	tCO2e Agroforestry^^	tCO2e Live fence
Swietenia macrophylla	95	257	233	23313	22176	0
Gmelina arborea	35	240	215	7967	7542	0
Casuarina angustifolia	34	266	244	8674	8305	0
Gliricidia sepium	26	172	0	2240	0	6031
Toona sureni	7	224	204	1498	1428	
Total climate net benefit	-	-	-	43693	39451	6031

NB: ^^Both woodlot and agroforestry are comparatively included, as it is unknown what future arrangement new farmers will select.

G6 Leakage & Uncertainty

G6.1 Leakage risk

To assess the risk of leakage we follow the guidance for land-use change and forestry projects outlined by the World Bank in Pearson *et al.* (2013). This approach considers three general sources of leakage[7]: 1) direct **activity shifting**, where project activities directly cause actors within the project area to move their emission-causing activities to elsewhere; 2) indirect **market effects**, where the reduced supply of emission-causing goods from the project area (i.e. timber) increases the market price of goods, thus leading to increased production (and emissions) elsewhere; and 3) indirect **super-acceptance**, where the alternative livelihoods activities of a project are so profitable that they attract new people to the region thus putting further pressure on forests.

Following the decision-flow chart method in Pearson *et al.* (2013, page 37), we assess the risk of leakage from the project to be negligible. Regarding indirect effects, the livelihood survey conducted for the project found that participants in the project are not significant contributors to local timber and fuelwood industries, thus no market effect is expected from project activities. Likewise, while the broader activities of the project do aim to significantly improve the livelihoods of project participants, there is very little prospect of a super-acceptance phenomenon. Carbon income and other livelihood activities are expected to provide incremental improvements in income, with existing livelihood activities (i.e. agriculture) remaining the core of people's income. In the unlikely case that project activities cause rapid and gross increases in livelihoods, inward immigration would be limited by existing land scarcity.

The main risk of leakage comes from activity shifting, where the land management prescriptions on participating farms may influence participants to move their agricultural and fuelwood collection elsewhere. We assess the risk of this leakage to be inexistent for three reasons. First, participants are only allowed to subscribe to the project if they have sufficient excess land so that their existing agricultural and fuelwood production is not affected. Likewise, the project targets lands that, at this stage, are considered by farmers of low agricultural productivity. Second, through offering a range of different technical specifications that allow for the continued production of crops, livestock and fuelwood, the need for participants to shift their activities elsewhere is diminished. Relatedly, the modelling of climate benefits (see Section G5.1) assumes that a proportion of dead biomass will also be removed from sites for fuelwood and some thinning will occur. Finally, the project sites are already

[7] Leakage is where changes within the project area lead to changes in activities outside the project area which increase emissions.

heavily deforested with a very low biomass baseline (see Section G4), thus existing emissions from deforestation (which could theoretically be shifted elsewhere) are very low—the main climate benefit from this project comes from the planting of new trees and improvements in soil management.

Despite the very low risk of leakage, the project will undertake a number of measures to minimise the risk from activity shifting (Table G22).

Table G22: Leakage risk and mitigation

Leakage risk	Risk level	Mitigation measures	Monitoring
Displacement of agricultural activities and fuelwood production	Low	- Land-use plans will need to demonstrate that they will not displace agricultural activities - Land-use plans will aim to increase agricultural and fuelwood production through improved soil management and suitable harvesting regimes - Community education and FMNR activities in the project will raise awareness about avoiding deforestation in the wider project area	- Field team will check for signs of displacement during monitoring visits - Should leakage be found to occur, the project will offset this by either requiring farmers to implement compensatory tree planting in the communal land area identified for underperformance compensation or by offsetting these emissions through the risk buffer

G6.2 Uncertainty

The main sources of uncertainty in our climate benefit estimates relate to assumptions in the model parameters, and to natural variability in the project. Below we outline how we have accounted for this uncertainty in the project design, and how we will continue to respond to uncertainty in the future.

Our primary tool for dealing with uncertainty in model parameters was to ensure that the SHAMBA model produced conservative estimates of the baseline and project scenarios (i.e. by ensuring that the former is higher, and the latter is lower, than in reality). This is the primary approach to dealing with uncertainty in the estimation of land-based GHG emissions in land-use change projects (Seebauer *et al.* 2013; Berry *et al*. 2013). The SHAMBA model has conservativeness built into its applicability conditions and model defaults (Woollen *et al.* 2017). We conducted a literature review of academic and technical literature to confirm that these conditions and defaults applied to the environmental conditions, tree species and soil management activities in our technical specifications. Through this literature review, we also ensured that our model inputs were themselves conservative, paying particular attention to those parameters found to be highly sensitive in the SHAMBA sensitivity analysis (i.e. allocations in the tree growth models to branches, coarse roots and stem; tree mortality; branch

turnover; temperature; stocking density; thinning regime; growth rates) (Ryan *et al.* 2014). Full details of the literature review for each technical specification, and the justifications for any assumptions, are outlined in the relevant Excel databases of SHAMBA model inputs (Annex F1).

In addition to the conservative nature of our climate benefit estimates, the application of the risk buffer (Section H on Risk Management) further contributes to deal with uncertainty. While our climate estimates are already conservative, the risk buffer ensures that, should the project deviate from its original objectives, the project is unlikely to have claimed a higher climate benefit than has actually been achieved. Combining the conservativeness in our modelling with the risk buffer generates 'double conservatism' to our estimated climate benefits.

In addition to these existing uncertainty measures, in the future we will continue to analyse and respond to uncertainty through the following measures:

- At the time of verifications, updating growth models and model assumptions based on the actual growth and activities achieved in the project;
- Following this analysis, making any associated adjustments to the risk buffer (Section H);
- Responding to uncertainty through a clear process of deliberative and iterative adaptive management at the project-, village- and farm-levels, where project actors will continue to learn from their experience and respond to variability and changed circumstances (Williams & Brown, 2014). This approach is described in Annex G2.

Part H Risk Management

H1 Identification of risk areas

The focal point for risk management of the project is the project coordinator (FCOTI and its CEO) who regularly communicates with the field team and farmers groups. The farmers groups are also involved in managing risks, while the PSC has an advisory role (see Sections I and E). The majority of the risk and mitigation actions, listed in Table H1, were identified by stakeholders during recent consultation meetings. To deal with present and emerging risks, the project is introducing a risk register, administered also by FCOTI, to create a single place where risks can be documented, tracked and prioritised for mitigation. This register will also inform the risk buffer periodic review (Section H2).

H2 Risk Buffer

A proportion of climate benefits generated by the project will be held in a risk buffer. The unsold credits serve as an insurance for unforeseen events that might cause emission reductions and reversals. For the estimation of the risk buffer we adopted PV's approved risk approach developed by Berry (LTS International, Forest for Life 2017).

The risk to the delivery of ecosystem services and relevant mitigation actions were identified and assessed against six categories (Table H1). The description of the likelihood and impact in Table H1 refers to project interventions under the different mitigation actions. The level of residual risk following mitigations was estimated by assigning a percentage of the climate benefits that could be lost by the impact of the risk, while a probability score was assigned to its likelihood.

The following scale was used: Very low = 0.05, Low = 0.1, Moderate = 0.25, High = 0.5, Very high = 0.75. The product of multiplying impact and likelihood values per risk was summed to estimate the final risk buffer percentage (Table H2) which for our project is 15%. The risk buffer will be revised at least every 5 years, reflecting changes to risks associated to the project.

