REFORESTATION OF DEGRADED LANDS IN SIERRA LEONE

Document Prepared by Swiss Carbon Value Ltd.

Contact Information

Project Title	Reforestation of Degraded Lands in Sierra Leone
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1 PROJECT DETAILS

1.1 Summary Description of the Project

Miro Sierra Leone Commercial Plantations Project consists of the establishment of high-quality commercial forestry plantations with short rotation species, for producing sawn timber, poles, plywood and biomass, for domestic and international markets, and providing environmental, social and economic benefits to local communities. To reinforce this, the Company holds the Forest Stewardship Council (FSC) Forest Management Certification[1] and follows the International Finance Corporation (IFC) standards.

The project is developed in the northwest of the country by Miro Forestry Sierra Leone (MFSL). The Company has been in Sierra Leone since 2012 and started its Greenhouse Gas (GHG) reduction project in 2016. The project area comprises of 26,897 ha under land lease agreements in the Tonkolili and Port Loco Districts. The project intends to establish approximately 12,000 ha of commercial plantations. By the date of development of this document, there were 5,600.99 ha planted and of that 4,005.86 ha are eligible under the selected methodology[2]. By the end of 2020, there were developed 8,902.94 ha.

Plantations are being established in community-owned land, leased to the Company with the approval of the Government. In return, the land-owning community obtains the payment for the lease and a benefit-sharing is arranged, payable into a community development fund.

Before the establishment of the plantations, the area had a scarce amount of tree cover, mostly comprised by grassland and a few forest patches and farmland.

The project generates GHG removals by the plantation of selected species such as *Eucalyptus pellita*, Eucalyptus hybrid cross *urophylla x grandis*, *Corymbia citriodora*, *Acacia mangium*, *Tectona Grandis*, and *Gmelina arborea*. On average, the project gross estimates to remove 63,583 tCO_2e annually and 1,907,488 tCO_2e during the entire project lifetime.

Additionally**Error! Bookmark not defined.**, the project is expected to bring a different kind of benefits. At a social level, the project will provide income to more than 600 people and around 80 communities in Yoni Chiefdom, contributing to the improvement of their well-being and their families Moreover, the Company has developed participatory Corporate Social Responsibility (CSR) activities for the enhancement of some of the local infrastructures and assists health, education, and general welfare of the local communities. At the environmental level, the project will include the improvement of the protective

[1] Supports/1_PDD/PO_Information/FSC/FSC MFSL Certificate

[2] AR - ACM003 A/R Afforestation and reforestation of land except wetlands (Version 02.0). Available at: Supports/1.PDD/Annex/Methodology_and_tools/AR - ACM003 A/R V2.0

function of the remaining extant forest cover within the project area as well as the establishment of a vegetative cover to minimize the intensity of desiccating winds, improve soil and water conservation.

1.2 Sectoral Scope and Project Type

Sectoral Scope 14 Agriculture Forestry and Other Land Use (AFOLU), under the category of Afforestation, Reforestation and Revegetation (ARR). The project is a stand alone project.

1.3 Project Eligibility

The eligibility analysis is performed for each of the compartments currently planted, considering the year of establishment and the 10 previous years. This analysis evaluates the non-stable forest during this period, which will be selected as the eligible area and the remaining areas will be defined as ineligible areas. Landsat 7 and 8 medium-resolution multispectral images were used to obtain forest and non-forest coverage through supervised classification.

Forest definition for the country[3] and the project area are indicated as areas greater than 0.5 ha, with a canopy density higher than 10% and a tree height above 5 m. Non-forest areas are composed of the remaining areas, not meeting this definition.

Eligibility period: The project has planted areas between the years 2016 and 2019, therefore, the period of eligibility includes the pairs of years: 2006 - 2016, 2007 - 2017, 2008 - 2018 and 2009 - 2019.

Eligibility analysis:

This analysis consists of i) the acquisition of Landsat 7 and 8 multispectral image data; ii) the correction of multispectral images, iii) land cover classification; iv) classification accuracy, v) final layer of forest and non-forest classification, and vi) final eligibility analysis, summing up the stable non forest areas for each period Figure 1 summarizes the eligibility analysis methodology.

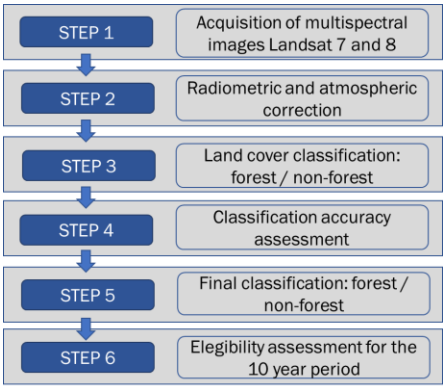

Figure 1 Eligibility analysis steps

[3] Supports/1_PDD/Annex/Library/Forest_Sierra_Leone_2015

i) Data acquisition:

Multispectral Landsat 7 and 8 images were downloaded for each assessed year. The multispectral images have a spatial resolution ranging from 15 to 100 m, covering an area of 185 x 185 km and with a revisit time of 16 days, and a spatial resolution of 30 m. These images are provided by the United States Geological Survey (USGS) and can be downloaded for free using the link: https://earthexplorer.usgs.gov/.

Landsat 7 images are downloaded for the years 2006 to 2009 (operation time from 1999 to 2013). This satellite sensor presents a fault from 2002, generating gaps in the images (absence of data and zones without information). To fill in and correct the absence of data, a mosaic is generated from Landsat 7 images, combining images from different months throughout each year.

4 Landsat 7 mosaics are composed for the years 2006, 2007, 2008 and 2009 covering the totality of the project area.

Landsat 8 images are downloaded for the years 2016 to 2019 (operation period: 2013 - to the present).

The images were consulted on 20th January 2020, obtaining 8 multispectral images with different Path, Row and Year (Table 1). Figure 2, shows an example of Landsat 7 and 8.

Table 1 Details of the downloaded images

Number	Satellite	Collection	Path	Row	Date
1	LE07	L1TP	201	54	28/02/2006
2	LE07	L1TP	201	54	04/04/2007
3	LE07	L1TP	201	54	02/02/2008
4	LE07	L1TP	201	54	08/03/2009
5	LC08	L1TP	201	54	15/01/2016
6	LC08	L1TP	201	54	19/12/2017
7	LC08	L1TP	201	54	21/02/2018
8	LC08	L1TP	201	54	24/02/2019

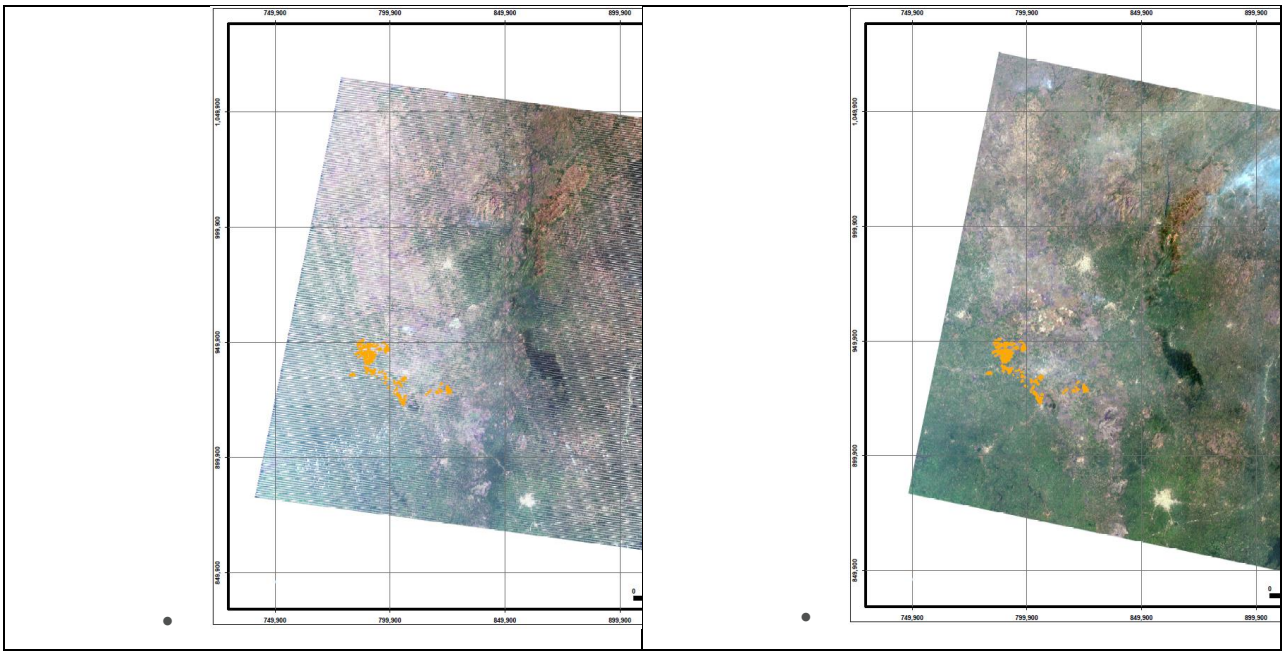

Figure 2. Landsat 7, 2006 (left) and Landsat 8, 2019 (right)

From Landsat 7, 4 composed images were obtained for the years 2006, 2007, 2008 and 2009 for the project area. The composed images are shown in Table 2.

Table 2 Composed images Landsat 7

Code	Name	Initial date	Final date
1	L07 Mosaico 2006 SierraLeone	01/01/2006	15/04/2006
2	L07 Mosaico 2007 SierraLeone	06/01/2007	15/04/2007
3	L07 Mosaico 2008 SierraLeone	01/01/2008	31/12/2008
4	L07 Mosaico 2009 SierraLeone	06/01/2009	15/04/2009

ii) Atmospheric and radiometric correction

After downloading the images, a radiometric and atmospheric correction is performed to homogenize the digital levels of the pixels that have been affected by faults in the sensor or by other external factors such as atmospheric interference. The atmospheric correction eliminates the effects of dispersion and absorption of the atmosphere on the digital levels of the pixels, obtaining the characteristic reflectance of each pixel.

iii) Land cover classification (LCC)

LCC is based on a supervised remote sensing technique, using the forest classification for the country, generating the following land cover categories forest, non-forest, water, clouds, cloud shadow and areas with no-data for each year. There were defined 62 and 105 random training areas, per year and randomly distributed along with the images (Table 3). The mosaic generated from Landsat 7 image is only used to correct the zones with no-data in the classification. A classification of the mosaics is not been made.

Table 3 Composed images Landsat 7

Number	Class	2006	2007	2008	2009	2016	2017	2018	2019	Total
1	Forest	14	11	20	12	19	17	19	19	131
2	Non-forest	65	40	62	45	63	66	83	80	504
3	Water	0	5	0	6	0	9	0	6	26
3	Cloud	0	0	0	0	5	2	0	0	7
4	Cloud's shadow	0	0	0	0	0	2	0	0	2
5	No data	8	6	7	6	0	0	0	0	27
Total		**87**	**62**	**89**	**69**	**87**	**96**	**102**	**105**	**697**

The separability between classes was assessed with the Jeffries – Matusita statistics, which is used to calculate the spectral separability between the training areas and the soil cover classes. In general, all the separability values between classes were close to 2, meaning that the training area has a significantly different spectral signature. Once the seeds and separability have been defined, the classification is carried out using the "Support Vector Machine" method from the ENVI 5.5 software. Then, a filter is made with the Majority / Minority Analysis function, to improve the classification.

Table 4, shows the separability values for the land cover classes in each of the classified years.

Table 4 Jeffries – Matusita separability

Class	2006	2007	2008	2009	2016	2017	2018	2019
Forest / non-forest	1.98	1.99	1.99	1.98	1.99	1.98	1.99	1.99
Forest / water	-	2.00	-	2.00	-	2.00	-	2.00
Forest / cloud	-	-	-	-	2.00	2.00	-	-
Forest / cloud's shadow	-	-	-	-	-	2.00	-	-
Non-forest / water	-	2.00	-	1.99	-	2.00	-	2.00
Non-forest cloud	-	-	-	-	2.00	1.99	-	-
Non forest / cloud's shadow	-	-	-	-	-	2.00	-	-
Water / cloud	-	-	-	-	-	2.00	-	-
Water / cloud's shadow	-	-	-	-	-	2.00	-	-
Cloud / cloud's shadow	-	-	-	-	-	2.00	-	-

iv) Classification accuracy

The accuracy of the classification is calculated using a confusion matrix with omission and commission errors resulting in a percentage of the overall accuracy of the classification.

The forest and non-forest classification for 30 control points were assigned randomly per planting plot and per year and were analysed comparing the classification and control high-resolution images (i.e. Sentinel 2, Google Earth images). This contrast generates the classified and real values of the confusion matrix (Table 5):

Table 5 Classification's accuracy for each year.

Year	Classification's accuracy
2006	86.67%
2007	90.00%
2008	96.67%
2009	86.67%
2016	86.67%
2017	93.33%
2018	96.67%
2019	83.33%

v) Final classification

The final land cover classification of each year was summarised in forest and non-forest categories. Table 6, shows the forest and non-forest land cover areas for the project area for each classified year.

Table 6 Forest and non-forest classification for each year

Year	Forest (ha)	Non-forest (ha)
2006	278.19	940.66
2007	321.50	1,138.20
2008	10.51	1,459.22
2009	133.24	1319.47
2016	256.43	962.42
2017	56.84	1,402.85
2018	3.25	1,466.48
2019	96.63	1,356.08

In the land cover classification process, it was found that of the 5,600.99 ha of the project area, at the end of 2013, 888.61 ha belonged to forest land, which is equivalent to 15.87% of the total project area. The grassland was the land cover that occupied the largest area with 4,696.16 ha, occupying 83.85% of the total area. The rest of the area is covered by cropland which is equivalent to 0.29% of the project area Table 7.

Table 7 Land Use Land Cover 2013

Land Use Land Cover 2013	Area (ha	% of the area)
Forest Land	888.61	15.87%
Cropland	16.22	0.29%
Grassland	4,696.16	83.85%
Total	**5,600.99**	**100%**

Subsequently, the 888.61 ha of forest land is taken and cartographically intersected with the 4,713.30ha of eligible area, obtaining 227.72 ha that does not meet the eligibility criteria. Table 8shows the result of crossing between layers.

Table 8 The intersection between eligible areas and forest land

Eligibility	Period	Land Use Land Cover 2013	Area (ha)
Eligible	2006 - 2016	Forest Land	46.64
Eligible	2007 - 2017	Forest Land	134.60

The 227.72 ha are reclassified and become ineligible areas in the eligibility layer, obtaining eligibility layer (Table 9).

Table 9 Eligibility discounts

Period	Initial eligibility (ha)	Discounted areas	Eligible area (ha)
2006 - 2016	839.49	46.64	792.85
2007 - 2017	1,121.34	134.60	986.74
2008 - 2018	1,456.30	7.31	1,448.99
2009 - 2019	1,296.17	39.16	1,257.01
Total	**4,713.30**	**227.71**	**4,485.59**

To the 4,485,59 ha of eligible area, it was discounted wetlands areas (465,03 ha), that were classified as eligible (non-forest) but imply a methodological discount (see section 3.2 Applicability of Methodology). As a result, from the already planted areas, 4,020.56 were initially classified as eligible. However, as part of non-forest landcover included, the project developer cannot assure that the croplands with 16,22 ha, are not going to be displaced. Thus, in order to be conservative, all croplands (16.22ha) are excluded from the project. As a result, the eligible area is **4,005.86 ha**[4] (Figure 3).

[4] PDD Supporting Documents/Shapes/Eligibility

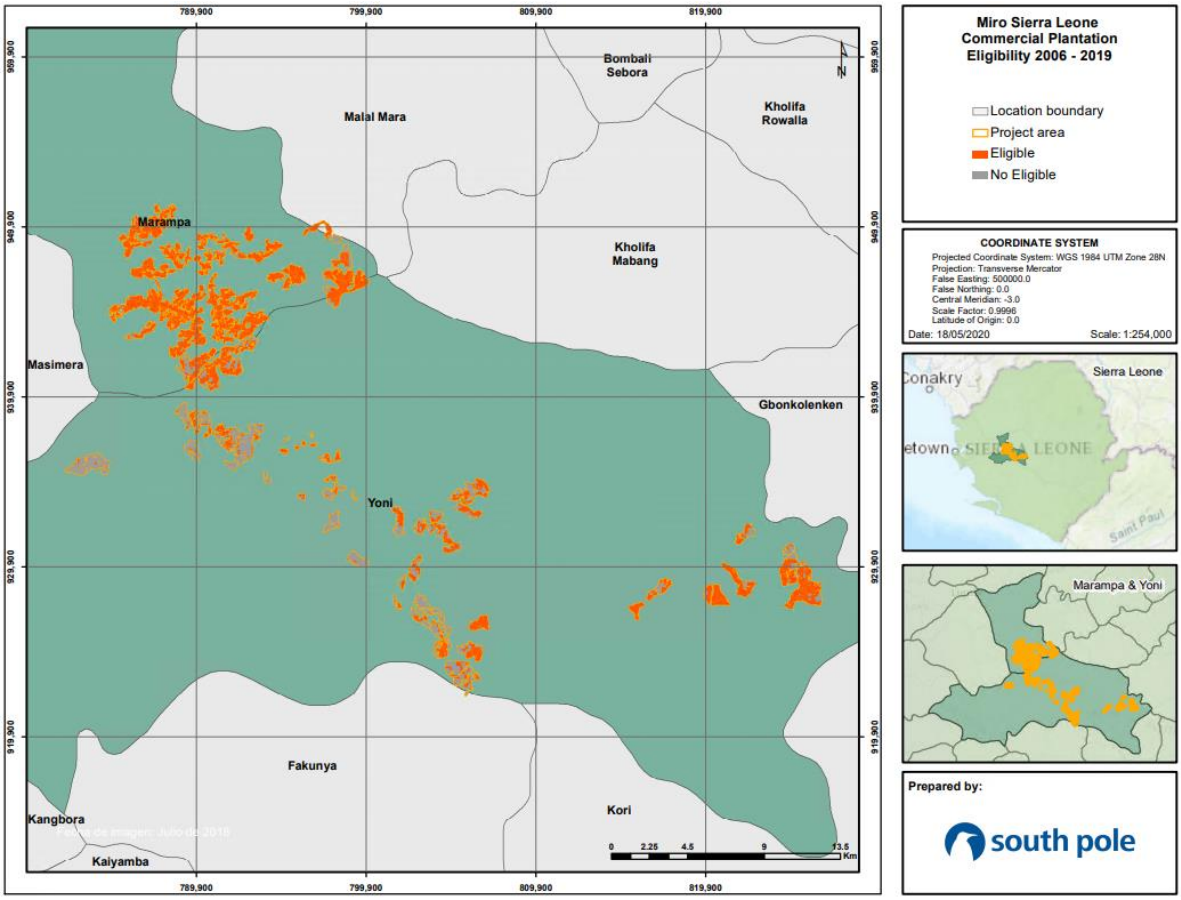

Figure 3. Eligible and non-eligible areas in the project area

1.4 Project Design

The project has been designed as a standalone project.