Table H1: Assessment of risks to the delivery of ecosystem services (ES)

Category	Risk Factor	Mitigation actions	Impact	Likelihood
Social	Land tenure conflicts and issues with recognition of land ownership	a) Land ownership declarations have been signed by each farmer and formally recognised / witnessed by local community leaders (Village Chief) and neighbours; thus, reducing the risk of land disputes. b) Project governance via farmers groups and PSC is in place to contribute to resolution land conflicts between project participants and external stakeholders.	High: Even though Land ownership declarations will be in place, the effect of land disputes in the delivery of ES could affect the development of activities and PES contractual arrangements.	Very Low: Although changes to land tenure legislation are taking place in some areas of TL, land tenure in rural areas is still based on customary law. Among farmers participating in the project and the community at large, there is a common understanding relating to land ownership (who owns what) and the boundaries of properties; this has been formalised now through land ownership declarations
	Farmers without land are not included in the project, which might create conflicts between participants and non -participants	a) Landless farmers are given the opportunity to participate in the project through nurseries production activities. b) A Grievance Mechanism open to all stakeholders is in place to address conflicts, complaints or concerns arising from the project. c) In addition to payments for climate benefits, the project is identifying additional livelihood opportunities to allow inclusion of additional community members that might not have enough land.	Low: Conflicts between project participants and non-participants will be diffused as soon as detected through the farmers groups and field team reducing its impact.	Low: Since 2011 no conflicts -internal or otherwise- have been identified. Mitigation actions a) and b) are already in place; reducing the likelihood of the impact.
	Corruption	Monitoring of activities and finances and accountability to the project governance parties.	Very low: In the event of corruption the impact should be minimal as it would be detected	Very low: Corruption has not been identified by the project or evidenced since the project started in 2011. The

Category	Risk Factor	Mitigation actions	Impact	Likelihood
			promptly.	history of the project coupled with a solid project governance makes the likelihood of corruption even less likely.
	Female un-representation in the project	Females are actively encouraged to participate through a female quota for farmers groups and PSC in addition to field activities.	Very Low: The impact to the project, even if female representation increments are modest, should not significantly impact the project.	Low: The project area is characterised as a patriarchal society where females and males have very well-defined roles, however, during community consultations, male farmers agreed that female participation should be promoted as it adds value to their activities.
	Farmers may not fully understand the PES agreement because this is a new concept to them.	a) Explanations have been provided to farmers since 2017 on how PES agreements work and how payments will be made. Regular meetings will continue to be held to reinforce understanding of the PES agreements and allow participants to voice their concerns or questions. b) Training of farmers on PES activities implementation, combined with performance monitoring will inform emerging compliance issues and lack of understanding of the PES agreement.	Very Low: The impact to the whole project is reduced by signing individual contracts.	Very Low: The key principles of the PES agreement have already been tested through implementation of re-stocking and payment arrangements for tree survival, suggesting that farmers understand the concept behind a PES agreement. In any case the project intends to strengthen understanding of the PES among farmers through mitigation action b).

Category	Risk Factor	Mitigation actions	Impact	Likelihood
Financial	Permanence of project actions are at risk in absence of carbon sales causing farmers to lose interest in the project and to harvest trees prematurely.	a) Farmers have agreed that if there is a period of no payment; they are committed to continuing with the project and permanency of activities. This is a component of the PES agreement. b) The project management has initiated talks with other parties interested in investing in the project. c) FCOTI is developing a strategy to identify additional livelihood alternatives (see Section F2). d) There are financial benefits for farmers to grow trees to maturity as harvesting of trees for timber sales is intended after the 30 years cycle while shade trees are a key element for some of the agroforestry arrangements farmers are implementing.	Low: Farmers have expressed their commitment to maintaining and continuing their project activities in absence of on-going payments. This is reflected in the PES agreements. Farmers' goodwill towards the project is in part a result of tangible benefits they have received by the project including scholarships, training and direct and indirect financial benefits.	Moderate: The project might not be able to sell credits immediately following credits issuance.
Environmental	Fire affecting project's areas	Awareness campaigns and exclusion of slash and burning activities in project sites and surrounding areas.	Low: A fire could impact areas of some project sites; however, sites are scattered therefore it would be localised affecting a small proportion of the whole project.	Low: Awareness of the need to reduce use of fire by farmers in the project area has been created. The use of fire for slash and burning seldom results in extensive wildfires in the region.
	Pests	Controlled by ongoing monitoring of sites and introduction of preventive and control actions.	Moderate: Tree mortality might be significant if an infestation occurs.	Low: Following implementation of control measures outlined in the Plantation Management document, the risk of an infestation is being reduced greatly.
	Landslides	Some plantations are established in steep terrain; however, the risk of	Low: The sites are small in area and scattered therefore the	Low: Potential for landslides in some areas of Soibada.

Category	Risk Factor	Mitigation actions	Impact	Likelihood
		landslides is comparatively moderate.	impact is considered low.	
	Tree growth and survival targets are not achieved	On-going monitoring and constant communication with and provision of technical assistance to the farmers to prevent growth and tree mortality issues. Corrective actions are in place for mortality losses through replanting and use of a communal area to compensate for potential underperformance.	Low: Trees are planted in diverse sites with different physiographic conditions, therefore minimising the effect of wide spread mortality and underperformance.	Low: Some trees might become stunted, whilst others might not survive in some areas, but is unlikely the whole project area will be affected.
Political	Lack of support by Timor-Leste's Government (GoTL) institutions	Endorsement of relevant government institutions has been received and frequent communication with Government stakeholders is maintained. We have a signed letter of support and the signing of a MoU between Secretary of State for the Environment and FCOTI.	Very low: Unlikely to have a major impact to project climate benefits.	Very Low: The project has always been well regarded by different governments with different political persuasions throughout the last 8 years. The presence of local government stakeholders in the PSC ensures continued support.
	Changes to Timor-Leste's legislation	The project fully aligns with the GoTL regulatory framework and keeps track of potential changes to the relevant legislation.	Very Low: The effects of changes in legislation might reflect changes on formalisation of land tenure. Any potential negative impacts from land tenure changes are mitigated by the introduction of land ownership declarations.	Very Low: Legislation in Timor-Leste is increasingly promoting sustainable use of natural resources. Legislation affecting carbon crediting is unlikely.
Technical	Insufficient in-country technical capacity to manage day to day operational aspects	Preparation of operating procedures and on-going training of local staff.	Low: Local staff is demonstrating that they are capable of conducting day to day activities with moderate external support.	Low: Provisions for full management of the project by local staff are in place, however, they will continue receiving support by non-Timorese project partners if required, including from CSU

Category	Risk Factor	Mitigation actions	Impact	Likelihood
	of the project			staff currently involved in the project.
Administrative	Poor record keeping and lack of accountability	Databases to track field activities (area size and tree planting) and storage of information relating carbon sales and payments are in place.	Low: Some delays on payments might occur if record keeping is not efficient.	Low: The project has a good track record on book keeping. Streamlined procedures for tree counting and area measurements have been implemented.

Table H2: Halo Verde Risk Buffer

Scales: Very low = 0.05, Low = 0.1, Moderate = 0.25, High = 0.5, Very high = 0.75

Category	Risk Factor	Impact (%)					Likelihood					Score
		VH	H	M	L	VL	VH	H	M	L	VL	
Social	Land tenure conflicts and issues with recognition of land ownership		50								0.05	2.50
	Farmers without land are not included in the project, this might create conflicts between participants and non-participants				10					0.1		1.00
	Corruption					5					0.05	0.25
	Females un-representation in the project					5				0.1		0.50
	Farmers may not fully understand the PES agreement					5					0.05	0.25
Financial	Permanence of project is at risk in absence of carbon sales causing farmers to lose interest in the project and to harvest trees prematurely.				10				0.25			2.50
Environmental	Fire affecting project's areas				10					0.1		1.00
	Pests			25						0.1		2.50
	Landslides				10					0.1		1.00
	Tree growth and survival targets are not achieved				10					0.1		1.00
Political	Lack of support by TL Government institutions					5					0.05	0.25
	Changes to TL legislation					5					0.05	0.25
Technical	Insufficient in- country technical capacity to manage day to day operational aspects of the project				10					0.1		1.00
Administrative	Poor record keeping and lack of accountability				10					0.1		1.00
Buffer												**15.00**

Part I Project Coordination & Management

I1 Project Organisational Structure

I1.1 Coordination and legal status

GTNT has delegated the management of the project to its local non-governmental organisation (NGO) partner FCOTI, which is legally registered in Timor (see Table I1). This arrangement has been formalised through a MoU (Annex I1), signaling a long-term collaboration between the two entities (refer to Table I1 for additional information).

I1.2 Organisational structure

The participating farmers have-formed five farmer groups, which with the assistance of FCOTI, serve as a forum to discuss project management, design of activities and budget spending. A Project Steering Committee (PSC) was formed to build bridges between the participants, other stakeholders (including local leaders and other marginalised groups), and the project coordinator.
The figure below illustrates the overall stakeholders' representation in the project.

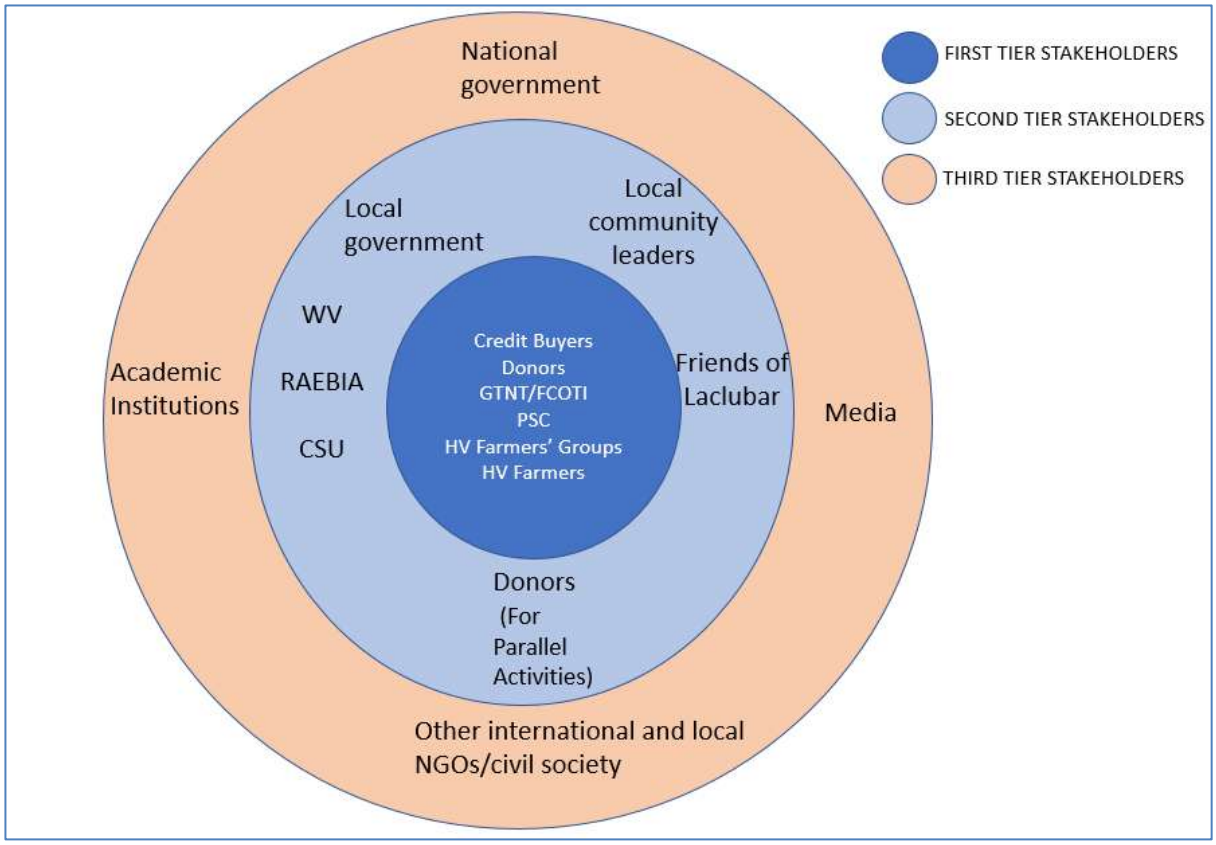

Figure I1: Stakeholder analysis diagram

The definition of stakeholders in the project is:

First tier: Those who strongly influence and/or are influenced by the project. They have a long-term

presence in the project and / or are investing in the project.

Second tier: Provide partnership, technical and to certain extent financial and governance support to the project as it may be needed

Third tier: Those who the project consult with from time to time and of strategic and macro policy importance to the project.

The details of stakeholders in the project are included in Table I1.

Table I1: Stakeholders' roles and influence to and by the project

Stakeholder Layers	Roles and Responsibilities	Influence to the Project (1= very weak, 5= very strong)	Influence by the Project (1=very weak, 5=very strong)
FIRST TIER STAKEHOLDERS			
Carbon credit buyers	Enter into an agreement with project coordinator in this case FCOTI (FCOTI acting on behalf of GTNT) to purchase the credits from farmers	5	5
Donors (tree planting expansion)	To provide funding for the expansion of tree planting in identified sites by the communities based on the project plan and proposal by FCOTI	5	4
GTNT	• Provide administrative and organizational support to FCOTI and financial incentives to farmers in the absence of carbon buyers. • Provide financial support to organizational development of FCOTI	5	4
FCOTI	• Act on behalf of GTNT as the project coordinator in the field and sign PES agreement with farmers and farmers groups on behalf of carbon buyers and GTNT. • Coordinate all project field activities	5	5
PSC	•Provide advice and overall guidance to the project implementation and PV farmer groups; •Serve as a platform for ongoing consultation with authorities at national and local government level as well as other stakeholders, to promote community ownership and leadership of the project; and	5	4

Stakeholder Layers	Roles and Responsibilities	Influence to the Project (1= very weak, 5= very strong)	Influence by the Project (1=very weak, 5=very strong)
	• Discuss suggestions and feedback from communities, provide endorsements and recommendations for project implementation and opportunities for project improvement		
Farmers groups	• Oversee the benefit-sharing mechanism, with the support of the project coordinator; • Prepare the Payment of Ecosystem Services' (PES) agreements, with the support of the project coordinator; • Promote socio-economic prosperity to each member • Facilitate consensus among farmers on project directions and implementation of recommendations made by the PSC, if deemed necessary; and • Facilitate communication with the Project Coordinator (i.e. grievances or complaints).	4	4
Individual farmers	• Comply with the PES Agreement • Carry out responsibilities based on PES agreement • Participate in Farmers Groups as members • Attend regular meetings when meeting is held	5	4
SECOND TIER STAKEHOLDERS			
World Vision	Provide technical support when needed in terms of Farmers Managed Natural Regeneration and other sustainable practice of agriculture	3	2
RAEBIA	Provide technical support when needed in terms of conservation agriculture and other sustainable practice of agriculture and land conservation	3	2

Stakeholder Layers	Roles and Responsibilities	Influence to the Project (1= very weak, 5= very strong)	Influence by the Project (1=very weak, 5=very strong)
Charles Sturt University	CSU- (Albury, Australia) who together with GTNT are recipients of a Darwin Initiative (DI) Grant. CSU supports technical aspects of the project until 2021 when the DI grant will conclude. CSU's role will be to provide carbon monitoring and carbon stock quantification specialist.	5	2
Local government	To provide leadership and ownership of the project To mainstream climate smart practices and promote mitigations and adaption measures to local communities	4	3
Donors (parallel activities)	To provide funding for parallel livelihood activities based on the plan of the project	5	4
friends of laclubar	To provide funding for scholarship program and other livelihood activities based on the availability of funding and needs in the communities	5	4
THIRD TIER STAKEHOLDERS			
National government	• To provide sound policies that will promote community based small holders carbon offsetting initiatives • To provide support to the project by promoting the project to the donors	4	3
Media	• To help disseminate and communicate the project ideas • To help publicity of the project to gain popular support • To educate the communities in the world about carbon offsetting project	3	2

Stakeholder Layers	Roles and Responsibilities	Influence to the Project (1= very weak, 5= very strong)	Influence by the Project (1=very weak, 5=very strong)
Academic institutions	• To provide studies and latest statistics and publications in relation to carbon offsetting activities • To carry out studies that can further promote overall climate smart practices and carbon initiatives in grass root communities	2	2
Other international organizations /civil societies	• Provide funding for tree planting expansion programs • Partner with FCOTI to seek funding for tree planting expansion • Provide social control to the project when relevant	3	2

The relationship of first tier stakeholders is illustrated in figure I1.2. The straight lines indicate the legally binding relationship based on contractual obligations while the dotted lines represent the line of coordination and collaboration.