1.5 Project Proponent

Organization name	Miro Forestry Developments Limited
Contact person	Mr. Andrew Collins
Title	Co-founder, CEO
Address	Office 4.01, 1-2 Paris Gardens – London - SE1 8ND
Telephone	Tel: +44(0)7899074158
Email	info@miroforestry.com

1.6 Other Entities Involved in the Project

Organization name	Miro Forestry Company Sierra Leone Ltd (MFSL)
Role in the project	Local support company, managed by Miro Forestry Developments Limited
Contact person	Mr. Andrew Collins
Title	Co-founder, CEO
Address	Office 4.01, 1-2 Paris Gardens – London - SE1 8ND
Telephone	Tel: +44(0)7899074158
Email	info@miroforestry.com

Organization name	Swiss Carbon Value Ltd.
Role in the project	Project developer
Contact person	Christian Dannecker
Title	Sourcing director
Address	Technoparkstr. 1 - 8005 Zurich - Switzerland
Telephone	Tel: + 41 43 501 35 50

1.7 Ownership

Land tenure in the project area is a customary type, and the transactions involving land-use follow traditional rules. The land is owned by Land-holding families, who often allow local communities to utilise areas for their crops on an annual basis although longer terms can be negotiated. The use of the land does involve the Chiefdom councils as the landholding families fall within them. All transactions in the community and family land require the approval of the Paramount Chief.

Miro has land lease agreements with the Chiefdom Council of each area. The agreement is negotiated with the landholding families and the communities residing on that land and includes village mapping to understand the land uses. The agreement is signed by the regent chief and representatives of the landholding families.

In the Tonkolili and Port Loki District, the contract was signed with the Chiefdom Council of Yoni Chiefdom, Yoni Mamela Chiefdom and Massimera Chiefdom, covering several hectares in different villages. The leases are stated for a duration of 50 years (renewable at the Company's option for 2 further periods of 21 years plus 7 years thereafter), following the current regulations and paying an annual rent, according to the laws of Sierra Leone. Additionally, a sharing agreement is enclosed to the lease providing 5% of net profit to be paid into a community development fund.

As evidence of the right to use the land for the establishment of the project, information of each land lease agreements is provided in Table 10**Error! Reference source not found.** and the complete documentation, including the demarcation map, and the registration stamp are available[5] in the supporting documents folder.

Table 10 Details of the land lease agreements

Chiefdom Council	Village	Year	Area (ha)
Yoni Chiefdom	Yoni Chiefdom	2011	20980
Yoni Chiefdom	Mamaka	2016	529,31
Yoni Chiefdom	Mashetheh	2016	87,5
Yoni Chiefdom	Rogbongba	2016	520
Yoni Chiefdom	Mashetheh	2016	87,5
Yoni Chiefdom	Mafala	2018	44,9
Yoni Chiefdom	Mangehun	2018	124,67
Yoni Chiefdom	Massankay	2018	463,91
Yoni Chiefdom	Massankay	2016	100,75
Yoni Chiefdom	Massankay	2017	81,4
Yoni Chiefdom	Massankay	2018	421,02
Yoni Chiefdom	Maserrybana	2018	71,51
Yoni Chiefdom	Matopie	2018	102,3
Yoni Chiefdom	Mayira	2018	208,54
Yoni Chiefdom	Mayogbor-Petify	2018	130,62
Yoni Chiefdom	Petify-Mayorbor	2018	80,25
Yoni Chiefdom	Romaka	2018	113
Masimera Chiefdom	Chaide-com Turay	2019	35,517
Masimera Chiefdom	Marainday I	2018	127,463
Masimera Chiefdom	Marainday II	2018	153,821
Masimera Chiefdom	Masakie	2018	100,468
Masimera Chiefdom	Mathempra	2018	37,19
Masimera Chiefdom	Mathonthen	2018	90,792
Masimera Chiefdom	Mayolla I	2018	262,885
Masimera Chiefdom	Mayolla II	2018	289,202
Masimera Chiefdom	Mayolla III	2018	185,42
Masimera Chiefdom	Rosarr2	2018	70,571
Masimera Chiefdom	Rosarr1	2018	111,688
Masimera Chiefdom	Rosint Lol	2018	38,845
Masimera Chiefdom	Yanabay I	2018	137,234
Masimera Chiefdom	Yanabay II	2018	85,965
Yoni Mamela Chiefdom	Baray-Nin	2019	151,121

[5] Supports/1_PDD/PO_Information/Land Lease

Chiefdom Council	Village	Year	Area (ha)
Masimera Chiefdom	Chaiducom-Turay	2019	56,3964
Yoni Mamela Chiefdom	Mabila Bana	2019	96,2269
Yoni Mamela Chiefdom	Mafala	2019	24,0213
Masimera Chiefdom	Makundu	2019	35,18
Yoni Mamela Chiefdom	Manjehun	2019	17,96
Yoni Mamela Chiefdom	Masabay	2019	98,336
Yoni Mamela Chiefdom	Masankay	2019	42,98
Yoni Mamela Chiefdom	Petifu-Mayorgbor	2019	24,85
Yoni Chiefdom	Rokembie 2	2019	61,6
Yoni Mamela Chiefdom	Romaka	2019	58,36
Yoni Mabanta Chiefdom	Romess	2019	98,78
Masimera Chiefdom	Yanabay	2019	257,4
		TOTAL	26897,453

1.8 Project Start Date

Start date: 16/05/2016

Although the Company has been present in the country, since 2012, the carbon project started on the date referenced[6] with the plantation of the compartment C02b with *Acacia mangium*, in accordance with the retroactivity requirements.

1.9 Project Crediting Period

Start: 16/05/2016

End: 15/05/2046

Total number of years: 30 years

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Table 11. Project scale

Project Scale	
Project	x
Large project	

The results presented in the following table include the discounts for rotational harvest and incorporate the Long-term average, which is achieved at the year 11 of the project (year 2026). For details on the

[6] Supports/1_PDD/PO_Information/Planting_Tickets_SL

complete calculation, please check the excel file of the ex-ante calculations in the supporting documents.

Table 12. Estimated GHG emissions reductions or removals

Year	Estimated GHG emission reductions or removals (tCO_2e)
2016	179
2017	24,075
2018	50,673
2019	94,350
2020	135,278
2021	179,178
2022	224,199
2023	269,773
2024	315,492
2025	361,254
2026	253,037
2027	0
2028	0
2029	0
2030	0
2031	0
2032	0
2033	0
2034	0
2035	0
2036	0
2037	0
2038	0
2039	0
2040	0
2041	0
2042	0
2043	0
2044	0
2045	0
Total estimated ERs	1,907,488
Total number of crediting years	30
Average annual ERs	**63,583**

1.11 Description of the Project Activity

Miro Forestry aims to achieve net GHG removals by establishing fast-growing commercial plantations in degraded lands. Because of this land degradation, the biomass accumulated in the baseline land cover is deemed to be zero. Thus, the growing of the timber will accumulate CO2 within the years.

For achieving the net GHG removals, the plantation established must be managed in a rigorous way. The company has developed policies and procedures to establish a world-class forestry plantation, reflected on their Forestry Management Plan (FMP), that covers all stages after the land is acquired, then the silviculture until the roads and harvesting operations, as is shown in Figure 4:

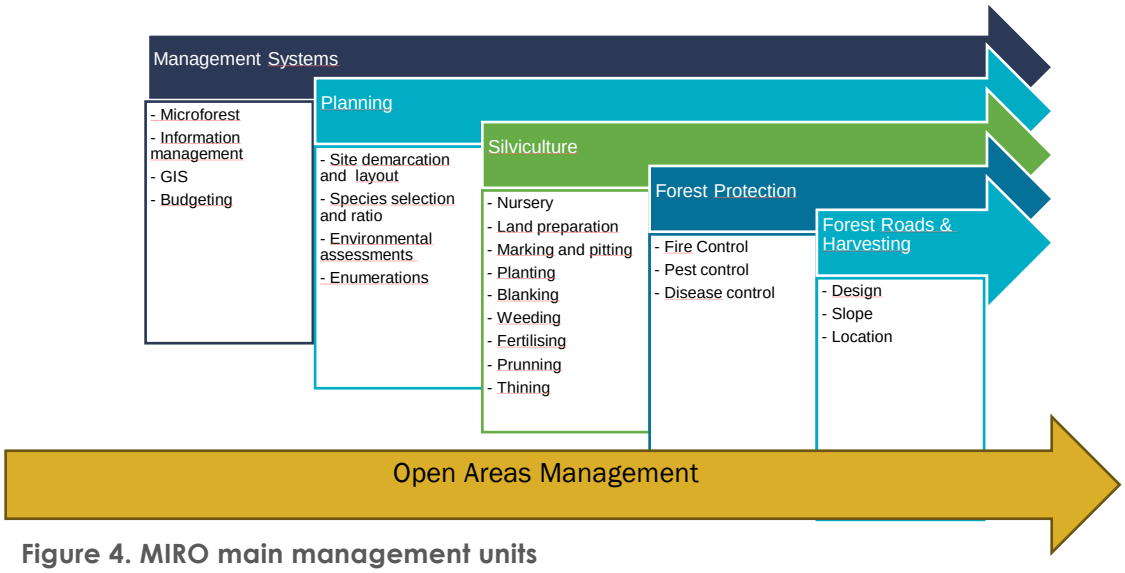

Figure 4. MIRO main management units

- **Management Systems**: One of the objectives of Miro Forestry is to guarantee the application and access to information global experiences of forest management. To achieve this, the Company uses a forest management information system called "Microforest". Microforest is a web-based plantation management system that encompasses the entire lifecycle of forestry operations. The system provides access to specialised information and establishes forest support systems that ensure all levels of management can quantify their decisions on reliable data based on plans; strategic plans covering 10 to 20 years, tactical plans (3 to 5 years), and the annual planting operations (APO) which includes monthly and daily financial and operative controls.

This software has been developed specifically for the forestry industry and has two main characteristics that make it unique for project management. Firstly, it is an integrated system of plantation management and natural resources that covers the entire life cycle of forest operations and includes modules that manage inventory, modelling, planning, scheduling, operations, and logistics (budgets). Secondly, it has a Geographic Information System (GIS) that provides the user with all the necessary attributed data in a map format, which allows permanent planning and efficient control.

Microforest consists of two main modules; the first is the Plantation Manager module, which allows the management of all forest issues related to the compartments (minor management unit). From this set of data, the requirements for the strategic plan and the different tactical plans can be developed. The second module that connects directly with the Manager of the Plantation is the Business Suite module, which provides the annual planting operations (APO), it allows the day-to-day management controls associated with the different activities and the related financial and reporting controls to the budget plan.

All the permissions and management of the information are divided into three levels: macro users, super-users, and users. Depending on the level of responsibility, as well as information management permits, a company personnel is assigned to a level.

The Company also uses Dropbox similar to an information management tool to store and share all company files with the support of online service providers to prevent the loss of information. The Miro Management System (MMS)7 is to be used purely for working documents, and the place to find Policies, Best Operating Procedures (BOP's), templates and checklists.

- **Planning:** The planning is divided in four areas, land mapping and planning, management of natural areas and conservation areas and management of commercial areas. For the first one, Miro Forestry assesses the terrain and examines the basic structure of soils and grass vegetation. Special consideration is given to important land planning issues such as land slope, water bodies, identification of any cultural sites, identification of riparian strips and sites for conservation protection, the existence of agricultural farms, condition of old logging roads, and wildlife habitats. Miro Forestry is currently using satellite images to identify and describe land and vegetation with regards to mapping exercises to be carried out in some areas. This information will enable Miro Forestry to identify areas for conservation, boundary verification, silvicultural planning, assist in the site and species matching, and to plan the best possible options for achieving a balance between land use, sustainable forest practices and care for the environment.

Regarding natural areas, environmentally sensitive and conservation areas are identified during the planning phase of operations and designated as conservation zones which are protected to encourage natural regeneration. It is the Company's policy to enable natural recovery and succession of conservation zones, and as such the primary management activity is to protect these areas, removing alien invasive exotics.

Conservation areas are delineated using GPS coordinates. Currently vegetation classification is done, wherever possible allowing this current vegetation to recover and climax. Only if it is the opinion of biodiversity experts will an alternative vegetation class be set as the desired vegetation class. At the time of land acquisition, a mini governance study is done and part of this includes a Rapid Environment Assessment (REA) to identify any potential sensitive areas and areas of degradation that will require remediation work.

[7] MMS File Structure, Responsibility and Naming Policy

Thirdly, for the conservation areas, prior to the plantation, are identified rivers, wetlands and stream banks with a 30 m buffer zones. In the same line corridors for fauna movement for conserving any existing biodiversity and wildlife. In addition, representative samples of natural vegetation are preserved, including grassland, shrubland and rocky outcrops. Additional sites may be identified as plantation expansion continues.

Based on the desired vegetation classification and status, management plans will be developed annually to remove alien invasive species depending on the infestation levels identified in the Microforest weed management module. This module facilitates the identification of current infestation levels and plans to ensure that these areas are returned to maintenance level.

All conservation zones are captured in the and Microforest conservation database (Figure 5 and Figure 6).

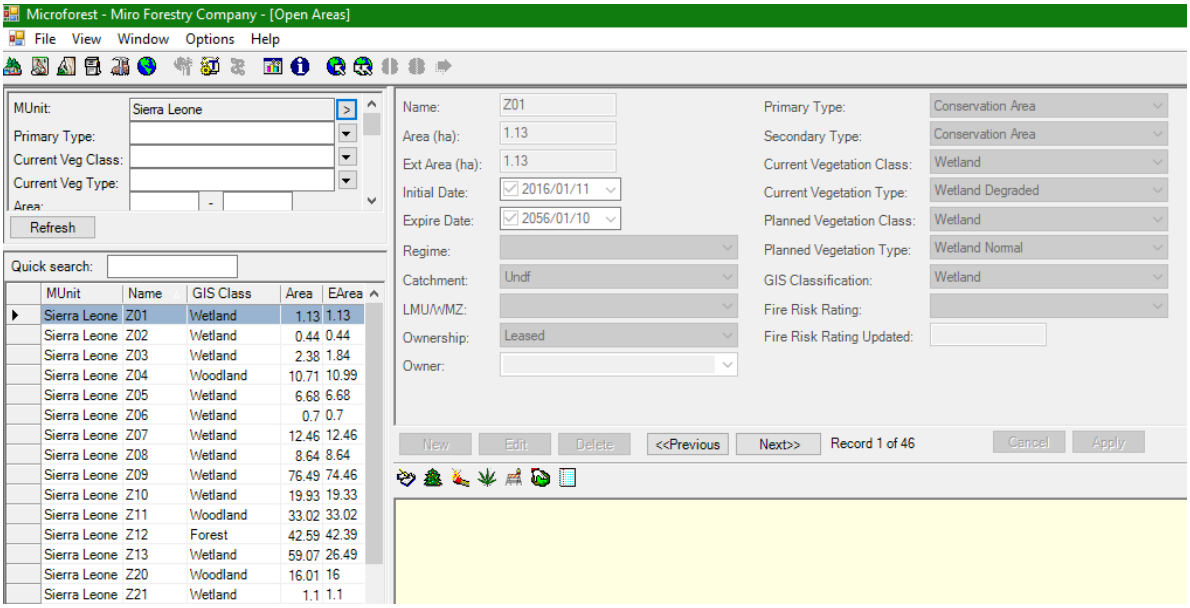

Figure 5. Microforest open areas management

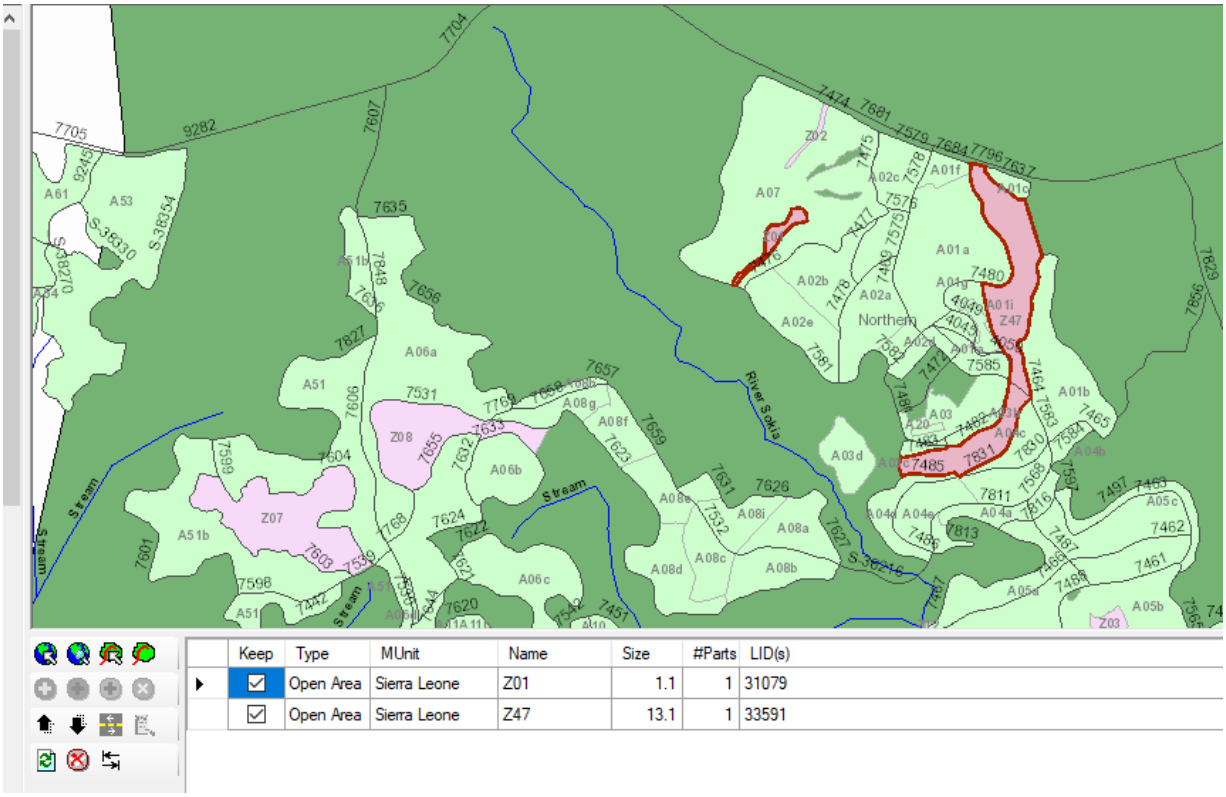

Figure 6. Mapping module from Microforest for open areas management

Finally, for the management of commercial areas, the following elements are considered: Site demarcation and layout, that encompasses the division of compartments (blocks) for the planting area. The planting blocks may comprise one or more annual groups and will be further divided into planting units ("compartments") of approximately 20-30 hectares (ha) each with roads around them. As much as possible the compartments will be based on-site classification informed by topography and soil data, as well as transport logistics.