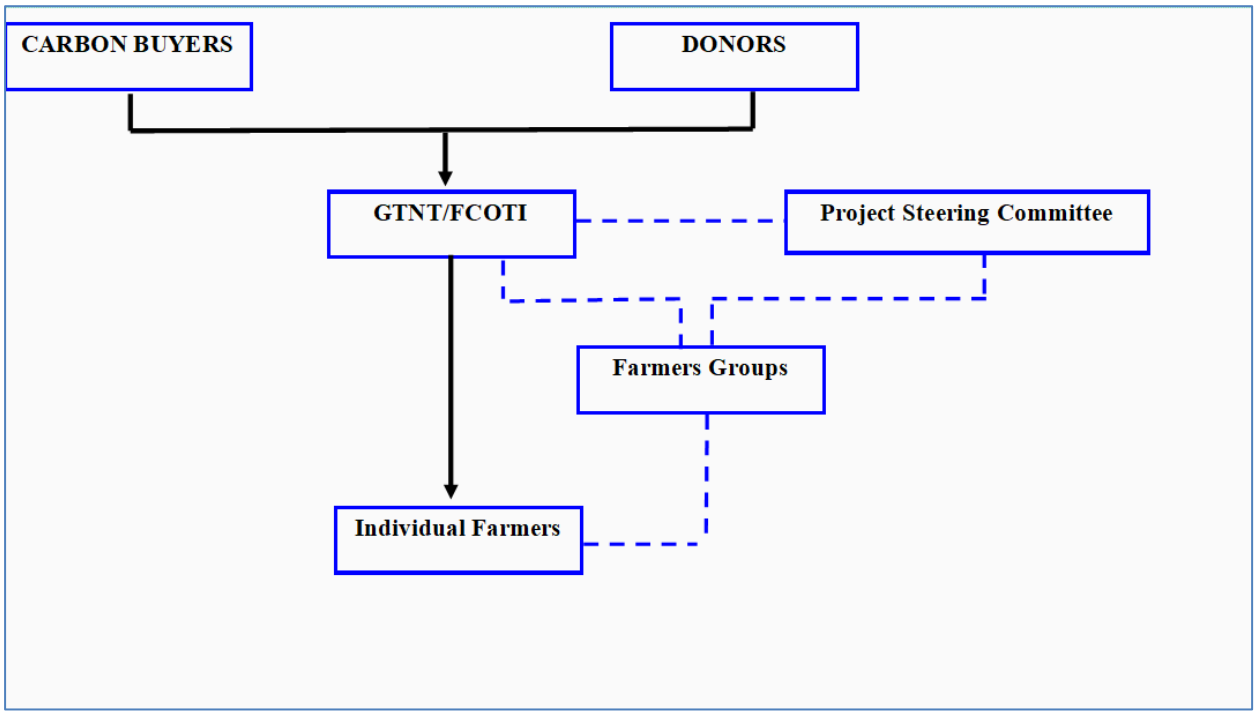

Figure I1.2: Relationship between first tier stakeholders

I2 Relationships to national organisations

The project team coordinates project activities with local community leaders and regional government institutions of Soibada and Laclubar. These leaders are also members of the PSC. At national government level, the project coordinator and the project coordinator have signed a Memorandum of Understanding (MoU) with the Secretariat of State for Environment of Timor-Leste (Annex I3). In addition, FCOTI participates in the national climate change working groups as an active member, organised by the National Directorate for Climate Change (DNAC).

The project will continue working with the Secretary of State of the Environment to:

a. Ensure alignment of the project with national legislation and GHG accounting;
b. Obtain clarification of the current situation regarding ownership of carbon rights in Timor-Leste;
c. Obtain confirmation that there is currently no potential for overlap between NDC targets and Plan Vivo Certificates; and
d. Obtain Details of measures that will be taken to ensure the project is aware of future developments in national legislation and greenhouse gas accounting and can respond accordingly

The Government of Timor-Leste, through its ministries (Ministry of Commerce, Industry and Environment, MAFF, Ministry of Public Works) is conducting a number of reforestation programs throughout the country aiming to minimise soil erosion and protect water resources. Our project, although not part of these programmes, is in sync with the objectives of these government initiatives. The National Directorate for Biodiversity Protection and Restoration is the focal point for the Convention on Biological Diversity (CBD) in Timor-Leste. This project will contribute to the five strategic goals in the CBD Strategic Plan for Biodiversity 2011 to 2020 and to Timor-Leste's National Biodiversity Strategy and Action Plan 2011 to 2020 (GoTL 2015).

I3 Legal compliance

The project complies with the following relevant International and National Timorese regulative framework, including -but not exclusively-:

- Government Decree 14/2017 - proposal for classifying Protected Areas
- Law 14/2017 - Forests' regime
- Decree-law 05/2016 - National System for Protected Areas
- Government Resolution 05/2012 - Environmental Policy
- 15/02/2012 – Approval of the National Biodiversity Strategy
- Decree-law 26/2012 - Environmental Base Law
- Decree-law 05/2011 - Environmental Licensing
- Government Resolution 33/2011 - National Action Program for Climate Change
- National Strategic Development Plan - 2011-2030
- February 2009 - National Plan to combat degraded soils
- National Parliament Resolution 06/2008 - Ratification of Kyoto Protocol

Timor-Leste has approved the long-awaited Land Law in 2017 (Law n. 13/2017), aiming to formalize land tenure (see Section C3). It is expected that the land tenure of project participants will not be negatively impacted by this law, as there are well-established traditional land titles held by project participants. In Timor-Leste, customary land tenures are recognised as legitimate means. This is being reinforced by the project introducing land ownership declarations (sample in Annex C2).

The project has adhered to a non-discriminatory employment policy based on the principles of equal employment opportunities (see Annex I4.). This policy was implemented during the recruitment of the field team. The selection process was completed by GTNT and FCOTI in a transparent and fair manner with

the assistance of members of the local government.

The service agreements that have been signed with the recruited staff follow the relevant Timorese employment laws and regulations. Employment agreements are updated in accordance to modifications to this regulatory framework. Example of matters related to worker's rights in Timor-Leste, and where the HV project goes beyond the minimum requirements include entitlements to leave, salaries above the stipulated minimum national salary and assistance with the social security coverage.

The current recruited staff is above 18 years of age. The project coordinator (GTNT) and FCOTI also have a child protection policy in place, in which all individuals and organisations that work in the project (but not exclusively) need to adhere to (see Annex I4).

TL does not have a regulatory framework on carbon ownership, carbon trading or similar, however, the MoU (Annex I3) signed between the project and the government of TL through the Secretary of State for the Environment (SSE) who is the top authority for Timorese climate change matters, explicitly guarantees carbon rights to local farmers. The country submitted its "Intended Nationally Determined Contributions (INDC) Timor-Leste 2016" to GHG reductions to the UNFCCC in 2016. The official information available and discussions with the SSE confirm that the GoTL focus is on climate change adaptation rather than mitigation due to the country's developing economy and the low contribution to global GHGs which is 0.003% of the world's total. An extract of the Government's official information in page 24 of the INDC document (GoTL and UNFCCC 2016) reads:

> The Republic of Timor-Leste is a small contributor to the greenhouse gas emissions by any measurable indicator and yet it is at the frontline of the wrath of climate change and sea level rise. It has a right to develop its economy and improve the well-being of its population. Limiting the global temperature to below 2°C relative to preindustrial levels, and pursue efforts to limit it below 1.5°C provides a moral imperative for Timor-Leste. The government has embarked on a number of actions which will result in increasing the use of renewable energy technologies, improve energy security and reduction of GHG emissions. However, the main focus for long term sustainable development still remains adaptation to climate change by addressing the adverse impacts of climate change. Timor-Leste has been at the forefront of responding to climate change as a Party to the UNFCCC through actions taken at the national level, as outlined in section 2.2.

To keep track of changes to national and international actions on climate change and related regulations, the project will continue working closely with the SSE and DNAC's national climate change working group, noting that DNAC is an office under the umbrella of the SSE.

In close communication with the PSC, FCOTI will monitor changes to any relevant legislation that might impact the project. In addition, FCOTI has access to legal assistance from one of the best law firms in Timor-Leste called Jurídico Social Consultoria; a contributing factor to ensure the project is complying with

Timor-Leste's relevant legislation.

I4 Project management

Annex I5 presents a timeline for project field implementation, that will be revisited regularly and updated as required.

The project coordinator has designed a database (db) in excel format which is being transferred to an Access db platform. The key information stored in the db includes records of PVs, monitoring schedules and results, issuance of credits and payments (Annex I6). Besides having the data in softcopy format, hardcopy versions will be also stored by FCOTI at its Dili's office. This will provide added assurances against data losses. The db will be managed by the in-country project coordinator. Regarding Plan Vivos, farmers will keep their original plan vivo maps and sale records in hard copy format, whilst copies of these documents will be kept in the FCOTI offices.

Business development, sales and PVC transactions in the Markit platform will be a responsibility of GTNT, assisted by FCOTI. Details are included in Sections I6.

I5 Project financial management

The project coordinator (FCOTI) acting on behalf of GTNT will be the main administrator of the PES funds. The mechanism to disburse these funds is channelled to an independent FCOTI bank account in Timor-Leste, under the name of FCOTI. FCOTI will establish a separate account with the sole purpose to be used for PES payments to the farmers. The way the funds are distributed are described in each of the PES agreements that the project coordinator will sign with each PV site holder. Up to a maximum of 40% of the funds will be used by FCOTI for coordination costs. In cases where FCOTI and its partner GTNT can mobilise funding from other sources to cover coordination costs, the deduction for coordination costs from farmer payments will be reduced, and the remaining amount will be paid to the farmers.

FCOTI is obliged to justify all the spending and keep all invoices and cash flow registered and up-to-date. The detailed balance sheet of these funds will be audited after every payment is done by the project coordinator. The payments to the farmers will be done in cash by FCOTI. Each farmer has then committed to put some of their payments in a common fund. This will be managed by the farmers groups.

In Annex I7, a project budget and financial plan template is presented. This plan summarises current foreseen operational costs, funding estimations coming from accreditation sales as well as other funding from the project coordinator funding sources. It has been agreed with farmers in the PES draft and through consultation with project participants that payment is contingent upon successful carbon sales, price of carbon and availability of funding.

Up to 2021, the project will rely on funding from GTNT for its coordination costs, which is further assisted by the DI Grant. The project aims to continue expanding activities for at least the next 10 years to 322 ha. Beyond 2021, the project will rely on carbon sales and funding partnerships for tree planting. The project's confidence in procuring funding for future tree planting is supported by the project's 10-year successful track record attracting funds from institutions and individuals for project expansion. Potential sources of funding identified at this stage, include the Partnership for Sustainable Agroforestry (PSAF) which is an initiative co-funded by the EU and the German government.

I6 Marketing

The Plan Vivo certificates will be marketed through the Markit environmental registry, as well as through the promotion and dissemination of the project via the project coordinator and the in-country project coordinator websites and social media. Other donors that will contribute in the future for funding of the project will also be able to market this project using their own channels.

Apart from this, GTNT, in collaboration with FCOTI, are using their established networks to find potential buyers of carbon credits, meeting and discussing with several multi-national enterprises. Once the potential buyers are identified, FCOTI, on behalf of GTNT, will coordinate the agreements between the community and the buyer.

During these past years, GTNT has been promoting the development of the project with several potential buyers in Australia. Based on these initial consultations, GTNT has been able to confirm that there is interest in the purchase of carbon credits from the HV project. Some potential buyers have verbally committed, and have indicated that they will be able to formalise the transaction once Plan Vivo's accreditation has been completed.

Apart from reaching Australian multi-national enterprises, GTNT, together with FCOTI, aim to reach out to international organisations that are working in Timor-Leste and which have policies to reduce their ecological/carbon footprint, especially those aiming to balance airmiles with carbon credits. In case of delays on sales and/or unsuccessful marketing on sales of credits, GTNT will provide funding to cover coordination costs and project development costs including financial incentives to farmers for caring for the trees up to a maximum of three years following issuance of PVCs. Beyond three years, GTNT's continued ability to cover such costs (coordination costs and project development costs including incentives to farmers) will be contingent upon availability of funding.

I7 Technical Support

Funds from a DI grant and GTNT have allowed training of local Timorese staff on social and biodiversity surveys, forest-carbon inventory, digital mapping and training of farmers on natural forest regeneration and sustainable agriculture. Technical support from CSU will be available at least until 2021. A strategy to strengthen technical management of the project by FCOTI prior to conclusion of the DI activities is in place. Currently FCOTI staff consist of a Timorese CEO with a strong program/project management, monitoring and evaluation background as well as experience managing staff. FCOTI also includes five field staff (3 in Laclubar, 2 in Soibada – one of them a female) who have formal technical training in agriculture. These five-field staff also have previous experience working with a Canadian-based NGO on reforestation activities. Periodic technical support for carbon modelling, GIS and Forest carbon monitoring after 2021 will be required. To address this need, FCOTI and GTNT are factoring technical support into the project's financial plan (Annex I7) and mobilising funding to continue working with CSU staff currently involved in the project. FCOTI will also coordinate with relevant government and non-government institutions to provide regular monitoring and technical assistance in the form of training and workshops.

It is anticipated that field staff currently employed will be able to provide training to new staff that might be recruited during the expansion phase. They will continue to assist farmers on the day-to-day activities. A proportion of COTI's income, which is allocated to the coordinator as part of the PES agreement, will be used to pay field staff salaries and maintain their working conditions (as part of project coordination activities).

Part J Benefit Sharing

J1 PES agreements

The transaction of carbon credits between the project coordinator and participants is formalized in the Payment for Ecosystem Services (PES) Agreement. Each participant signs an individual agreement with FCOTI, on behalf of GTNT. Individual participants agree to follow their plan vivo in return for staged, performance-related payments. The template for each PES Agreement is provided In Annex J1, where all the procedures are specified, including monitoring targets and payment schedules, security of land tenure, etc.

The process to develop the project's benefit sharing mechanism that was agreed with by farmers, consisted of three stages implemented through meetings and discussions. During the first stage, the project coordinator informed farmers about the concept of sales of carbon, monitoring and performance obligations. Farmers were also asked to discuss the type of payment arrangements they would prefer, including when payments should take place and in what form (i.e. cash, technical or materials). The meetings took place on 22/09/2017 in Laclubar and 23/09/2017 in Soibada. The meeting minutes and list of participants, as well as feedback and project directions provided by farmers, can be found in Annex E.1. The project coordinator made a public announcement and sent invitations to all relevant stakeholders two weeks prior to these meetings. The public invitations were delivered through advertisements in a national newspaper, church announcements, word of mouth and phone calls.

The second stage was the design of a PES contract (draft format) between participants and the project coordinator. This PES draft was then presented (third stage) explained and discussed with farmers at another community meeting on the 19th February 2019. The minutes of this meeting and list of participants can also be found in Annex E.1. The final document included technical management options for trees planted prior 2019 and for new sites (i.e. areas established in 2019 and onwards).

The PES agreement, including payments on performance and deduction for project coordination cost, was explained to participants in the local languages Tetun and Idaté. The consensus among farmers was their intention to sign this document, which will replace any existing agreements between farmers and the project coordinator.

The project sees management of farmers' expectations as a key element to its success. The PES clearly states that continuous payment to farmers beyond 2021 will be contingent upon availability of internal funding by the project coordinator and/or successful sales of carbon credits. This has been discussed with farmers during the process described above. Participants have agreed to sign to this condition in the PES.

The PES also includes an agreement with farmers that ensures tree permanence during the project cycle of 30 years and their commitment to preserve their trees. By linking tree plantings with livelihoods, as explained in Section F2, the goals of the PES regarding tree permanence are strengthened.

The project envisages that some farmers will harvest some of their trees to sell timber once the 30-year period is over. This will be part of a harvesting cycle system, which means that any tree that is harvested will be replaced and that the climate benefits are still realised following the end of the PV project. We have collected information that shows that there are financial benefits for farmers to grow trees to maturity and that replanting them will also be financially attractive (see Annex J5). There is also an agreed condition under the PES contract, that requires farmers to re-plant any tree that is damaged or harvested during the current cycle or beyond the 30-year period. Should trees be harvested during the crediting period, farmers will be required to refund the carbon payments received (a condition proposed to the farmers during the FPIC process). This is also part of the PES agreement. Minutes of the consultation with participants to draft the PES agreement and its conditions is included in Annex J4

Throughout the project period, new participants are welcomed to discuss opportunities to participate in the project. All new farmers who express their interest will be subject to prior assessment by the field team based on the procedure that has been written in a brochure in Tetun and distributed to all community leaders (Annex J3). The brochure has a process flow diagram that describes how a new farmer can participate in the project and how the farmer can benefit from the project. The selection criteria is based on: a) Uncontested land tenure, that the land is not already forested and that the land is accessible enough b) The capacity of the new farmers, to implement and manage the activities they are proposing c) The participants have enough land so that their existing agricultural and fuelwood production is not displaced or impacted.