Miro Forestry assesses the terrain and examines the basic structure of soils and grass vegetation. Special consideration is given to important land planning issues such as land slope, water bodies, identification of any cultural sites, identification of riparian strips and sites for conservation protection, the existence of agricultural farms, condition of old logging roads, and wildlife habitats.

- ***Silviculture:*** *Eucalyptus spp*, *Acacia mangium* and *Gmelina arborea* have been selected as the main species for the project. The company aims to grow high quality trees to produce sawn timber, transmission poles and wood-based panels products. All selected species has several advantages and qualities that make them suitable for the project. Firstly, by its versatility of site and end-product. Eucalyptus It is currently the most used species for producing pulp-wood for the paper industry, the major timber used for transmission poles across the tropics, it is also used for wood based panels including Medium Density Fibre board (MDF), Orientated Strand

Board (OSB), and plywood, all broadly used in construction industry. Additionally, these species can be suitable for a wide range of climatic conditions and soil types.

The silviculture activities include the following:

- Nursery management: The Tree Breeding Centre is the facility where nursery operations takes place. The seeds are nursed in trays which contains insert cups. Cocopeat is used instead of soil. The cocopeat is mixed with slow-release fertilizer and poured in the insert cups. The seeds are sown in the insert cups by means of hand sowing and a sowing machine. The trays with sown seeds are then taken to the greenhouse with shade netting. After germination of the seeds, the seedlings take some time in the greenhouse depending on the species and the growth rate. They are then taken to the hardening off tables before they are taken to the field for planting.
- Planting target: The land that the Company currently has under a lease is approximately 12,000 hectares that means 65% of the total area is suitable as productive areas for planting. As a result, to provide certainty of available land to fulfil the Company's future planting strategy (which requires 20,000 ha), the Company is pursuing opportunities to now secure an additional 10,000-15,000 ha of land. The ratio projected to be planted since 2020 is 1500 ha per year focused on the three main species: Eucalyptus pellita (60%), Gmelina arborea (30%), and Acacia mangium (10%).
- Slash management: Predominantly, the vegetation on the land currently under lease is degraded scrubland with fast-growing elephant grass (Chromolaena odorata), numerous small trees, and shrubs. As part of the land preparation activities, weeds will be controlled by the application of glyphosate as a pre- and post-plant spray application.
- Land preparation: Various mechanical land preparation techniques are employed by the Company including the use of large mechanical chopper-rollers, roam disc harrows, tractor and bulldozer-drawn rippers, ploughs and other land preparation implements. Where the use of such mechanical systems are difficult, manual methods are used, though the result is often a lower quality planting surface with greater weed proliferation still present.
- Planting: Planting is targeted for between April and October annually (funding timing and other constraints permitting) depending on the weather during that period. All planting materials are transported from the nursery using flat-bed trucks and brought to the planting site only on the day of planting to limit the transplantation shock to the plants. The project adopts a general spacing of 2.3 m x 3.6 m for all species. (stocking: 1207 stems per hectare). This activity will be completed by the end of October of each planting year depending on the weather where possible. In the case of eucalyptus, the seedlings are removed from the seedling tray insert and placed upright in the planting hole deep enough to cover the root plug and a short portion of the stem. Soil is then placed around the roots, ensuring that the seedling remains in a vertical position and firmed down using the fingertips. A water-retention gel is then used that will assist the seedling by

providing access to water if there is a break in rainfall during the early days of establishment.

- Survival survey and blanking: Where the planting has been done on schedule between April and October survival surveys are carried out within 2 weeks following planting to determine the need for blanking which, if necessary, is completed within 3 weeks to prevent an uneven stand. Blanking is then carried out where seedling mortality turns out to be more than 10% or concentrated at various spots. A second assessment is carried out in March/April of the following year to determine any casualties following the dry season. In all cases blanking is done using a large healthy nursery stock.
- Weed Control: It should be noted that common weeds grow faster than newly planted trees and unless the weeds are controlled effectively, the plantation investment will suffer seriously (and may even fail completely). Weeding, whether performed manually, mechanically or by hand, can only remove weeds that have germinated – seeds will continue to germinate, and follow-up inspections and weeding will always be required. Weeding must therefore be performed before the weeds are able to seed to be effective.

Manual weed control:

Slashing or Hoeing

Slashing is done either as a full cover operation whereby the entire area is slashed, or a spot operation carried out where the weeds are only high in certain areas such as the inter-row. Slashing is carried out as low to the ground surface as possible to ensure that the frequency of necessary weeding is reduced. Care is taken to ensure that the tops of the trees are not damaged, where appropriate, a spot weeding is undertaken around the tree to ensure that there is a visible gap between the tree and the weeds, thus minimising the damage.

Hoeing on the other hand is undertaken using one of two methods as appropriate:

- Ring hoeing: an area of 50 cm to 1 m in a radius around the tree is hoed and the rest is left, slashed, or sprayed with herbicide.

- Line hoeing: the tree line is hoed, and the inter-row is left, slashed appropriate. Line hoeing on slopes is carried out along the contour to prevent erosion.

Mechanical weed control

Tractors are used where appropriate, towing a disc, slasher or herbicide spraying by wind box. This can be very cost-effective if carried out under the correct conditions – great care is taken to ensure that the conditions are suitable and that there is sufficient inter-row space.

Chemical Weed Control

When necessary chemical weeding is undertaken using glyphosate (herbicide) or other approved herbicides to control any weeds, and when done timely this is the most effective and preferred way of weed control in areas where weeds are faster growing than tree crops. It is good practice to follow up

land preparation for planting with chemical broadcast weed control to create a weed free area when planting. Appropriate measures should be taken to prevent chemicals damaging crops when doing any chemical weeding after planting. An example will be using plastic cones to cover small trees before applying chemicals/herbicides in the proximity of the trees.

Before undertaking chemical weed control any spraying team will be well-trained in the use of the chemical and equipment and provided with personal protection equipment (PPE). A chemical store personnel will also been trained when storing large quantities of chemicals/herbicides.

- Fertilizing: As part of the land preparation activities, a nitrogen, phosphorus, and potassium (NPK) chemical fertiliser and trace element mix fertiliser is applied.
- Pruning: This operation is carried out to provide a knot-free timber from the growing tree. Branches that develop up to, at least, a third of the tree height are removed during the first, second, third, fourth and fifth years of establishment, approximately. Intensive pruning of buds and branches is also undertaken regularly after the first pruning operation. As a cost saving measure this operation is run concurrently with singling, where necessary.

- ***Forest protection:*** Considers fire protection and pest and diseases control. Fire prevention measures require active engagement with the local community. The company is trialing a community cassava fire belt initiative, supporting communities to plant cassava along the firebreaks to encourage maintenance and protection and to reduce incidents of accidental community fires by encouraging ownership and investment into the fire breaks.

Fire risk reduction methods focus on physical methods of preventing fires from occurring or reducing the potential severity of fires. Weed control methods aim not only at preventing competition with young trees but also at reducing the volume of combustible material that builds up beneath the trees. Intensive weed control methods as outlined above are used for both purposes. Fire breaks are a further tool used to reduce the impact of fires and aid in the ability to fight them. Fire breaks at 10 metres wide is created around planting units and serve as access routes within the plantation. Compartment roads, external boundary roads, crest roads, secondary roads and valley bottom cut-off roads serve as fire breaks, and vegetation management (weed control) is done to reduce the risk of fire spread.

Fire preparedness is of high importance during the fire season (December – April). Miro Forestry has acquired equipment to manage fire outbreaks. Three pickups are permanently fitted with high-pressure, low-volume water deployment devices known as “bakkie-sakkies”. Firefighting staff and tools are already in place and fully functional.

Pest and disease control are important in plantation forestry. There tends to be a narrower genetic base in plantation forests as compared to natural forests and increased movement of material, leading to a higher risk from pest and disease transmission.

Pest and disease issues can include fungal, bacterial, and biological pathogens. The impact of pests and disease vary, but can lead to reduced growth rates, reduced yields, lower quality timber and total crop failure – all of which have a significant financial impact.

The Company actively employs a range of preventative and control methods to combat pest and disease. It aims to maintain a diversity of planting stock, to ensure that the genetic base of the plantation is wide and varied. It has a dedicated research and development department that trials new commercial species for deployment, continuously evaluates its planted material, and engages with leading research institutions including the Forestry and Agricultural Biotechnology Institute (FABI) in South Africa, to ensure that it is abreast of the latest information on pests and diseases.

Within the nursery, the Company aims to keep conditions as sanitary as possible to ensure that the planting stock is free of pests and disease. The Company aims to avoid exposing trees to extreme temperature or abnormally high or low levels of water or fertiliser, to eliminate wherever possible unhygienic conditions and weeds, and to remove dead or dying plants regularly. Where necessary, pesticides and fungicides are employed to combat pathogen outbreaks. It is aware that chemical control is mostly unsuccessful unless supported by thorough cultural management strategies and aims to ensure that the Company's staff are aware of the need for plant sanitation throughout all operations.

Harvesting: Contemplates road construction, thinning and final clear-fell.

Road construction is based on the following elements: Road densities in relation to land type, slope, and gradients, avoiding road construction near water bodies, identifying seasonal streams within planting blocks, limiting soil erosion and run off and contamination of water bodies, designing roads to meet planting and future harvesting requirements and limiting noise and dust pollution. To facilitate proper planning and construction of roads and mitigate against some of the possible impacts identified previously, the Company also employed the use of GIS techniques to map its landed areas as well as field surveys to ensure proper slope and gradient alignment of road construction to planting areas.

Thinning and Singling/Stem Reduction

Thinning and singling/stem reduction are undertaken to reduce total stems per hectare. This allows the trees greater space to increase girth and enhance its eventual end timber use and value. Stem reduction is carried out to reduce multiple shoots on the main stem. Multiple stems might develop because of damage to the main stem, or when management decide to grow a crop from live stumps after clear-felling of suitable species (for stem reduction). The shoots of undesirable qualities (the smallest or worst stem form) are removed to maintain stronger and healthier shoots to develop into good pole size or small size timber. The first round of singling is done in the year following the year of planting. A second stem reduction might be required at a later stage to ensure a good stand.

Thinning

Thinning of trees is done to reduce the number of planted stems per hectare to allow the remaining trees more growing space to increase in diameter.

Typically, unwanted trees are marked out by a trained tree marking team to the management prescription, by painting a white mark on one side of a tree. Trees with poor form or size will be marked out before marking the remainder trees.

The number of trees remaining after a thinning varies because of species and product specifications (Table 13).

Marked trees are harvested where suitable markets for these smaller diameter products exist or felled to waste where no such market exists or removed when the tree form is very poor.

Table 13 Thinning regime

Species	Operation	Average age (years)	Stocking before thinning (trees/ha)	Stocking after thinning (trees/ha)
Eucalyptus spp	1st and final thinning	2	1208	800
	Clear-fell	8-10		
Acacia mangium and *Gmelina arborea*	1st thinning	2	1208	800
	2nd thinning	4	800	500
	3rd thinning	6	500	300
	Clear-fell		300	

For performing the abovementioned activities, the company works together with several stakeholders as follows:

Chiefdom Council of each area. For the land lease, the company negotiate with the landholding families and the communities residing on the lands on interest. The process includes village mapping to understand the land uses. The agreement is signed by the regent chief and representatives of the landholding families. In addition, the 95% of the employees are local.

Amalgamated Area Development Committee (AADC), which represents the communities at all levels with issues related to the identification of land for plantation establishment, payments, concerns from the communities and all other matters. Periodic meetings are held between the AADC and the management of MFSL. AADC is made up of representatives from all the various communities within the lease area[8]

National authorities such as Environmental Protection Agency (EPA), the competent authority that considers and decides the application for an Environmental and Social Impact Assessment License. In the same line, the Ministries of Agriculture, Forestry and Food Security, Lands Country Planning and Environment and Water resources are considered, as mentioned in the section 1.14Compliance with Laws, Statutes and Other Regulatory Frameworks

[8] Supports/1_PDD/PO_Information/Procedures/Social/ MFC Land Development – Policy, Implementation Framework

As a final comment, it is important to point out that Miro Forestry is not located within a jurisdiction covered by a jurisdictional REDD+ program[9].

1.12 Project Location

The project plantations are located in the Yoni and Masimera Chiefdoms within the Tonkolili and Port Loko Districts, in the Northern District of Sierra Leone (Figure 7). The Company's current landholding is 26,897 ha. The landholding is located between latitudes 8.31 and 8.51, and longitudes -12.18 and -12.35 and is located adjacent to the main highway heading east from Freetown and Port Loko into the provinces. This road network provides access to Freetown and the major port sites of Sierra Leone. The plantation is nearest to Yonibana a small town, nearly 91 miles from Freetown.

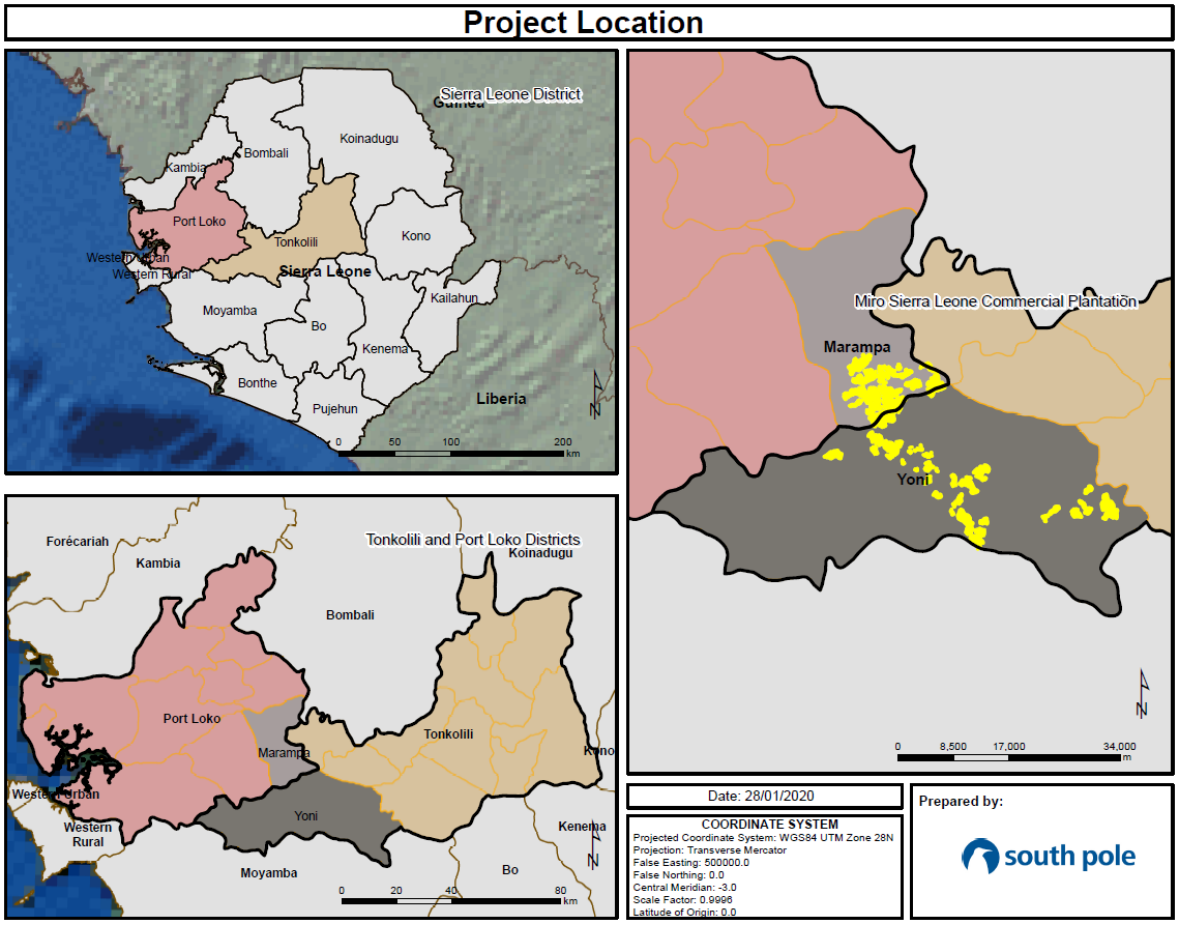

Figure 7. Project Location in Sierra Leonne, and the location of the plantations (yellow polygons).