Main risks to PES agreements are:

1. Farmers may not fully understand the PES agreement because this is a new concept to them.
2. Farmers may lose interest in the project if there is a lack of payments to them.
3. Trees may be harvested prematurely as the farmers see greater economic value in selling tree products than the benefit, they get from carbon sales.

Mitigations measures:

1. Several explanations have been provided to the farmers since 2017 on how PES agreements work and how payments will be made. All explanations were provided in the local dialect, using terms that could be easily understood. Regular meetings will continue to be held to reinforce understanding of the PES agreements and allow participants to voice their concerns or questions.

2. Most farmers in the project are those farmers that have already been planting trees. In the 2017 baseline household survey, 80% of respondents said that the main benefits of tree planting were to improve their land and the environment and have a future income from timber sales. Farmers see income from tree payments as a bonus. They understand the fickle nature of markets with their coffee and other food crops. However, the project will endeavour to manage expectations and motivate farmers to stay engaged by encouraging annual tree planting and keeping them informed of the status of carbon markets and sales. The farmers groups serve this purpose.
3. Light thinning of planted trees is encouraged as part of forest management requirements and targets included in the PES agreement. The project coordinator and the field team will monitor tree harvesting contravening the agreement and will issue corrective actions as per the contract which states that trees are not be harvested for at least 30 years (excluding thinning prescribed) and that trees harvested beyond the 30 years are to be replanted. The project staff will continue promoting awareness of environmental protection and the importance of sustainable forest management.

Other risks and their mitigation measures are described in Section H.

Consultation with New Participants (2022)

New participants (2022) were consulted and informed about the activities through a series of meetings that took place in Laclubar, Manehat, Lacluta and Dilor. The meeting in Laclubar was intended for farmers in the existing Northern project area, while the meeting in Manehat was intended for farmers in Manehat, Soibada, Barique-Natarbora and surrounding areas (Southern region). The meetings in Lacluta and Dilor was intended for sucos in Dilor, Uma Tolu and Bibileo (Southern Viqueque Municipality).
The schedule of meetings is summarised:

Date of Meetings	Location of Meetings	Intended Sucos
26 July 2002	Laclubar	Orlalan, Batara, Funar, fatumaquerec L
02 August 2022	Lacluta	Uma tolu, Dilor, Bibileo
04 August 2022	Manehat	Barique, Manehat, Fatumaquerec Soibada, Manlala Soibada
19 August 2022	Dilor	Uma tolu, Dilor, Bibileo
23 August 2022	Laclubar	Orlalan, Batara, Funar, fatumaquerec L

J2 Payments & Benefit Sharing

Payments will be disbursed to participants based on performance targets as outlined in the PES agreement. Details on how performance-based payments will be applied are described in the monitoring tables in the PES agreement.

The payments to the participants are described in the PES agreement itself, in Annex J1. When the monitoring thresholds and/or targets are not reached, then the participant has an opportunity to remediate with a list of corrective measurements agreed by the project coordinator. If the corrective measurements are implemented within an agreed time, then payments will be made, otherwise they will be cancelled.

The project is including old and new plantings under the following payment conditions:

a) **Achieved target:** Farmers meet 100% of their target and will receive their payment in full for that year.
b) **Achieved threshold:** Farmers that only achieve the threshold target will be issued with 50% of their payment and a 'corrective action' (i.e. to implement the rest of the activities). If they achieve this corrective action within a time agreed with the project coordinator, they will receive the remaining 50% of their payment. If they fail to achieve this corrective action within the agreed time, payment will be reduced to a quantity that is proportional to the benefits that they have currently achieved.
c) **Under the threshold:** Where a farmer does not achieve their threshold, they will be issued with a 'corrective action'. If they achieve this corrective action within a time agreed with the project coordinator, they will be paid in full. Otherwise, their payment will be reduced to a quantity that is proportional to the benefits that they have currently achieved.

Each participant will enter into an individual PES agreement. Regarding fairness in the distribution of payments, it is important to highlight that all agreements have the same calculation of the carbon credits. Monitoring targets will be based on planting year and management requirements; however, the payment distribution will be the same for all farmers based on their performance as explained above. When there are not enough buyers to pay the total to all participants, the payments will be divided equitably to all participants, depending on their performance as described in the monitoring plan in PES agreement. In case any participant feels that he/she has been unfairly paid, they can use the grievance mechanism to put forward his/her complaint (see Part E).

Threshold and conditions for excluding farmers/sites from the project.

For sites/farmers classified to be UNDER THE THRESHOLD who fail to undertake recommended corrective actions which, mainly include but not limited to, restocking (replanting of dead trees), in two successive monitoring period, i.e. biennial (two-yearly) monitoring based on PES agreement, will be excluded (dropped out from the list) from the project. The project, at its own discretion, may decide to exclude the farmers/sites earlier than the biennial monitoring when it is deemed necessary to do so. To replace the

carbon stock lost from the identified failed sites, the project will find other privately owned plots and interested farmers within the same AOI of the project and will replant trees of the same species utilizing the same planting management model. Given that many farmers continually seek to participate in the project, finding new locations for replanting should not be difficult. The funding withheld from the sites UNDER THE THRESHOLD will then be used to pay the new participants.

For sites/farmers classified to be ACHIEVED THRESHOLD who fail to undertake recommended corrective actions which, mainly include but not limited to, restocking (replanting of dead trees), in two successive monitoring period, i.e. biennial (two-yearly) monitoring based on PES agreement, will still be maintained in the project. However, the payment will only be made corresponding to the achieved threshold level. To replace the 50% or less carbon stock lost from these identified sites, the project will find other privately owned plots and interested farmers within the same AOI of the project and will replant trees of the same species utilizing the same planting management model. Given that many farmers continually seek to participate in the project, finding new locations for replanting should not be difficult. The funding withheld from the sites ACHIEVED THRESHOLD will then be used to pay the new participants.

New sites for replacement of UNDER THE THRESHOLD and ACHIEVED THRESHOLD can be one large site and may be larger than the combined size of UNDER THE THRESHOLD and ACHIEVED THRESHOLD sites in the existing project. Carbon stocks for the size in excess will be calculated as additional carbon credit.

The way payments are distributed has been discussed and agreed with all participants. The aim is that, from the total carbon credits, part of the payment will be deducted corresponding to a buffer risk of 15% estimated by the project (Section H). From this new value (net of buffer allocation), a maximum of 40% will be deducted for project coordination costs. The deduction of a maximum of 40% from net payment for project coordination cost may vary depending on whether project coordinator is able to mobilize additional funding to cover the coordination cost. If there are sufficient resources to cover the coordination cost, then the coordination percentage (40%) will be released to the participants. Participants also will contribute to the Group Common Fund based on their respective group agreements. The farmers' common funds will be activated once the first carbon purchase agreements are in place.

Due to the lack of banking facilities in Laclubar and Soibada, payment to participants in the form of cash will be hand-delivered to them in annual general community meetings held either in Laclubar or in Soibada. Annex J2 provides records of meetings where the PES agreement has been discussed and agreed.

Part K Monitoring

K1 Ecosystem services benefits

K1.1 Development of a monitoring approach

The following monitoring approach (see Section K1.2) was developed through consultations with participating farmers and communities. It implements best practice approaches to community monitoring of socio-economic and environmental aspects, both of biomass and soils, and aims to maintain local legitimacy of the monitoring regime.

K1.2 Monitoring framework for ecosystem service benefits

The projected carbon benefits from tree planting and soil management are outlined in Parts F and G. Figure K1 describes how this modelling is linked to the process of monitoring, verification and carbon payments. We have based our monitoring framework on best practices in activity-based monitoring to verify modelled carbon benefits from changes to biomass and soils (Plan Vivo 2017; FAO 2011; VCS 2012).