[9] South Pole research under the verification standards database

Tonkolili District is referred to as the midpoint District of Sierra Leone because of its central location in the middle of the country, bordering 6 out of 11 other districts that constitute the country. In the north, it is bordered by the northern region Districts of Bombali and Koinadugu; in the east, by the eastern region District of Kono; in the south east by the eastern region District of Kenema and southern region District of Bo; in the south by southern region District of Moyamba and in the west by the north western region District of Port Loko.

According to the new (2017) re-districting and re-regionalisation, Tonkolili District lies in the Northern region of Sierra Leone and Port Loko District lies in the north western region.

In 2011 the Company signed a land lease for 20,980 ha, split into Yoni Block A and Block B (Figure 8), leased from the traditional landholders and ratified by the Government. In 2017 3,137 ha of forest management within this land lease area were certified by the FSC with certification number C135138. In 2018 a further 1,800 ha were leased in the Masimera Chiefdom, this area is known as the Masimera plantation.

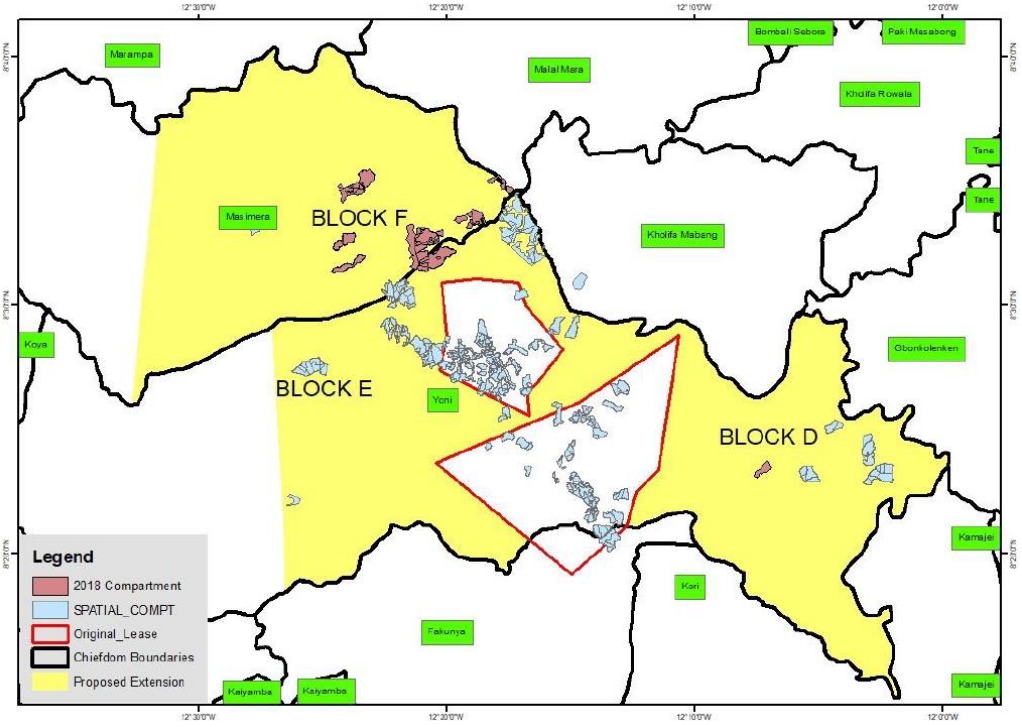

Figure 8. Project Area: First Leasing block A (north), block B (south) and Blocks D, E, F for leases after 2011. Source: ESIA 2018[10]

All the properties leased are distributed across different communities, divided by the Chiefdom as follows (Table 14):

[10] Supports/1_PDD/PO_Information/ESIA/MFSL ESIA for Miro New Leases – GeoData 02082018

Table 14 Communities present in the project area

Yoni Chiefdom	Massimera Chiefdom
Royanka	Mayolla
Ronolla	Yanabay
Kulkoss	Kombabonk
Mamorka	Rosint Lol
Masecheleh	Marainday
Bongababay	Rosar
Kethibio	Robaylla
Masegkra	Mathorthe
Patisu	Makuserry
Malosie	Masimera
Makomgba	Chai-Turay
Rothongbai	Mabilabana
Masangba	-
Matetie	-
Makessie	-
Patfumayagbo	-
Mafala	-
Manjehun	-
Mabilla Banna	-
Rogbogban	-
Masanki	-
Robisbana	-
Mashenkra	-
Mayira	-
Maranda	-

1.13 Conditions Prior to Project Initiation

All the descriptions of the climate, topography, hydrology, soils, ecosystems and biodiversity, vegetation and fauna, have been extracted from the Forestry Management Plan (FMP)[11] for the project:

Climate

The project is located within an area that has a humid tropical climate, with two rain regimes: the wet season from May to November and is related to the tropical maritime monsoon, that flows from southwest to northeast; and the dry season which ranges from December to April and is associated with the dry Harmattan winds that blows from the Sahara region[12]. The mean yearly rainfall for the

[11] Supports/1.PDD/PO Information/MFSL Forestry Mgt Plan V8 FINAL 2019

[12] https://www.globalsecurity.org/military/world/africa/sl-climate.htm

country is over 2500 mm. Rainfall is unevenly distributed within the year as shown in Figure 9, which means high water stress for the plants and the crops during the first five months of the year, while from June to November the high volumes of rain could cause an erosion hazard, especially on increased slopes.

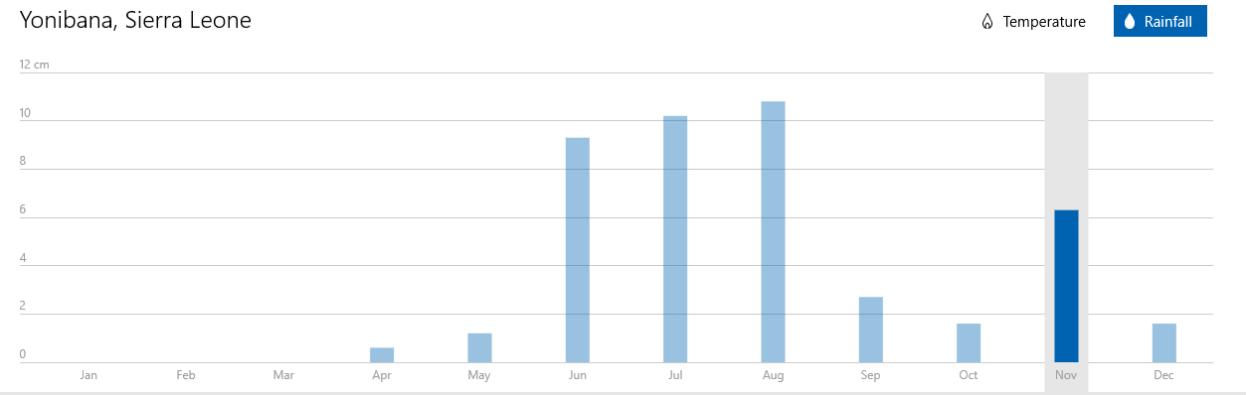

Figure 9 Average annual rainfall for Yonibana, Sierra Leone. Average from 30 years (Source: FMP Miro Forestry)

The mean daily minimum and maximum temperature ranges are fairly constant throughout the year ranging from 22°C to 31°C, and a mean annual temperature is 27°C (Figure 10). Humidity is also high all year round.

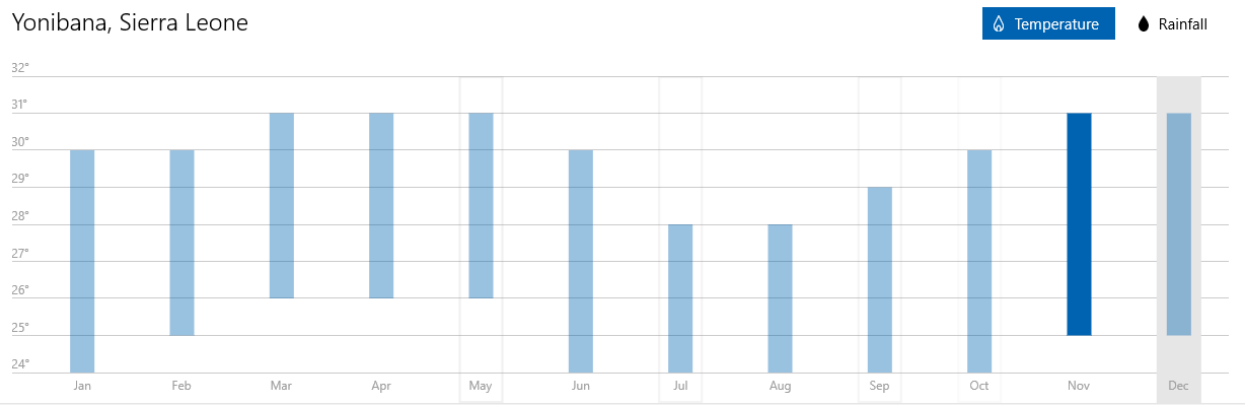

Figure 10. Annual Temperature ranges for Yonibana Sierra Leone (Source: FMP Miro Forestry)

Hydrology:

The project is located within an area crossed by several streams and rivers. The main river is the Gbangbaia river (Figure 11) in the limits between the northern and the southern province, in the Mabinti region.

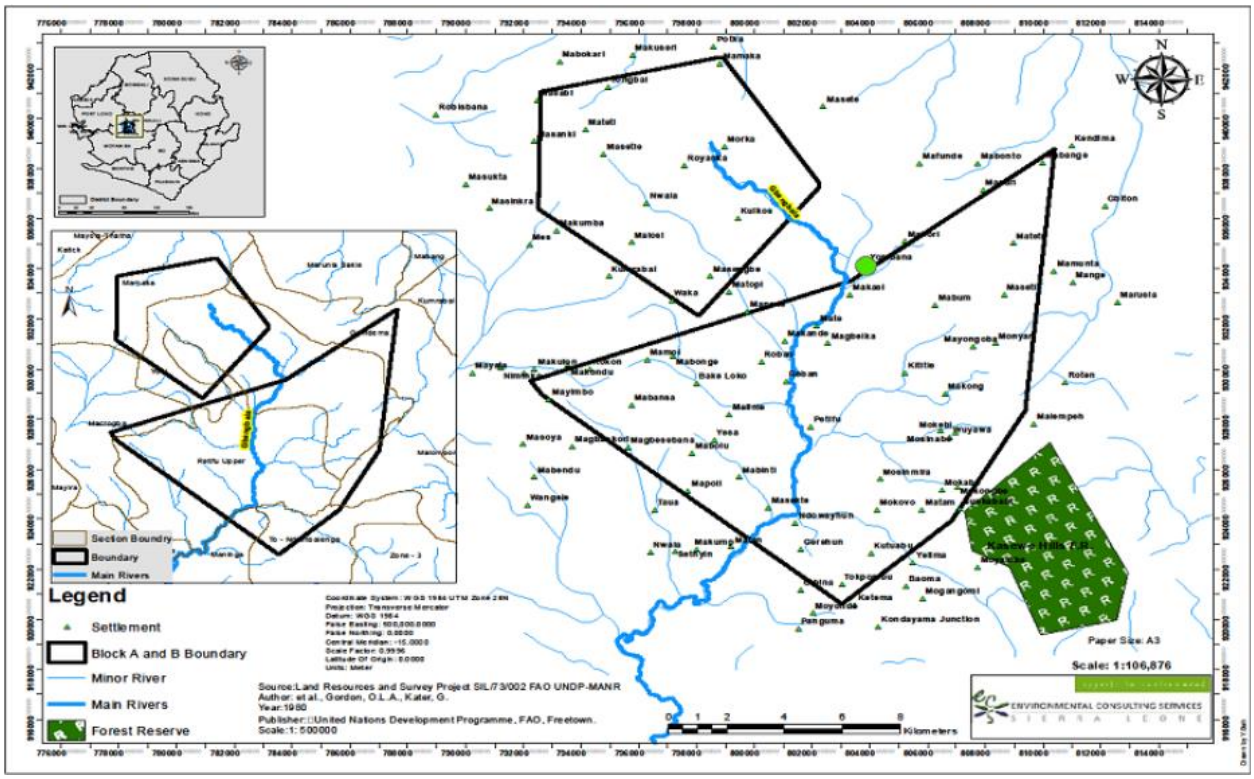

Figure 11. River Gbangbaia, and tributary rivers. Source: FMP Miro Forestry

Figure 12 shows the water level variation between 2002 and 2016.

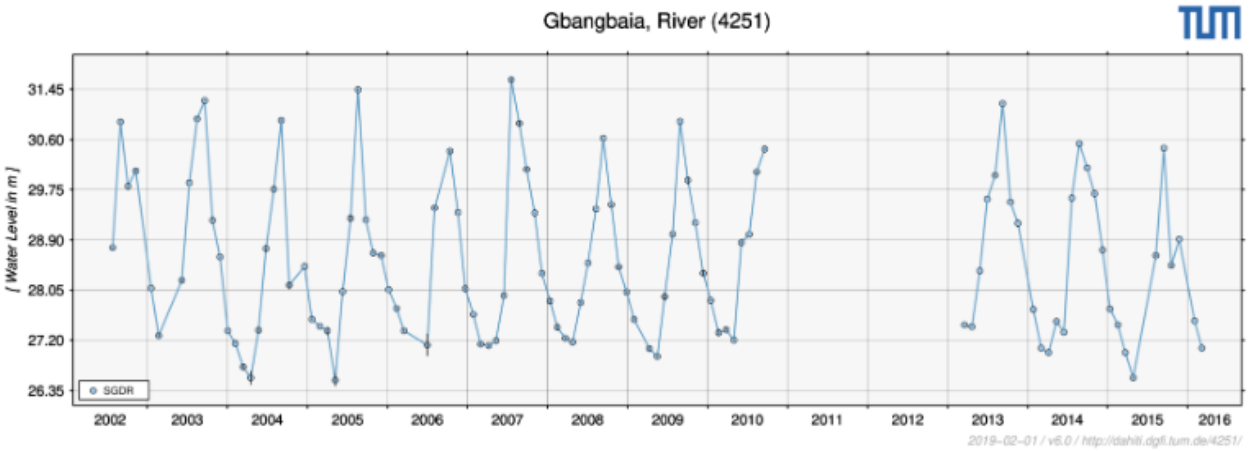

Figure 12. Water level variation 2002-2016

(Source: https://dahiti.dgfi.tum.de/en/4251/water_level/)

Topography

The project area is in the Leonean geological formation, which consists of a series of high-grade basic granulites flanked by amphibolites, with local Rokel river group, with some deposits of alluvium and colluvium in wetlands and valleys. The bedrock consists of fresh and weathered coarse-grained magnetised granites that are overlain by different types of alluvial deposits mainly gravel and sand. The

soils are dominated by sandy and clayey sediments of the Marampa upper group, with some deposits of alluvium and colluvium in valley/swamp areas.

Three topographic zones occur within the study area. 1) Gentle slopes of 1% to 5%, with elevations from 0 m MASL at the Rokel River, to 20 m MASL in the north. In this topographic zone, extensive wetlands occur which are saline in places. 2) Strong slopes from 2% to 15% at elevations from 20 m to 600 m, where numerous perennial and ephemeral channels occur, segmenting this area into many micro catchments. 3) Steep to very steep slopes of more than 30% occur at 40 m to 320 m altitude. This mountainous region runs in the north west to southeast direction and splits the area into two major catchments draining towards the Rokel River.

Soils

Sierra Leone has been grouped into 12 soil associations by the Land and Water Development Division (LWDD). Most soils in Sierra Leone are acidic tropical soils (pH 4-5), ferralitic and excessively leached as a result of the humid tropical conditions.

The project area is underlain by the quaternary and tertiary, recent marine alluvial sediments (Figure 13). The derived soils are sandy, occupying the lower elevations near and adjacent to the wetland areas. The clayey varieties occur on elevated sites. Soils are typically deep and dark in hue, with some red variants. These Ferralsols and Cambisols present favourable sites for agriculture. As some of these sediments are associated with concave and low-lying areas, some sites are commonly associated with wetlands and scarce drainages.

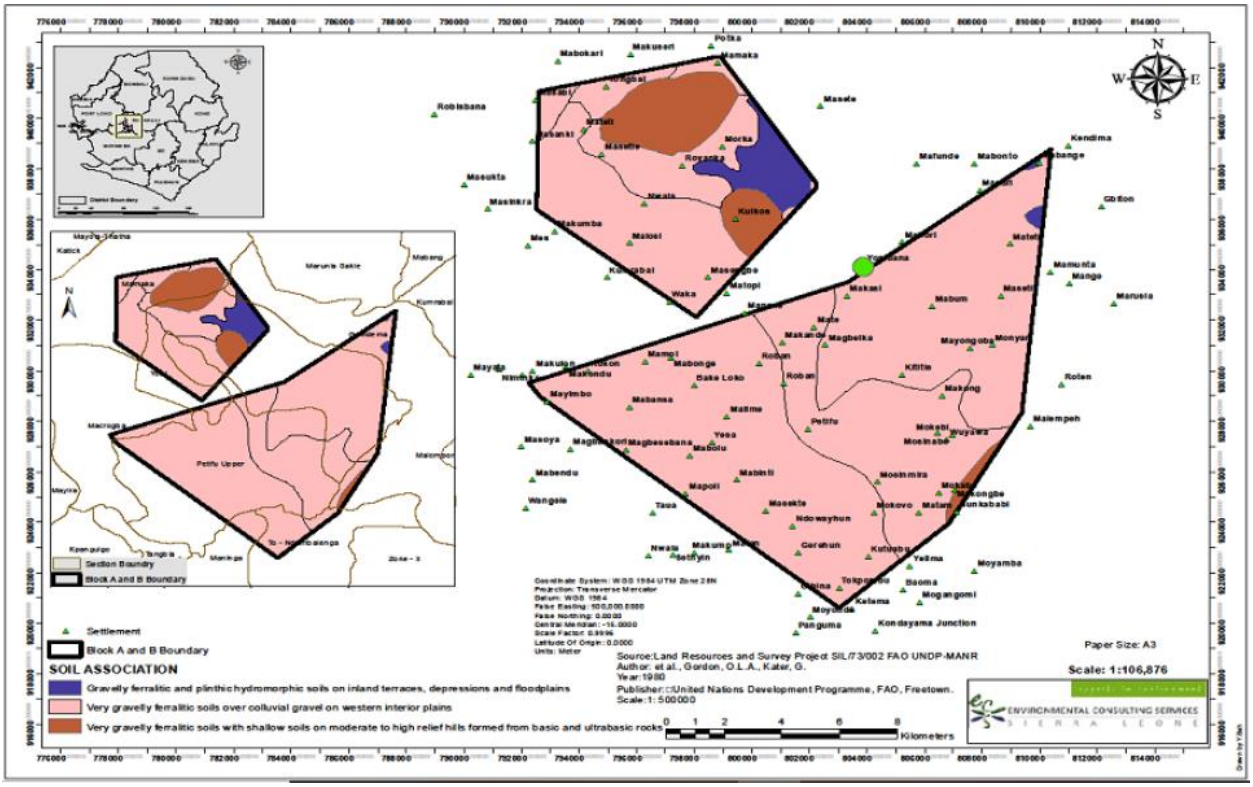

Figure 13. Soil associations in the project area (Source: FMP Miro Forestry)

Ecosystems and Biodiversity

The project area has limited tree cover. The rest of the area is dominated by wetlands and 'farm bush'. Charcoal and slash production, and burn agriculture are still very common in the area.

Areas that would most likely have supported forest vegetation are now mosaics of forest patches, farmland, and wooded grassland, with low potential for natural regeneration due to changed species composition with few exceptions being abundant, such as grass or fire-resistant trees.

These landscapes are classified as degraded forest (savanna mosaic). There is an important negative human impact on wildlife and flora, with the extraction of high valued timber species, unsustainable hunting of wildlife and conversion of forests to other land uses. The protection and connectivity of remaining high forest patches, including gallery forests along streams are crucial for the survival of forest-related and often endemic flora and fauna in the region.

Vegetation

The high seasonal rain in the project area (June-December), favours the dominance of elephant grass (*Andropogon gayanus*) within the project site. There are also patches of native palm trees scattered across the landscape, interspersed with savanna bushes, shrubs, and herbaceous species. In the following figure (Taken from the Environmental Impact Study conducted in 2016), it can be appreciated the characteristics of such grass (Figure 14):

Figure 14. Elephant grass and oil palm prior to the plantation's establishment.

Such type of grassland is likely the result of frequent cultivations and fires.

Regarding other type of vegetation present in the project area, a total of 226 plant species belonging to 71 families were recorded. The most common family in the project area is Rubiaceae with 81 species.

Land uses in the project area are presented in Figure 15.

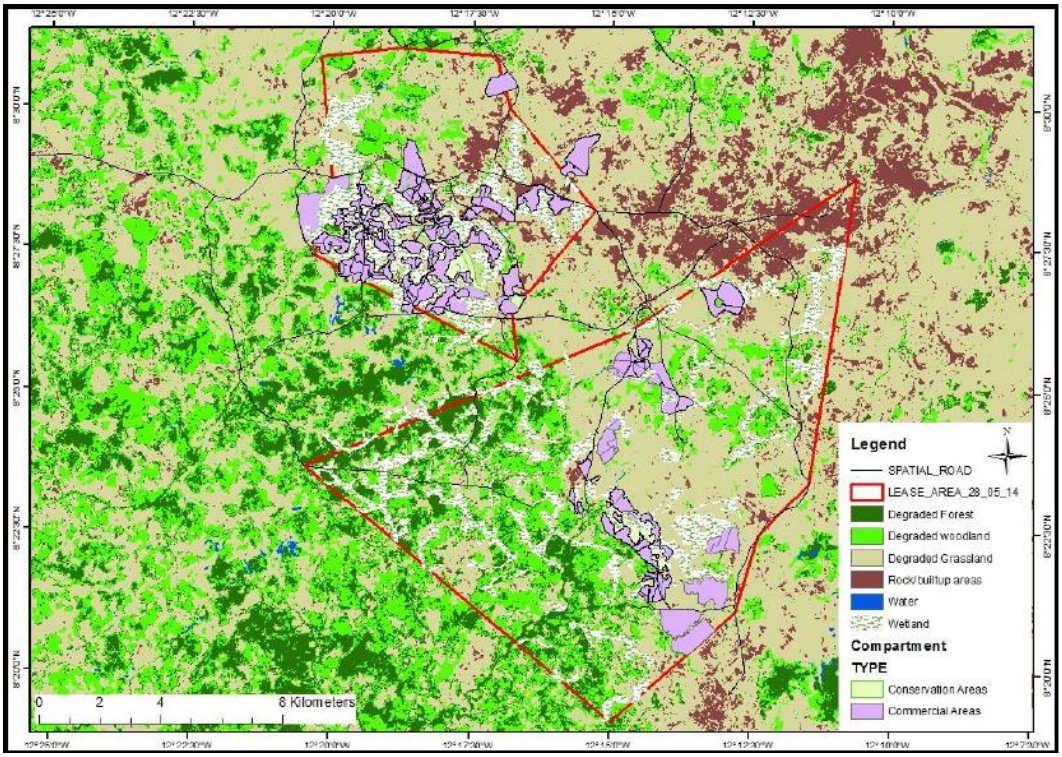

Figure 15. Land use in the project area, with commercial and conservation areas (Source: FMP Miro Forestry)

Fauna

Although birds are seen in flocks of large numbers, initial studies show a very limited occurrence of mammals. This absence of mammals must be connected to the fact that the endangered and threatened species move away from noisy and busy areas (i.e. heavy vehicular and human movements). Interviews with local hunters confirmed that mammals, amphibians, reptiles, and birds, prefer habitats apart from human settlements. The most common species are small animals such as squirrels, antelopes, monkeys, and porcupines.

A total of 108 bird species were recorded during the entire study. Out of these, one is of global conservation concern[13]: Classified as Vulnerable (Rufous Fishing Owl - *Scotopelia ussheri*). The high diversity found in the project area (16 communities) is impressive and represents 16.27% of the species documented in the whole country. One documented species (Lemon dove - *Aplopelia larvata*) needs further confirmation since it is the first time it has been documented in Sierra Leone. Another striking species that needs a deeper study is (Abyssinian Ground Hornbill - *Bucorvus abyssinicus*), which has been reported by the locals to be common in the area. The Crested Malimbe (*Malimbus malimbus*) is also recorded in this study and implies an increase in the spatial distribution of this species, which was limited to the south eastern and western part of the country.

[13] http://datazone.birdlife.org/species/search

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

Current Forest plantation Policy and Legal Framework in Sierra Leone

Miro Forestry Sierra Leone's project (MFSL) is subject to a range of statutory, environmental, and social legislation in Sierra Leone, that varies from the local to the national government (Table 15). The Company will comply with the Forest Stewardship Council (FSC) Principles and Criteria.

Table 15. Legal Framework in Sierra Leone

Law, Statute, Framework	Description
The National Lands Policy (NLP), 2016	The National Lands Policy approved by Cabinet in November 2016 manifests the aspiration of Government's efforts to address the major issues related to land management and administration in Sierra Leone. The aspiration of this policy is to move towards a clearer, more effective and just land tenure system that shall provide for social and public demands, stimulate responsible investment and form a basis for the nation's continued development. Specifically, it enunciates Policy Statements in respect of the key components of the National Land Policy such as access to land and tenure, land use, regulation and the management of special land issues, land administration structures, land laws and the Constitution. The vision for the Sierra Leone Land Policy is to have an effective land tenure and management system that will provide for clearly defined ownership forms and rights, tenure security, effective and transparent land administration, and, foremost, ensure equitable access to land for all citizens and stimulate responsible investment for the nation's continued development.
Forestry Act: 1988, and the requirements for a forest plantation	Most of the land, farm bush, primary and secondary forest within the Yoni Chiefdom that have been utilised by Miro Forestry Company are likely to be Government-owned. Section 18 of this Act stipulates that: The Chiefdom Council of any chiefdom may conclude an agreement with the Chief Conservator of Forests providing for the constitution as a community forest of any land within the Chiefdom, subject to the approval of the District Forest officer for the district in which the land is situated. Every Agreement under this act shall: Describe the area included in the forest by reference to geographical features, markers, co-ordinates and measurements and indicate the same on a map of suitable scale, which shall be annexed to the agreement; Describe the forest resources and potential of the area; Indicate the purpose of the forest, such as the supply of fuel, building poles, production of commercial timber, protection of soil and water supplies; Contain a detailed inventory of any rights that will be suppressed upon the

Law, Statute, Framework	Description
The National Lands Policy (NLP), 2016	The National Lands Policy approved by Cabinet in November 2016 manifests the aspiration of Government's efforts to address the major issues related to land management and administration in Sierra Leone. The aspiration of this policy is to move towards a clearer, more effective and just land tenure system that shall provide for social and public demands, stimulate responsible investment and form a basis for the nation's continued development. Specifically, it enunciates Policy Statements in respect of the key components of the National Land Policy such as access to land and tenure, land use, regulation and the management of special land issues, land administration structures, land laws and the Constitution. The vision for the Sierra Leone Land Policy is to have an effective land tenure and management system that will provide for clearly defined ownership forms and rights, tenure security, effective and transparent land administration, and, foremost, ensure equitable access to land for all citizens and stimulate responsible investment for the nation's continued development.
	constitution of the forest and provide for adequate compensation for such rights, either in money or through the allocation or equivalent rights in other lands within the Chiefdom; Contain a list of existing rights that will be confirmed by the agreement; and Be valid for such period not exceeding 99 years as it is reasonable in view of the purpose for which the forest is to be constituted. A community forest agreement may be terminated or modified by mutual consent of the Parties. The Chief Conservator of Forests shall agree to the termination or modification of an agreement when the needs of the community require such termination/modification. Before agreeing to the modification or termination of any community forest agreement, the Chief Conservator of Forests shall give such notice as it is reasonably necessary for any person affected to communicate their view on the modification or termination under consideration. The Minister may at any time revoke or modify a notice constituting a community forest in a manner contrary to any agreement under this section regarding such forest. The Minister shall also revoke or modify a notice constituting a community forest as necessary to reflect any medication or termination of an agreement.
The Factories Act, 1974	This Act was signed by the President on the 22nd May 1974 and the date of commencement was on the 30th May 1974. It deals with the health and safety measures as they concern any worker in a place of work that can be

Law, Statute, Framework	Description
The National Lands Policy (NLP), 2016	The National Lands Policy approved by Cabinet in November 2016 manifests the aspiration of Government's efforts to address the major issues related to land management and administration in Sierra Leone. The aspiration of this policy is to move towards a clearer, more effective and just land tenure system that shall provide for social and public demands, stimulate responsible investment and form a basis for the nation's continued development. Specifically, it enunciates Policy Statements in respect of the key components of the National Land Policy such as access to land and tenure, land use, regulation and the management of special land issues, land administration structures, land laws and the Constitution. The vision for the Sierra Leone Land Policy is to have an effective land tenure and management system that will provide for clearly defined ownership forms and rights, tenure security, effective and transparent land administration, and, foremost, ensure equitable access to land for all citizens and stimulate responsible investment for the nation's continued development.
	considered as a factory. The interpretation of a "factory" in Part 11, Section 3 as any premise where persons are employed in manual labour for the purpose of making gains makes it applicable to the operations of Miro Forestry (SL) Limited.
Local Government and Administration, Act 2004	The enactment of the Local Government Act in 2004, paved the way for the establishment of local government councils that replaced the appointed local councils or management committees, which are accountable and answerable to the local communities. The Local District or Town Council is the highest political authority in the locality with legislative and executive powers, and responsible for promoting the development of the locality and the welfare of the people in the locality with the resources at its disposal (The Local Government Act 2004). The local council is responsible among other things, for the mobilisation of human and material resources necessary for overall development and welfare of the people in the locality; promoting and supporting productive activity and social development; initiating and maintaining programs for the development of basic infrastructure and provide works and services; initiate, draw up and execute development plans for the locality; oversee Chiefdom Councils in the performance of functions delegated to them by the local councils; determine the rates of local taxes and approved the annual budgets of Chiefdom Councils and oversees the implementation of such budgets. The local council is also responsible for the formation of committees.

Law, Statute, Framework	Description
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	The Chairman is elected by universal consensus for a four-year term. The Vice-Chairman, who is elected by the elected Councillors assists the Chairman. In addition, there is a Chief Administrator, who is appointed by the local council. He/she leads the administration and is the Secretary to the local council. The local councils are made up of several Wards. Each ward establishes a Ward Committee, which consists of every Councillor, the Paramount Chief of the Chiefdom and no more than ten others, at least five of whom shall be women, residents in the ward, and elected by the ward residents. The Ward Committee is responsible for mobilising residents of the ward for the implementation of the self-help and development projects; provide focal point for the discussion of local problems and needs, and take remedial action where necessary; organises communal and voluntary work; make proposals to the local council for the levying and collection of rates for special projects and programs and educate the residents on their rights and obligations in relation to local government and decentralisation.
Chiefdom and Village	Paramount Chiefs constitute an important component of governance. They are elected for life by Chiefdom Councillors, who in turn are elected by residents in each chiefdom. Each of the 149 chiefdoms in Sierra Leone has a Paramount Chief or a Regent Chief who is appointed upon the death of a Paramount Chief until a successor is elected. A Paramount Chief is appointed for general administration, the maintenance of law and order, and the development of their chiefdom. The administration of the

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	Chiefdom occurs through a hierarchical system of traditional authorities under the Paramount Chief. There is a Chiefdom Speaker who assists him and deputises him when he is absent from the Chiefdom. The Chiefdom is divided into sections comprising a number of villages. A Section Chief leads each section while a Town Chief heads each village. The primary tasks of the Chiefdom Structure are for the distribution of land, collection of land taxes, and the settlement of disputes. The Paramount Chief works with a Chiefdom Committee, the council of elders, and the Native Administration. The local government powers relate to raising and disbursing of funds. The Ministry of Local Government and Rural Development in consultation with the respective Paramount Chiefs appoint local court chairmen in the 149 chiefdoms in the country. The local court buildings are known as court barriers. There are 287 court barriers throughout the country. The Native Administration utilises the services of the Chiefdom Police and has "locks ups" for law enforcement purposes.
The Environment Protection Agency Act – 2008 and its Amendment in 2010.	This Act which was signed as a legal document in September 2008 and amended in July 2010 established by the Environmental Protection Agency (EPA). Following the enactment of this Act, a National Environment Protection Board was established within the EPA. The Board facilitates coordination, cooperation, and collaboration among Government Ministries, local authorities and other governmental agencies, in all areas relating to environmental protection. The Department, subject to the Act,

Law, Statute, Framework	Description
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	also coordinates environmentally related activities and acts as the focal point of national and international environmental matters, relating to Sierra Leone. Under the EPA, the introduction of any internationally banned chemicals or substances into Sierra Leone is prohibited, as well as the discharge of any hazardous and toxic substances into the air, soil, land, and water. Failure to comply with this regulation is an offense, and the defaulting company or NGO is liable on conviction, to a fine not exceeding Le2,000,000 or a term of imprisonment not exceeding two years, or both, fine and imprisonment. The EPA also defines clear rules for projects requiring an Environmental and Social Impact Assessment (ESIA). The ESIA must be presented as a report submitted to the Executive Chairman of the Department. All mining companies, INGOs, NGOs or project developers, are required to carry out an ESIA, which must be approved before the beginning of any operations. The Board may also disapprove of an ESIA license if it envisages that the Company's or NGOs activities would have a significant adverse effect on the environment and the communities.
The Forestry Regulations-1989	These regulations are deemed to have come into force on the 1st July 1990. The chief conservator holds the same responsibilities as he does for the Act of 1988 being the head of the Forestry Division. Generally, community forests are managed by the Forestry Division or by agreement with the Division; it could be managed by the local government, or Community Forest Association. Based on this responsibility of the

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	Division, no protected forest shall be tampered with in any way as is stated in Section 21, subsection 2 of the Forestry Act-1988 (REF), without written permission from the Chief Conservator of the Forest. In Section 15 of the Forestry Regulations 1989, subsection 1, it is stated that a license may be issued by an inspector of the Forestry division to clear land in a classified forest. However, having acquired this license, deforestation of, or vegetation removal from the environment, can only be affected under certain conditions. These conditions are found under Section 15, subsection 3, and are highlighted below: Removal of vegetation can be done for the land preparation for the nursery and planting of crops for only within an area licensed for this purpose The specified land areas shall be cleared within a stated time, but trees requested not to be felled, removed or damaged, are to be left standing. Trees to be felled shall be identified, except where total felling is authorised A forest severance fee and a minor forest produce fee shall be paid in respect for all forest produced that is merchantable, which may be removed by clearance of vegetation. At the closure of the project, the area shall be replanted with approved crops or trees by the Company, or provision made for this to be done by payment of the estimated reforestation cost. The required method of cultivation and silviculture specified by the chief conservator must be employed.