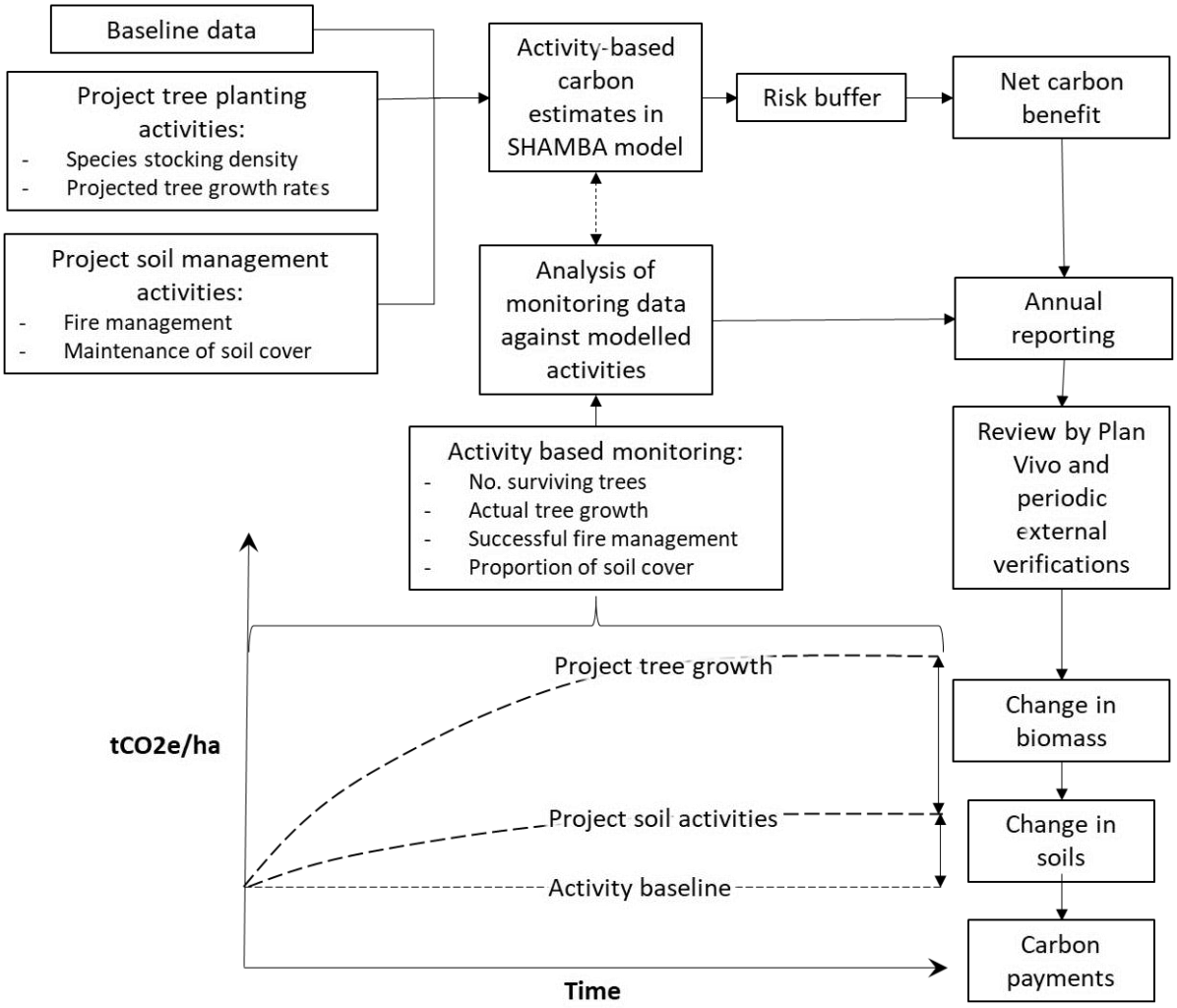

Figure K1: Activity-based monitoring of modelled carbon benefits (based on FAO 2011)

K1.3 Monitoring indicators

The indicators that will be monitored are those parameters used in the SHAMBA model that directly impact the estimation of climate benefits (i.e. the difference in carbon between the baseline and project scenarios). These parameters are also used to monitor performance targets included in the PES agreement. In the case of the technical specifications in this project, these are:

K1.3.1 Stocking density of project species

The monitoring of tree survival and stocking density will be conducted in accordance with the protocol "Survival tree specification v1" (Annex K1), developed by the project. It will be completed by the farmers themselves in their properties, who will count every live tree planted by the project that is included in their PV agreement. The activity will be supported by the field team by providing instructions and basic materials to undertake the counting. The field team will also perform a random sampling of minimum 10%

of the total project area to verify the reliability of the assessment conducted by the farmers. Following verification, the results of farmers' assessments will be compared with the initial planting records of each site at the time of planting to estimate survival rates (%) for each site. An overestimation by farmers of tree numbers (>5%) for a given site will trigger additional verification on that particular site; if not already included in the 10% sample. This is completed on years 1 and 3 post-planting, and will identify if compliance has been met for payment and if any re-stocking or early corrective actions are required.

K1.3.2 Tree growth (diameter at breast height -dbh- and tree height)

The monitoring process will be similar to the one used to capture the parameters that were included in shamba for the climate benefits (Annex F1). Plots sampled in 2018-2019, which correspond to sites planted since 2011, will be re-measured.

For future monitoring, the current stratification (agroforest / woodlots) will be expanded and new random plots allocated to new sites. The sampling design of live fences will be separate from sampling of woodlots and agroforest, but the same approach described in this section will be used.

We will estimate the number of plots required using the excel "plot number calculator" included in Annex G4. New sites and modifications of areas for existing sites (if needed) will be mapped using a handheld GPS, as per the current process, to enable updating of the master GIS layer. The next step is to run a random plot tool in the GIS platform to locate the additional plots required. The new plots will be exported from GIS and uploaded in a handheld GPS by the project's field coordinator, for installation in the field. Field data will be collected as described in the Forest Inventory Procedure (Annex G3). The data to collect will include dbh and where relevant to the model, tree height. This information will be used to update the technical specifications of the project (additional details in section a) below).

The field information will be recorded either on paper or a tablet and then entered/downloaded in the project field data base. This information will be sent to the forest carbon specialist to:

a) Establish the average dbh growth rate / species and height growth (where relevant to the model), which will be the new input to include in SHAMBA to then run the model. The monitoring schedule will be used to calibrate growth inputs at years 5 and 10 of the monitoring period. This will occur prior to third-party verification of the project, in accordance with PV's guidelines. The results of the "fresh run" in shamba can then be compared with the previous shamba outputs, including growth curves.

b) The information on dbh growth rate / site will be the base of performance monitoring as per the PES agreements (Annex J1).

The information collected will be stored by the field coordinator in an access database developed by the project. The information to store includes Farmer name, Plan vivo ID, site ID and details of the PV sites (area, species, age, registration date), monitoring details and corrective actions.

The tree sampling specifications are:

- 10% maximum error and 90% probability;
- Stratified random sampling by agroforestry and reforestation (woodlots) types with separate sampling for live fences.
- Sampling frequency: Diameter growth of sites established in 2019 and onwards will be measured when they are 5 and 10 years of age. Diameter growth of sites established before 2019 will be measured during periods 5 and 10 of the crediting period. As an example, if the crediting period for the project starts in 2020; a site established in 2021 will be measured in 2026 while a site that was established in 2012 or 2018 will be measured in 2025.
- Parameters to measure: site slop and dbh for all species plus tree height for *Sweitenia* and *Gmelina*.
- Type of plot and size: temporary, circular 7.5 m radius (177 m^2) with correction to the horizontal plane for slopes greater than 10 degrees;
- Conducted by the field team by sampling 4 plots / ha / site (or its equivalent: i.e. 2 plots for a 0.5 ha site).
- The random generation and layout of plots will be completed using the Arcgis random plots tool on a single shapefile that will include all PV sites mapped by the field team.

K1.3.3 Soil management

Considerations that underpin the project's monitoring approach for soil management include: i) The return of organic material (live or dead) to the soil is regarded as the practice with the greatest potential to increase SOC levels; ii) soil management activities that the project will implement reflect parameters that drive conservatively the RothC feature for SOC in the SHAMBA model; and iii) the difficulties of accessing a soil laboratory in Timor-Leste to assess soil carbon stocks changes and the high cost that would imply exporting soil samples. We are therefore basing our monitoring on activity-based soil management to assess:

a. Unburnt area as a percentage of the total area per site and reduction or elimination of burning of residues in site.
b. Evidence of mulching or any other conservation activities or conversely, detrimental activities.
c. Increased awareness among project and non-project participants through *show and tell* field days with champion farmers: assessed by the number of farmers that attend field days organised to demonstrate progress of this intervention.