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	As a method of environmental protection, it is stated in Section 38, Part XI, that no land between the high and low watermarks, nor those above the high-water mark on both sides of the bank of any waterway, covering a distance of one hundred feet (approx. 33 m), shall be cleared of any vegetation except permitted by the local authority. Sacred bushes are protected by the stipulated regulations of Section 40, whereby clearance of vegetation from land designated as a sacred bush, is prohibited except by clearance authority from the chief conservator.
The National Protected Area Authority (NPAA) and Conservation Trust Fund (CTF) Act, 2012	In Part 111, Section 12 (2), of the Act, it states that the Authority, without prejudice to the generality of subsection 1 has responsibility to (a) ensure the protection of natural ecosystems and threatened biodiversity in Sierra Leone including the establishment and maintenance of representative and sustainable samples; (b) oversee the management of local and private nature reserves and sanctuary throughout Sierra Leone including zoos and wildlife, rescue and rehabilitation centres; (c) supervise the management of wildlife outside conservation areas; (d) regulate wildlife conservation and management throughout Sierra Leone in accordance with the Wildlife Conservation Act, 1972 (Act No. 27, 1972); (g) develop and implement wildlife conservation education programs throughout Sierra Leone; (h) promote biodiversity research; (n) prepare detailed inventory and mapping of fauna and flora; (o) establish a detailed biodiversity monitoring program including a GIS unit that would store and disseminate data on the status of biodiversity in Sierra Leone; (p) carry out other functions and programs

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	as may be necessary for the attainment of the objects for the Authority including- (iii) development of national biodiversity and conservation policies in line with international best practices; (iv) preparation of national strategic action plans for the conservation of key biodiversity species such as Pygmy Hippopotamus; (viii) overseeing the implementation of CITES; (xi) promoting policies for enabling by local forest edge communities to participate and co-manage national resources inside and outside National Protected Area.
The National Lands Policy (NLP), 2016	The National Lands Policy approved by Cabinet in November 2016 manifests the aspiration of Government's efforts to address the major issues related to land management and administration in Sierra Leone. The aspiration of this policy is to move towards a clearer, more effective and just land tenure system that shall provide for social and public demands, stimulate responsible investment and form a basis for the nation's continued development. Specifically, it enunciates Policy Statements in respect of the key components of the National Land Policy such as access to land and tenure, land use, regulation and the management of special land issues, land administration structures, land laws and the Constitution. The vision for the Sierra Leone Land Policy is to have an effective land tenure and management system that will provide for clearly defined ownership forms and rights, tenure security, effective and transparent land administration, and, foremost, ensure equitable access to land for all

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	citizens and stimulate responsible investment for the nation's continued development.
Ministry of Agriculture, Forestry and Food Security	This Ministry is mandated to preserve, conserve, and manage the commercial exploitation in order to guard the most sustainable and permanent regenerating forest reserve. It is responsible for issuing licenses to exploit and maintain all forest types including mangroves, on public lands, and to monitor their harvesting so that they are sustainable and ecologically stable.
The Ministry of Lands Country Planning and Environment	The Ministry of Lands Country Planning and Environment has the right to issue state lands for development purposes. In regards to development activities, this aspect has been removed from the lands ministry to the local council administration with technical advice from the lands ministry as and when necessary.
Ministry of Water Resources	The Ministry of Water Resources is responsible for coordinating the activities of the water distribution subsectors, as well as the development of water supply and the generation of water. It is expected to develop the water resources and enhance current production to meet and satisfy the needs of the country as well as provide adequate water supply to the nation. It enhances the improvement of water supply and delivery facilities and the maintenance of existing ones.

Law, Statute, Framework	Description
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International Agreements to which Sierra Leone is a signatory	The Stockholm Convention on Persistent Organic Pollutants Convention on Biological Diversity (CBD) Convention of the International Trade of Endangered Species-(CITES)

1.15 Participation under Other GHG Programs

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

The project is not registered and does not intend to register under other GHG programs.

1.15.2 Projects Rejected by Other GHG Programs

The project has not been rejected by other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project is not registered and does not intend to register under other Emissions Trading Programs.

1.16.2 Other Forms of Environmental Credit

The project is not registered and does not intend to register under other Forms of Environmental Credit.

1.17 Additional Information Relevant to the Project

Leakage Management

Leakage is not expected to occur in the project area due to the project activities, so it is deemed to be zero. The plantation is being established in non-forest areas, as explained in the eligibility section. The project is being established primarily in non-used grassland areas, therefore all agricultural areas and other importance areas are excluded from the land lease agreements. The exclusion of the agricultural lands is indicated in the eligibility shapefile. As a conclusion, no leakage is expected since agricultural land is excluded.

There was no cattle present in the project area and no grazing activities prior to the project activities as stated in the Environmental and Social Impact Assessment Report (ESIA) [14]. Consequently, there is no displacement of grazing activities.

Commercially Sensitive Information

This Project Description Document does not contain any commercially sensitive information.

Sustainable Development

Sierra Leone developed "The Agenda for Prosperity – Road to middle income status"[15] in 2013. This is framed in Sierra Leone's Vision for 2013-2035 to become a middle-income country. This agenda states eight pillars to achieve that vision. Those pillars are economic diversification to promote inclusive growth, managing natural resources, accelerating human development, international competitiveness, labour and employment, strengthen social protection systems, governance and public sector reform, and gender quality and women's empowerment.

The Company works under all the applicable regulations within the country, complies with high environmental and social international standards such as FSC, and works with international partners such as Finnfund[16], that only invests in sustainable and responsible businesses.

MFSL aims to have a substantial economic impact in the areas it has operations in through employment, community development and local procurement of supplies, and infrastructure. The impact of its operation contributes to generate achievements in almost all pillars set by the Government:

- Economic diversification to promote inclusive growth and international competitiveness: The economy of the country has historically relied on mineral exploitation. The MFSL project promotes forestry plantation that will supply domestic and international markets, generating incomes for the country.

[14] Supports/PDD/PO Information/ESIA

[15] http://www.sierra-leone.org/Agenda%204%20Prosperity.pdf

[16] https://www.finnfund.fi/en/investing/investments/miro-forestry-ghana-sierra-leone/

- Managing natural resources: Areas of special interest are identified and managed according to special procedures. A natural resources manual, that applies to all forest land not currently planted to commercial species, and includes natural habitats, special conservation sites, maintained areas, riparian zones and wetlands, wildlife, cultural, sites, and ecological processes. The objective of this document[17] is "to optimise land dedicated to Special Management Zones (SMZs) through effective planning in such a way that operations are done safely and do not cause land degradation, affect the productivity of management, and mitigate the impacts of these operations on the aspects of the environment".

  The Company also has an Environment and Conservation Manual[18], developed for the management and monitoring of high conservation values on Company land, either owned or leased. This procedure includes the compliance on national laws and codes that apply and where there is no existence of such laws, the ILO[19] – Code on Safety and Health in Forestry" and IFC[20] Standards.

  Above all, the Company operates under all national regulation regarding environment and management, as evidence the Company performed an Environmental and Social Impact Assessment[21] fulfilling the requirements of the Government for its forestry plantation project and obtaining the Environmental Impact Assessment License[22].

- Accelerating human development and strengthen social protection systems: MFSL has a Policy of Corporate Social Responsibility[23] (CSR) that focuses on education and skills development, including forestry and agricultural training (scholarships), support educational and agricultural infrastructure, improved access to water, healthcare awareness, access to microfinance and livelihood projects and improved charcoal making, alternative energy and clean cook stove initiatives. Along with this policy, there is a budget for related projects.
- Labour and employment: The Company trains its workers on compliance with all national regulations, implements periodical trainings, and has several procedures that aims for labour and employment safety such as: driver rules, Ebola action plan, health and awareness campaign, snakebite identification, emergency plan. Such documents are provided in the supporting information folder[24,25].

[17] Supports/1_ PDD/PO_Information/Procedures/Conservation/Conservation Management Prescription

[18] Supports/1_PDD/PO_Information/Procedures/Conservation/High_Conservation_Value/Prescription/2016-09-21 HCV Assessment and Management Prescription

[19] International Labour Organization

[20] International Finance Corporation

[21] Supports/1_PDD/PO_Information/ESIA/MFSL ESIA FINAL Report (2014)

[22] Supports/1_PDD/PO_Information/ESIA /MFSL EPA Permit

[23] Supports/1_PDD/PO_Information/Procedures/Social/MFD CSR Overview and Principles (2016.08.24)

[24] Supports/1_PDD/PO_Information/Procedures/Health and Safety/

[25] Supports/1_PDD/PO_Information/Procedures/HR/

- Gender equality and women's empowerment: MFSL has a Gender Action Plan[26], that identifies a baseline and propose two types of interventions such as a women's mentoring programme and an up-skilling training programme. The desired outcomes are that Miro women apply for a more senior position and a reduction in turnover to improve positive working behaviours.

  Monitoring all of these activities are included in the Annual Monitoring Report[27] of the Company.

Further Information

Not applicable

2 SAFEGUARDS

2.1 No Net Harm

The Company pursues having long-lasting beneficial effects in terms of socially and environmentally through the achievement of the project's goals. To assure a responsible and sustainable forest management standard, the Company obtained an FSC certification[28] in 2017. In the same vein, the Company has identified its environmental and socio-economic impacts through the development of an Environmental and Social Impact Assessment (ESIA), accredited by a local consultant[29] in 2014 and a new study for areas annexed after 2014[30]. In addition, MFSL performed a Need Assessment Survey[31] in 2016, in order to make a sound judgement in the needs of the communities located in the project area.

A detailed description of the identified impacts and its mitigation measures is available in the ESIA.[32]. Below is a summary of the main impacts and the steps taken to mitigate them:

Socio-economic Impacts

The implementation of the project activities, such as road construction and maintenance, facilities construction, plantation, weed control, plantation management and harvest, might generate incidents and accidents to the workers. To prevent and mitigate them, the Company trains its personnel in safety topics and makes annual refresher courses to diminish the potential for accidents. Such courses are developed and implemented by the Safety, Health, Environment and Quality (SHEQ) Officer. The content includes:

- safe job practices and procedures;

[26] Supports/1_PDD/PO_Information/Procedures/Social/MFD Gender Action Plan 2018
[27] Supports/1_PDD/PO_Information/Procedures/Reporting
[28] Supports/1_PDD/PO_Information/FSC
[29] Supports/ 1_PDD/PO_Information/ESIA/MFSL ESIA FINAL Report (2014)
[30] Supports/ 1_PDD/PO_Information/ESIA/MFSL ESIA for Miro New Leases – Geodata020082018
[31] Supports/1_PDD/PO_Information/Procedures/Social/CSR Needs Assessment 2016
[32] Supports/1_PDD/PO_Information/ESIA/MFSL ESIA FINAL Report (2014)

- accident prevention;
- safe lifting practices;
- how to read and understand Material Safety Data Sheets (MSDS);
- safe material and waste handling practices; and
- proper control and maintenance of equipment and waste facilities.

Concerning socio-economic impacts, areas of high and diverse values to the communities such as wetlands, streams, forest and permanent agriculture are usually retained by the communities[33] and excluded from the land lease agreements. That means, the communities keep their resources for crop culture. It is important to point out that land selected for lease to MFSL for plantation establishment by the communities is usually degraded, and mostly comprised by grassland or poor farm bush. Keeping that in mind, most impacts related to displacement of agriculture and livelihood means are avoided.

Environmental Impacts

Project activities execution might affect the surrounding environment, and the most important impacts that may arise are erosion of soils and pollution of air, soil, water, and vegetation. The Company applies several measures to avoid and mitigate such effects:

- Development of plantations in stages to minimise the size of the area exposed to erosion at any one time.
- Terracing is prescribed for upland sites.
- No slopes steeper than 25% should be considered for plantations.
- Installation of erosion control civil works: Contour banks and contour drains, table drains well maintained and regular cross drains or culverts installed.
- Providing adequate sanitary and waste disposal facilities in labour camps, administrative buildings and eating areas.
- Operation is executed following safety procedures and safe handling and application methods, dosage, timing, frequency of application, disposal of surplus, packing materials, and cleaning of equipment.
- The Company is committed to employing non-chemical weed control wherever practical, and a strategy of reduction in chemical use over time where chemical control is considered necessary for current pest and weed problems. MFSL will only use weed control products that are acceptable in terms of the FSC Principles, Criterion, Policies and Guidelines.
- MFSL has a detailed Domestic Waste Management Plan, that includes the identification and management of all waste generated by the project. The Plan also contains the operation of domestic waste facilities, composting procedures and facilities, record-keeping, training responsible personnel, PPE for employees, and a monitoring system. The Company intends to

[33] Supports/1. PDD/PO_Information/Procedures/Conservation/High_Conservation_Values/Assessments/MFSL HCV Assessment Final Report (Unique 2016)

reuse, recycle, and minimise waste generation. With this Plan, the impacts caused by waste are being avoided and mitigated. The complete Plan is available in the supporting documents folder [34].

- Hazardous waste (oils, solvents, fuel and oil filters, batteries, aerosol cans, empty agro-chemical containers, medical waste and electronic waste) are treated separately, following rigorous regulations that are included in the Hazardous Waste Management Plan[35].

Other impacts that may arise are those related to forest fires (loss of fauna, flora, crops and properties). For avoiding, controlling and mitigate them, the Company has a Fire Management Plan[36]. The Plan includes firefighting checklists, schedules, firebreaks maintenance, water points, maps, and related procedures to prevent and control forest fires.

Concerning biodiversity, the main impacts are those related to vegetation removal and fauna disturbances:

- Vegetation removal is only applied for essential works.
- Where possible, large trees and vegetative cover, are retained for its ecological role and function.

2.2 Local Stakeholder Consultation

Miro has multiple means of stakeholder engagement, formal and informal, which are regulary uded and trusted by all parties. These include multi-stakeholder forums (MSF) that meet regularly, specific meetings in project areas, individual and group engagement by community liasison officers and if required the suggestions, complaints and issues process that is widely policised by the company. These methods of communication will be used throughout the project development, implementation and feedback processes, along with the use of the visual materials that detail the project and potential benefits that were developed and utilised for the local stakeholder consultation (Figure 16).

The risks to the project reflect the general company plantation operating risks and are covered regularly in the stakeholder meetings and through community and employee training and engagement. The VERRA certification processes and visits will be communicated through the stakeholder forums and community engagement processes (See the stakeholder engagement plan[37] for further details).

The projects communicates the following elements in this way:

[34] Supports/1_PDD/PO_Information/Procedures/Waste Management/Domestic Waste Management Plan

[35] Supports/1_PDD/PO_Information/Procedures/Waste Management/Hazardous Waste Management Plan

[36] Supports/1_PDD/PO_Information/Procedures/Fire Management/Fire Management Plan

[37] Supports/1_PDD/PO_Information/Procedures/Social/Stakeholder Engagement/MFC Stakeholder Engagement Plan 2015

- Project design and implementation, including the results of monitoring: All monitoring details are publicly available in both the company Annual Report and the Environmental Protection Agency (EPA) reports. Annually at the MSF meetings, the company shares the results of the previous year, specific monitoring results (e.g. water quality) are shared with local communities.

- Risks, costs and benefits the project may bring to local stakeholders: This is frequently covered with stakeholders, from first communication and then regularly afterwards. In the first instance this is discussed at the village mapping excecise (before land leasing), then again during the participatory development of the community development action plan (CDAP), and then regularly during the Corporate Social Responsibility (CSR) planning.

All risks of the project are covered frequently through community awareness, especially around the fire season. The pictorial material developed for the LSC covers the risks (see below).

- All relevant law and regulations covering worker's rights in the country: This is covered frequently by the HR team and the Unions. This is often also a frequent topic of discussion at MSF meetings. Through the company's grievance mechanism there is a channel for all complaints and questions regarding worker's rights.

- The process of the VCS certification: The LSC preparation and development is explained in the in the following section. After completing the validation and verification process, the company has timetabled a follow-up with stakeholders to inform and discuss the next steps.

Local Stakeholder Consultation process

The consultation process took place during September and October 2020. The preparation of the process began with the construction of a map of the actors[38] with an influence on the carbon project, and the identification of easily accessible communication mechanisms for each type of actor, in order to organize the meetings.

Educational material[39] was developed to support the explanation of each of the project's components: for example, the soil cycle, climate change, and the importance of the conservation of environmental resources. A PowerPoint[40] presentation was also prepared for the meetings with government authorities; physical material (images) was prepared for meetings with the rural communities (see Figure 16).