Activities a. and b. will be undertaken simultaneously during the scheduled monitoring period. The sites will be revisited for each one of the monitoring periods, ideally at the same dates (or closer). Details in Annex K2.

People involved in monitoring activities:

- Community based monitoring: via farmers for survival assessment.
- FCOTI (field team): coordination of activities, field data collection and verification of survival (tree counts) by farmers, tree growth and soil management.

K1.3.4 Harvested wood products

The prescribed thinning will correspond to the specific conditions of each site and the residual stocking targets described in the PES monitoring schedules. Monitoring of wood use, including domestic consumption and sales, will be undertaken during the socio- economic periodic assessments the project will conduct (Section K2). From a technical perspective, field staff will conduct pre-thinning and post-thinning rapid assessments based on basal area and stocking measurements.

K1.4 Payments to farmers and managing underperformance

Payments to farmers will be calculated according to their success against two types of activities: 1) tree planting survival and growth, and 2) soil management. Each one of these activities are associated with a separate carbon pool (see Section F). Total payments made to a farmer will be calculated based upon their level of achievement under the respective carbon pools for that year. For example, if a farmer achieves their tree planting threshold, but not their soil management threshold, they will only be paid for the amount of carbon associated to biomass. The level of achievement for each carbon pool is divided into three categories: *Achieved target*, *Achieved threshold* and *Under the threshold* (see Section J2).

Following collection of field monitoring data by FCOTI, the results are stored in the project's database and the results communicated to farmers groups in one of their regular meetings within 2 months of the assessments. The meeting will be a two-way feedback to adjust project activities as required. Corrective actions might include:

a) Re-stocking of sites by participating farmers to compensate for mortality
b) Farmers compensate their trees' low growth and corresponding estimated carbon deficit by planting trees in a communal land designated by the farmers' groups; and/or
c) Soil management amendments for underperforming sites through additional training and periodic

visits by the field team to follow up progress.

K2 Socio-economic impacts

The socio-economic monitoring plan will use social research techniques to determine livelihood impacts among project participants throughout the life of the project. Qualitative and quantitative data will be collected and a variety of mediums used to analyse and present findings (written, visual and aural). All participating households will be interviewed annually to gather information on changes in income, labour, resource use, wellbeing, food consumption and biodiversity awareness and knowledge over time, as compared to the baseline household survey undertaken in 2017. The information gathered will alert us to any negative impacts occurring as a result of the project, and any barriers to production or livelihood change, so we can try to address them. We will facilitate discussion of such issues with regular community meetings and farmer training activities. Regular feedback and dialogue on challenges will enable rapid responses to project planning and implementation. Non-participating households will be interviewed every two years to understand reasons for non-participation and to overcome inequities or barriers to participation. It is anticipated that, over time, households not involved in the project will become increasingly aware of the opportunities for income generation from the carbon project and be interested in participating. Household labour availability and land size were highlighted as barriers for non-participating households. It is anticipated that alternative pathways for non-participating households to be involved in the project will be further explored. This might include landless households undertaking nursery production or seeds' collection and treatment. Other potential livelihoods opportunities that might benefit the community at large are summarised in Section F2.

Household interviews will be semi-structured with closed and open questions, whilst group interviews will utilise open questions to enable in-depth discussion. Case studies will be developed to enable a better understanding of how the project is impacting livelihoods in positive and/or negative ways. Information on indicators will be collected where possible at the same time when the carbon monitoring is taking place. Structured interviews will take place the year before PV verifications, this information will enable comparison with the HH baseline. Details of the social monitoring are provided in Table K2.

Table K2: Socio-economic indicators

Socio-economic indicators	Monitoring method	Monitoring frequency	Responsibility
Changes in income of HV participants as a result of carbon payments.	Interviews with project participants and project database on payments	See right column	CSU up to 2021, then FCOTI on year 4 and 9 prior verification
Participation in the rural micro grant program	Activity register	annual	FCOTI
Payments for compliance with PES agreement	Plan Vivo participant's database	As scheduled in the PES agreement	FCOTI
Increased participation of women in the HV project	Project register	annual	FCOTI
Participation of HV Participants in Conservation Agriculture	Interviews with project participants	See right column	CSU up to 2021, then FCOTI on year 4 and 9 prior verification
Participation of HV Participants in FMNR	HV farmers groups meetings and personal communication	Annual	FCOTI / HV farmers groups
Number of scholarships. Number of women receiving training in micro-business development and participation	Activities register	Annual	FCOTI

K3 Environmental and biodiversity impacts

K3.1 Environmental Indicators

Monitoring of environmental indicators will be undertaken concurrently with other monitoring activities or day to day project activities where possible. Details of the environmental indicators monitored can be found in Table K3.

Table K3: Environmental indicators

Indicator	Method	Monitoring frequency	Responsibility
Area (ha) impacted by invasive species or pests within or in the perimeter of planting sites	Visual observation / GPS data capture	All year round	FCOTI / HV farmers
Area (ha) or number of trees planted by the project growing spontaneously (wildings) outside planting sites	Visual observation / GPS data capture	All year round	FCOTI / HV farmers
Area (ha) included in FMNR (deforestation reduction and native forest enhancement)	Project's register db / GPS data capture	Annual	FCOTI / HV farmers

Number of water courses included in project sites	Satellite imagery and ground truthing	Annual	FCOTI

K3.2 Biodiversity indicators

Depending on availability of financial resources, a biodiversity baseline will be undertaken across the landscape in stratified random sample areas of: 1) project tree plantations; 2) degraded areas / non-planted areas; and 3) dense forested areas. This will give us an indication of how the biodiversity of project tree plantations compares with unplanted areas and more dense forests. Sampling sites for forested areas and degraded areas will be selected from satellite imagery while planting sites will be selected from the spatial data the project has captured.

Community Consultation will take place to ensure farmers agree with the activity. An important consideration for the project is to focus efforts and resources trying to spot species that are present but that are also detectable. Based on preliminary field work concerning biodiversity completed in 2018, we will initially sample terrestrial mammals, birds, frogs and other reptiles. Monitoring will be conducted yearly.

Other fauna groups, such as bats and butterflies, could be added later on to the annual monitoring if resources and expertise become available. Twenty planted sites will be surveyed using 0.5 ha plots.

Key indicators used:

- Abundance counts of individual species
- Presence/absence of individual species
- Species richness (number of species detected)
- Species composition (the kind of species present and their relative abundance)

Monitoring will be carried out by COTI's field team, supervised by experts from Charles Sturt University and a biodiversity expert from the Northern Territory Department of Environment and Natural Resources (Australia). Specifics of the field monitoring for each fauna group is based on the experience of the project's ecologist and his knowledge of Timor-Leste's biodiversity.

K4 Other monitoring

The monitoring of indicators included in Table K4 will be conducted by FCOTI on an annual basis and concurrent to other monitoring, such as the socio-economic activity.

Table K4: Degradation, institutional and governance indicators

Aspect	Indicator
Drivers of degradation	• Number of households (HV farmers) implementing reduction of burning practices (Section K 1.3.3) • Attendance of project and non-project farmers to FMNR, sustainable agriculture and soil management field day activities • Area under FMNR • Wildfires occurrence
Institutional	Relevant changes to strategies, regulations and legislation at national or regional level that might impact the project
Governance	PSC and HV farmers groups meetings and attendance of project participants

Annexes

A2 Project background

B1 Spatial information

B2 Biodiversity information

C1 Baseline social survey

C2 Sample of land ownership declarations

E1 Farmers meetings, minutes and photos

E2 Plan vivo maps (examples) and photos

E3 Grievance, farmers groups and PSC

F1 Climate benefits (SHAMBA model inputs and outputs)

G1 Plantation management

G2 Adaptive management

G3 Forest Inventory procedure-Eng and Tetun

G4 Baseline estimation

I1 Agreement between GTNT and FCOTI

I2 Official registration FCOTI

I3 MoU between FCOTI and Government of TL

I4 GTNT and FCOTI policies

I5 Project timeline

I6 Database template

I7 Budget and financial plan

J1 Draft PES agreement (producers agreement template)

J2 PSC meetings

J3 Brochure for farmers

J4 Minutes August 2019 participants consultation

J5 Timber cost benefit estimation

K1 Tree survival monitoring

K2 Soil management monitoring

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