[38] Supports/1_PDD/Stakeholder_Consultation/Stakeholder mapping carbon project 2020
[39] Supports/1_PDD/ Stakeholder_Consultation/ Environmental Educational Programme
[40] Supports/1_PDD/ Stakeholder_Consultation/ Carbon credits working document

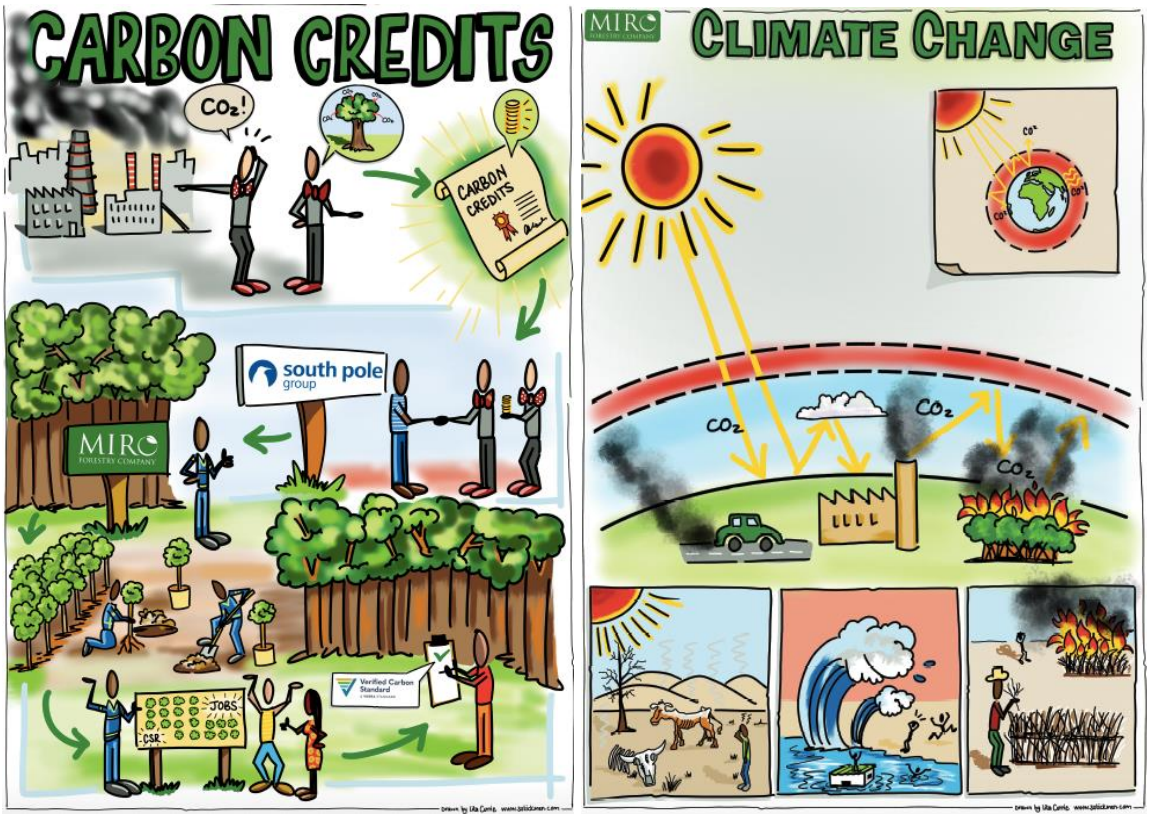


Figure 16. Instructional material presented during the meetings

Subsequently, the convening of the actors to the meetings was initiated via formal letters to the presidents of the traditional councils and municipal and environmental authorities. The invitation letters explained Miro Forestry's interest in certifying its plantations as part of the climate change mitigation strategies and invited the stakeholders to discuss the issue in subsequent meetings (Figure 17).


Figure 17. Participants at meetings in Rosiut Thonkla and Mayolla[41]

In this way, 12 meetings were held in the following communities: Bonkababay, Petifu, Mafala 2, Manjehun, Mapoli, Marainday, Mabankra, Mayolla, Petifu Makoserry, Rosarr, Rosiut Thonkla y Yanbay[42]. See **Table 16**:

Table 16. Date and attendance of community meetings

Communities	Meeting date	Number of participants
Bonkababay	29/09/2020	22
Petifu	29/09/2020	59
Mafala 2	10/10/2020	26
Manjehun	01/10/2020	24
Mapoli	01/10/2020	29
Marainday	28/09/2020	26
Mabankra	07/10/2020	22
Mayolla	07/10/2020	20
Petifu Makoserry	28/09/2020	24
Rosarr	28/09/2020	29
Rosiut Thonkla	07/10/2020	34
Yanbay	28/09/2020	8
Total		**323**

During the meetings, the topics relevant to the project were presented, with attendants were encouraged to participate in the discussion: these included environment and climate change, water (water cycle, water use, soil (importance, soil cycle), and conservation (ecosystems and conservation and carbon credits). In addition, Miro Forestry gave a brief background on the Carbon Credit project and the purpose of the stakeholder consultation as part of the Carbon Credit Certification process. It was further explained that Carbon Credit sales mean benefits for communities via increases in the CSR

[41] Supports/1_PDD/ Stakeholder_Consultation/ Photos
[42] Supports/1_PDD/ Stakeholder_Consultation/ Attendance lists

project. The role of the parties in the Carbon Credit process was explained, as was the role of Miro Forestry, government and local stakeholders, and South Pole. Miro Forestry provided a clear explanation of climate change and its causes, the greenhouse gas effect and explained the solutions to climate change, which underline the Carbon Credit project. The participants had the chance to ask questions concerning the topics addressed.[43.] Table 17 shows the comments that were received during the consultation meetings.

Table 17 Comments collected during the community meetings

Comments
Bonkababay
The responses and discussions from the community made the session very lively and educational. All the topics were covered during their own presentation. One participant said that the discussion today had made them understand that their activities had been destroying the environment and causing a lot of sickness, and that poor agricultural practices and felling trees had caused big changes in the climate. A young leader from the presentation and the learning map said that the attitude and behavior of human being has a lot to be answer for and emphasized we must find ways to stop the bad things in their communities. There were no specific questions on or comments around Carbon Credit Certification, although there was some interest in growing trees in an outgrower project.
Petifu
They understood the carbon credit discussion and asked about the role of South Pole: the facilitator explained that South Pole is a company that helps Miro become certified and sells the credits once they have been certified.
Mafala 2
Some participants said that it was good to receive this sort of education to make their lives safer and healthier. There were no comments or questions about Carbon Credits.
Manjehun
Climate change and carbon credits topics were discussed during the meetings. A comparison between FSC certification and carbon certification was done. As the plantations increase, more jobs will be required and also it will be an increase in CSR projects. No comments or questions about carbon credits.
Mapoli
The participants thanked the facilitator for the important topics explained to the members present. They understood the certification process, and compared it to FSC. They asked about their role and the facilitator explained that they needed to be informed and should raise any concerns if they had any – they did not have any concerns about Carbon Credits.
Marainday
Participants promised to stop contaminating the water and polluting the environment based

[43] Supports/1_PDD/ Stakeholder_Consultation/ Letters/Carbon Credit_Community Engagement Minutes

Comments
on what they had learnt that day. They support Miro and its generation of Carbon Credits; they wanted to know whether they need to do anything else to help the certification – they were advised that they did not. **Mabankra** One participant said that the indiscriminate felling and burning of trees and is the cause climate change and of soil erosion and the infertility of the soil. From the map discussed, they were able to realize that they were not handling their environment well. They were advised to maintain the desirable environmental standards if they wish to live in a conducive atmosphere. They discussed Carbon Credits and certification and supported Miro's project. **Mayolla** The participants were able to understand that they are misusing the natural resources which are very meaningful to their lives by littering, poisoning the water as a method of fishing, and by indiscriminate burning and cutting down of trees, etc. They had no comments or questions about Carbon Credits. **Petifu Makoserry** About one third of the participants were able to identify the hazards and favorable conditions in both the bad and good environments on the map displayed by the tutor. At the end of the meeting, they acknowledged that they had understood the information and promised to go by the lesson learnt from the meeting. They supported the Carbon Credit project. **Rosarr** Participants were very happy with the awareness training; they believed in what they were taught and promised to follow the lessons learnt. They asked whether Miro could help them to grow trees and also become certified for carbon credits; they were told about the outgrower project and that it may be something that they can do in the future if Miro is successful. They asked how they would benefit and the facilitator showed them the poster and explained that certification would mean more trees planted by Miro, which would mean more jobs and CSR projects. **Rosiut Thonkla** One participant raised a concern that Miro had contaminated their water supply during pre-spraying. The facilitator explained that Miro has high standards of spraying and testing for contamination, but also advised that, if they have concerns, they should raise them as a grievance, and they will be investigated. There was some discussion about Carbon Credits and some additional explanation about the system using the poster. They had no more comments about Miro or Carbon credits **Yanbay** One participant asked whether it will be of benefit if they chose the best environment, like the one seen on the map with the good and bad environments. Participants were able to explain the use of water and how hazard incurred up til now had been caused by the indiscriminate burning and cutting down of trees.

In the comments received, it is clear that the participants at the different meetings understood the topics and that there was interest in increasing the amount of forest in the area around the

communities, with the project asked to collaborate with the communities to encourage the planting of trees; however, this is not currently a possibility for the project.

The meetings with the government entities were carried out at a multi-stakeholder meeting, where the participants had the opportunity to present the objective of the certification of the carbon project and give answers on the doubts generated around the subject. Below (see Table 18) is the list of entities that were consulted.

Table 18. Government entities consulted in multi-stakeholder meeting

Entity	Meeting date
Local Council Women's Leader-Masethleh AADC- Masimera The District Chief Executive- Port Loko The District Chief Executive- Tonkolili Environmental Protection Agency (EPA)[44] Radio Gbafth	20/07/2020

The issues addressed during the meeting with the representatives of the government entities can be found in the minutes,[45] which reflect the issues discussed and the comments made during the consultation process. A summary of the main questions that arose in this stakeholder category can be found in Table 19.

Table 19 Comments collected during government representative meetings

Comments
Hon. Aaron Aruna Koroma, on behalf other multi stakeholder members, contributed that Sierra Leone is part of the Kyoto Protocol and the Environmental Protection Agency has domesticated some of the commitment signed up by the Sierra Leone government under the Kyoto Protocol. He said he is happy with the Carbon Credit project as he expects it to generate additional income for the company, which, by extension, will benefit communities. He stated that the Gola Forest in Kenema had initiated a similar project in 2016. During the meeting, it was suggested that the company support communities with planting trees so that local communities could directly benefit from carbon credit sales. The following questions were raised: • If a community wants to preserve forest for carbon credit sales, what is the process? • Miro also emits carbon into the air: how does that affect the carbon credit sales? Other multi stakeholder members asked the following questions:

[44] Supports/1_PDD/ Stakeholder_Consultation/Meeting Minutes EPA-SL

[45] Supports/1_PDD/ Stakeholder_Consultation/Multi Stakeholder Meeting on Carbon Credit

Comments
• What are the improved farming techniques that are preferable to slash and burn? • How will the carbon credits be calculated and how transparent will the process be to communities? In response, it was said that the company will continue to engage communities on sustainable farming practices and further advice will be received from South Pole on the communities' responsibilities in the context of carbon credits. The facilitator responded that Miro emits carbon which offset through threes planted and the remainder of carbon credit will be sold. The meeting ended in anticipation to see the kickstart of the Carbon Credit project and the multi stakeholders' members plead with Miro to create the necessary avenue for communities to trade carbon credits of reserved community forest.

During the meetings with the communities, it was evident that there was an understanding of the issues involved, and participants were able to identify the environmental impacts caused by traditional practices. Miro Forestry expressed its interest in supporting communities in building capacity for the more sustainable use of natural resources. It was made clear that the benefits of carbon credits will be reflected in the increase in employment opportunities and the management of activities by Miro CSR.

The comments received during the consultation process do not lead to changes in the project design. The interest of the communities in Miro Forestry supporting the planting of trees on communal lands is not possible, as it is not currently within the scope of the company's management; however, it is an initiative that will be studied to determine whether it is possible to implement this in the future.

2.3 Environmental Impact

As mentioned in previously, the Company performed an Environmental and Social Impact Assessment (ESIA)[46] in the Yoni Chiefdom, Tonkolili District, in 2014, in compliance with the requirements of the Sierra Leonean Environmental Protection Agency (EPA – SL), the competent authority that considers and decides the application for an Environmental and Social Impact Assessment License. As MFSL extended its land lease area, an additional ESIA was developed in 2018 for the additional areas. In the same way, Miro undertakes rapid environmental and social assessments on each allocated leased area prior to development.

The License was obtained[47] in 2016 and subsequently has been updated. Such license allows MFSL to source land for plantation development from resident communities within a determined area situated in the Yoni Chiefdom, Tonkolili District.

[46] Supports/1_PDD/PO_Information/ESIA/MFSL ESIA FINAL Report (2014)
[47] Supports/1_PDD/PO_Information/ESIA/

The developed study confirmed the project is established on degraded lands, having previously suffered with the slash and burn agriculture, and a scarce tree presence as it was covered by grasses and low-level bushes. In the same thread, the ESIA concluded that the project will not generate significant air emission pollutants nor significantly pollute the waterways.

Plantation activities will have a positive effect on the socio-economic situation in the area and on the environmental conditions. The main positive effect is job creation and the consequent improvement in the welfare of workers and their families. Also, the Company contributes to the improvement of health and educational facilities. Concerning environmental conditions, besides the contribution to the reduction of GHG gases, the establishment of a tree cover on a previously degraded land improves the soil condition and offers habitat for the fauna.

The potential negative impacts will occur mainly in the construction and operation phases. Such impacts can be avoided and mitigated with the compliance of the mitigation measures included in the ESIA and in the Company protocols related. Environmental impacts are detailed in the **Error! Reference source not found.** Section.

Additionally, the Company conducted a Habitat and High Conservation Value Assessment[48], as an addendum to the Environmental and Social Impact Assessment. This assessment focused on three points: First, in quantifying of the actual threat to IUCN[49] red-listed species and native ecosystems potentially resulting from project implementation, additionally, the identification of High Conservation Values within the concession areas and finally, their management in line with the FSC standard.

Such assessment concluded that "*a variety of wildlife species (ungulates, primates and birds) can still be found in the area, considerably more so in or close to the remnant forests along streams, and in the more extensive wooded areas in the south-west of the concession. None of the Endangered, Vulnerable or Near Threatened animal species (IUCN red list) identified as present in the Environmental and Social Impact Assessment could be confirmed: their presence is deemed to be unlikely or very unlikely with the exception of the Sooty Mangabey…".* The assessment also concluded that areas of conservation value are outside of the developed land and they will remain outside the direct influence of the Company, thus, they will not be affected by the operations of the Company.

2.4 Public Comments

The Public Comments period went from January 26th to February 26th, 2021. No comments were received.

2.5 AFOLU-Specific Safeguards

Stakeholder engagement: MFSL is committed to engaging with the stakeholder in the communities that its operation impacts, to ensure they are listened, and their view is considered as the Company conduct

[48] Supports/1_PDD/PO_Information/Procedures/Conservation/High Conservation Values/Assessments/MFSL HCV Assessment Final Report (Unique 2016)

[49] International Union for the Conservation of Nature and Natural Resources

their business. To achieve that commitment, MFSL developed a Stakeholder Engagement Plan[50] (SEP), which guides on implementing a stakeholder's approach that aligns with international good practice.

There has been an ongoing communication process between the Company and the stakeholders of the project since 2013. Initially, it was conducted by third-party consultants as part of the ESIA and was focused mainly on the land-leasers. As the project starts advancing, the process was extended to a wider range of stakeholders within the project area.

For identifying stakeholders, there were used mapping tools such as the influence/dependence matrix and influence/support mapping:

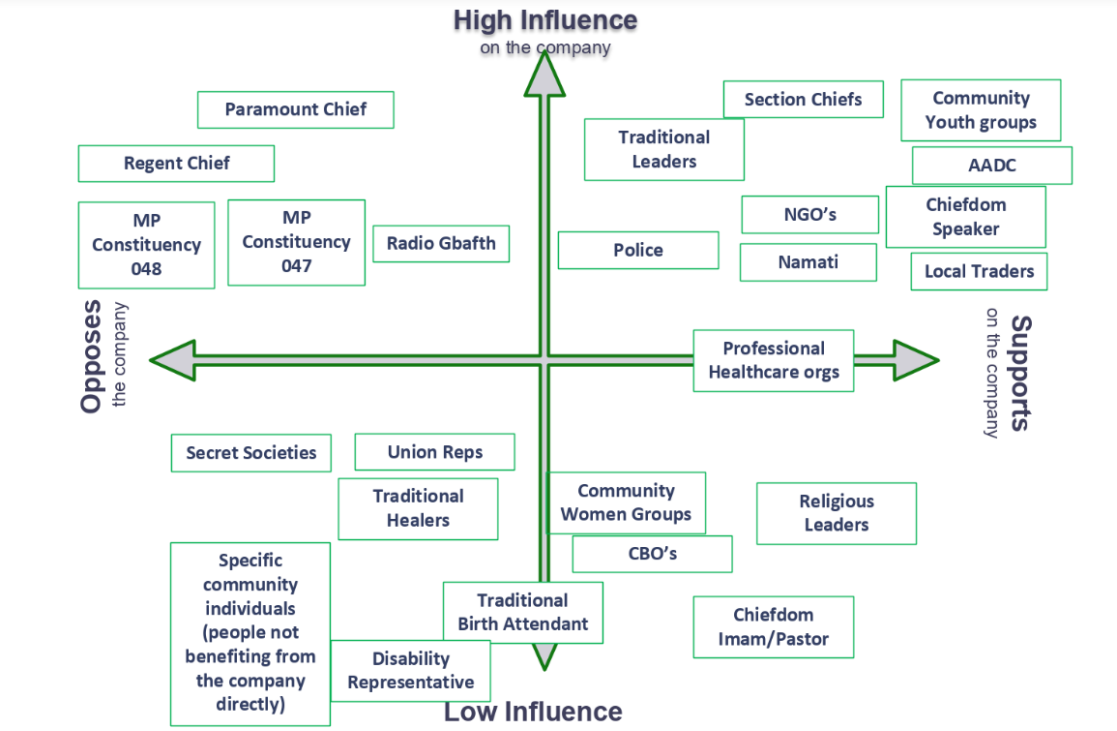


Figure 18. Stakeholder mapping results. MFSL 2018.

Acronyms:

AADC: Amalgamated Areas Development Committee
CBO: Community Based Organisations
MP: Member of Parliament
NGO: Non-Governmental Organisation

[50] Supports/1_PDD/PO_Information/Procedures/Social/Stakeholder Engagement/MFC Stakeholder Engagement Plan 2015

The current results of the stakeholder identification process are provided[51] in the supporting documents folder. A summary of the stakeholders identified (until April 2018) is presented in the following table:

Table 20. Stakeholders identified by MFSL

Category	Number
National and Regional Government	16
NGOs	2
Unions	1
Research Institutes	0
Academic	2
Forestry companies	2

In the same way, MFSL has engagement procedures regarding information dissemination, consultation and feedback, and engaging with employees. Those procedures include tools for performing the task-related and strategies (Table 21).

Table 21. Stakeholders engagement procedures

ENGAGEMENT PROCEDURE	TOOLS	MFSL COMMITMENT
Information Dissemination: • Written and verbal information about the different project activities to stakeholders • Accessible to all groups • Can be in terms of anticipated impacts and on-going management and mitigation of social, environmental, Human Resources (HR) and Health and Safety (H&S) issues	• Distribution/displaying of documents (information leaflets, maps, minutes of meetings) • E-mails/SMS messages • Meetings (public meetings, focus groups meetings to target vulnerable groups) • Media announcements (radio, newspaper) • Open door events • Posters/Billboards	Information dissemination strategies must be tailored to benefit specific target groups: • Documents to include pictorials where possible • Written documentation to be accompanied by verbal explanation where possible • Meetings to be conducted in local language, where this is not possible an interpreter must be available • Information provision events are arranged, and communities are informed about meeting in advance • All information dissemination is followed by information sessions to provide clarity should it be required
Consultation and Feedback: • Two-way sharing of	• Focus Groups • One-to-one discussions	• Relevant information will be provided to stakeholders in advance of consultation

[51] Supports/1_PDD/PO_Information/Procedures/Social/Stakeholder Engagement/MFSL Stakeholders list April 2018.

ENGAGEMENT PROCEDURE	TOOLS	MFSL COMMITMENT
information between the Company and stakeholders • Accessible to all groups	with affected individuals • Grievance Mechanism • Ad hoc informal discussions between Community Liaison Officers (CLO) and local communities • CLO to be available with an 'open door' policy at certain times	• Care will be taken to ensure that all views are incorporated (in particular gender and livelihood differences at local community level) • Outcomes of consultation processes will be reported back to stakeholders, including; responses to any requests, consideration to suggestions, minutes of meetings
Employees engagement: • as much of a priority as external stakeholder engagement • Two- way process	• Timber and Woodworker's Trade Union • Grievance Mechanism • Internal line management systems	• To respond promptly to all grievances raised through the formal mechanism • To maintain regular contact with the Union and its representatives • To be transparent in all decisions • Regular information and feedback sessions with employees on environmental, social, legal and Occupational Health and Safety (OHS) topics

Source: MFSL SEP 2015

Also, MFSL has defined specific roles and positions to manage the stakeholder's engagement and interactions:

- Community Manager (CM): Responsible for coordinating constant ongoing communication with stakeholders concerning land agreements and employment

The Company employs four Community Liaison Officers (CLOs), and one Corporate Social Responsibility Officer (CRSO) all of whom are from the local area. These Officers along with supervision from the Community Manager (CM) are in constant engagement with the people of the community and have been doing exceptionally well.

The stakeholder engagement procedures will be used predominantly by the CM, CLOs, and CRSO with oversight from the Community Manager (CM). The Company Nurse, H&S Manager, and Human Resources (HR) Manager have roles to play with the stakeholder engagement, as they have constant contact with the workforce and often give workshops within the communities.

To identify risks to local stakeholders due to project implementation and how to mitigate such risks, MFSL developed, in collaboration with the communities, a policy and timeline for agreeing in advance land for plantation establishment as well as providing a forum for open discussion. Acknowledging that, MFSL engages the communities through the Amalgamated Area Development Committee (AADC) which represents the communities at all levels with issues related to the identification of land for plantation establishment, payments, concerns from the communities and all other matters. Periodic meetings are

held between the AADC and the management of MFSL. AADC is made up of representatives from all the various communities within the lease area[52].

In June 2014, a Livelihood Study[53] was performed to identify the socio-economic status of households and communities within the MFSL project area. The study was designed to capture baseline data to ensure that livelihood maintenance and improvements are based on real and reliable information. The information captured included:

1. Household composition of communities within the lease area.

2. Sources of household income.

3. Health and sanitation status of the various communities.

4. Employment-related activities and the proportion of community members engaged in such activities.

5. The identity of key livelihood activities that can be improved and to propose alternative sources of livelihood to be implemented in partnership with the communities.

One of the conclusions of the aforementioned study was "the project area is not in conflict with human settlement. All areas to be planted have been demarcated meticulously to avoid encroachment on human settlements. Communities are given advanced notice before any afforestation program and MFSL only plants on land that is allocated by the free will of the communities."

To safeguard the stakeholder's property rights and resources usage, MFSL has a policy and procedures[54] to commence afforestation on land, which includes land acquisition meetings with a full quorum of the AADC, MFSL CLOs, and a Member of Parliament (MP), identification and clear demarcation of the land, exclusion of areas of special interests ASIs (community farming, proposed school and or football sites, village expansion and society shrines), and agreements for individual land ownership.

This process allows MFSL and the community to clearly know the boundaries of the areas to be planted, and the ASIs that must be excluded. In the same way, it involves the participation of the most relevant stakeholders, in order to keep the process transparent and inclusive. A summary of the procedure to commence land afforestation and the stakeholder engagement is presented in the next figure:

[52] Supports/1_PDD/PO_Information/Procedures/Social/ MFC Land Development – Policy, Implementation Framework
[53] Supports/1_PDD/PO_Information/Procedures/Social/ MFSL Livelihood Study and Development Plan
[54] Supports/1_PDD/PO_Information/Procedures/Social/ MFSL Livelihood Study and Development Plan

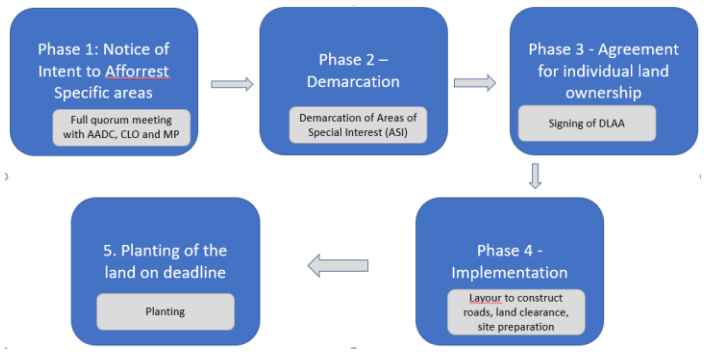


Figure 19. Summary of the procedure to commence land afforestation and stakeholder engagement

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Large-scale Consolidated Methodology: AR - ACM003 A/R Afforestation and reforestation of land except wetlands (Version 02.0)[55].

In addition, the following Tools are applied by the project:

• Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities. [56].

• Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities (Version 04.2)[57].

• Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities (Version 01.1.0)[58].

• VCS AFOLU Non-Permanence Risk Tool (Version 4)[59].

3.2 Applicability of Methodology

The project meets each one of the applicability conditions of the methodology as described in the next paragraphs:

a) The land subject to the project activity does not fall in wetland category

According to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, "Wetlands include any land that is covered or saturated by water for all or part of the year, and that does not fall into the Forest Land, Cropland, or Grassland categories".

Considering that there is presence of flat zones and wetlands adjacent to the project area, A GIS analysis[60] was performed to assure the project is not being developed in wetlands. A dataset[61] of wetland classes, according to the Centre for International Forestry Research (CIFOR), was compared to the planted area. As a result[62], it was found that part of the currently planted area falls into a category of Wetland (Table 22). Thus, the zone was removed from the eligible area and not considered for the GHG calculations (Figure 20).

[55] Supports/1_PDD/Annex/Methodology_and_tools/AR-ACM0003_ver02.0
[56] Supports/1_PDD/Annex/ Methodology_and_tools/ ar-am-tool-02-v1.pdf
[57] Supports/1_PDD/Annex/ Methodology_and_tools/ar-am-tool-14-v4.2
[58] Supports/1_PDD/Annex/ Methodology_and_tools/ar-am-tool-16-v1.1.0
[59] Supports/1_PDD/Annex/ Methodology_and_tools/AFOLU_NON-Permanence_risk_Tool_v3v4
[60] Supports/3_Shapes/Wedlands
[61] Supports/1_PDD/Annex/Library/Gumbrich_et_al-2017-Global_change_Biology
[62] Supports/1_PDD/Annex/20200210_wetland_AR_MIRO_SierraLeone

Table 22. Wetlands analysis

Period	Wetland
2006 – 2016	210.94
2007 – 2017	108.47
2008 - 2018	90.63
2009 - 2019	54.99
Total	**465.03**

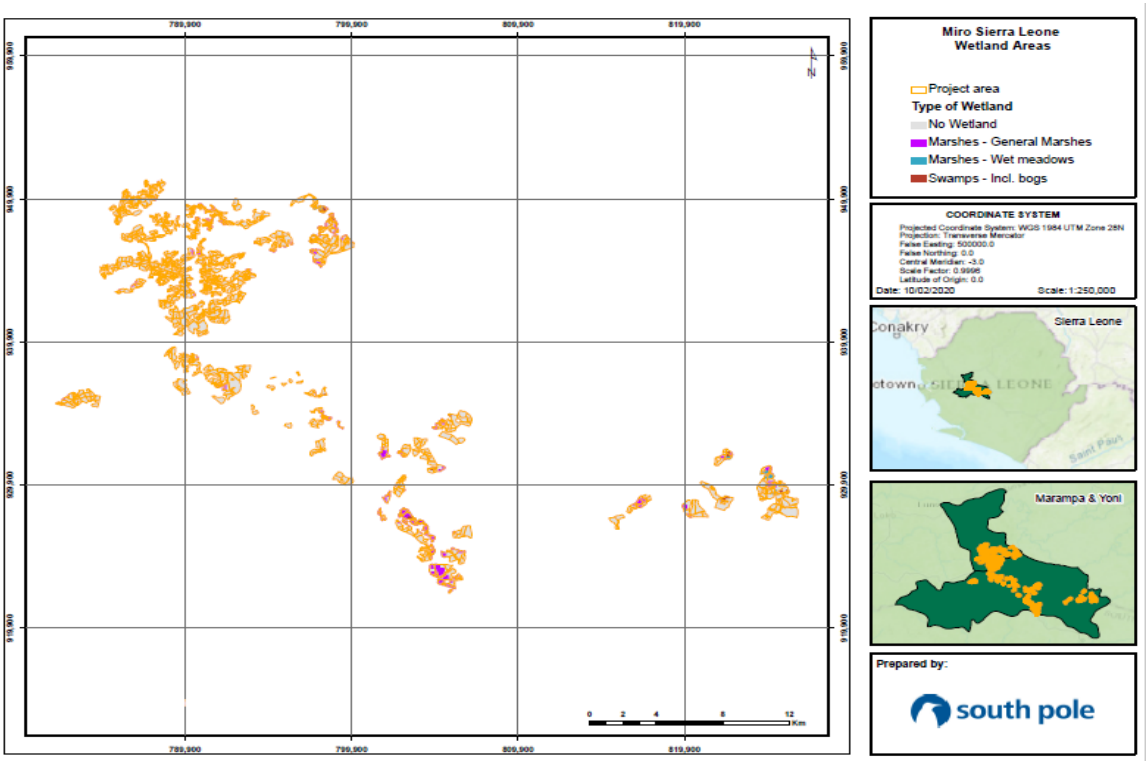


Figure 20. Wetlands identification

In addition, Miro's procedures were consulted with the intention of guaranteeing they are not operating upon wetlands[63], finding that Miro Sierra Leone leases land directly from individual communities and from land holding families. In most cases communities will demarcate available land that they intend to lease to Miro. Miro will then determine if the land is suitable for forestry with a technical criteria. Wetlands and swamps within the operational area are a key component of the agriculture landscape. Miro forestry do not have direct control of these wetlands and swamps because these lands are actively farmed, Miro have classified them as degraded swamp or wetlands, so Miro will not acquire these lands from communities.

[63] Supports/1_PDD/PO_Information/Soils survey procedure

Once communities have shown the potential land that they intend to lease to Miro, a detailed survey is conducted using satellite images, aerial drone mapping, and ground truthing to identify and map out all unsuitable areas and also classify vegetation types. If there is a wetland within the potential area the community intend to lease to Miro, then it will be delineated and mapped out as a potential conservation area. Finally, Miro employs the services of a soil scientist who will conduct a detailed soil survey of all potential areas to be leased from communities. Wetlands and swamps within the proposed lease areas are confirmed by the soil scientist then these areas will be marked as unsuitable for planting. See Figure 21:

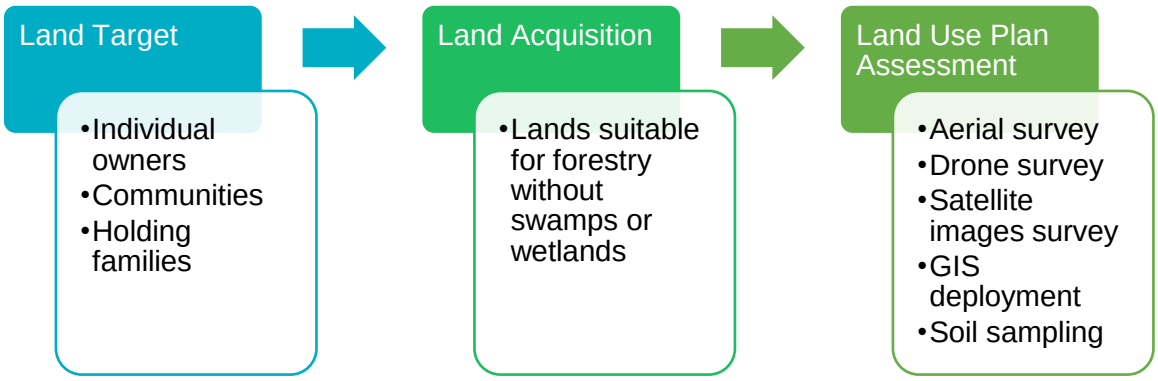


Figure 21. MIRO Land Use Procedure

A combination of all the steps mentioned above will inform the decision if it is a commercial or a conservation/open area, then this classification is uploaded into Microforest, so it can be managed for the silvicultural department.

(b) Soil disturbance attributable to the project activity does not cover more than 10 per cent of area in each of the following types of land, when these lands are included within the project boundary:

(i) Land containing organic soils;

The project area does not contain organic soils, as showed in the section 1.13 in the Soils paragraph. Most of the soils are sedimentary.

(ii) Land which, in the baseline, is subjected to land-use and management practices and receives inputs listed in appendices 1 and 2 to the methodology.

The area of land on which this tool has been applied is not subject to any of the cropland or grassland management practices listed in Table 1 and 2 of the appendices of the methodology. The baseline before the project start date was short-term cropland and grasslands without any inputs.

3.3 Project Boundary

The project is being developed in Sierra Leone, West Africa; in the Tonkolili and Port Loko Districts, in the Yoni and Marampa Chiefdoms. A map with the project boundaries is shown in Figure 7 in Section 1.1 **Error! Reference source not found.** and in **Error! Reference source not found.** in Section 1.3 **Error! Reference source not found.** of this document. The boundaries correspond to the physical limits of each plantation compartment.

The land is community owned, as described in Section 1.7 **Error! Reference source not found.** of this document, and leased for 50 years for the establishment of plantation and auxiliary project facilities.

Concerning the relevant GHG sources, sinks and reservoirs for the project and baseline scenarios, in the following table are indicated and explained, according to the selected methodology:

Source		Gas	Included?	Justification/Explanation
Baseline	Source 1: Above-ground biomass	CO_2	Yes	Major carbon pool of the baseline. Biomass contained in stem, branches and leaves of bushes.
		CH_4	No	No cattle activity in the baseline scenario.
		N_2O	No	Baseline activity does not include N_2O generation.
		Other	No	N/A
	Source 2: Below-ground biomass	CO_2	Yes	Biomass included in the roots of the vegetation cover are considered in the baseline scenario
		CH_4	No	No cattle activity in the baseline scenario.
		N_2O	No	Baseline activity does not include N_2O generation.
		Other	No	N/A
	Source 3: Dead-wood and litter	CO_2	No	Since the baseline cover is mostly comprised by grassland and agricultural land, the presence of deadwood and litter is deemed to be zero.
	Source	CO_2	No	Project does not include the disturbance of organic

Source		Gas	Included?	Justification/Explanation
	4: Soil organic carbon (SOC)			soils. Thus, emissions are not expected in this compartment.
Project	Source 1: Above-ground biomass	CO_2	Yes	Major carbon pool of the project. Biomass contained in stems, branches, and leaves of trees.
		CH_4	No	No cattle activity in the project scenario.
		N_2O	No	N/A
		Other	No	N/A
	Source 2: Below-ground biomass	CO_2	Yes	Biomass included in the roots of the vegetation cover are significant in the project activity
	Source 3: Dead wood and litter	CO_2	Yes	Biomass generated by limbs and pruning are left in the plantations soil. Thus, there is an accumulation of carbon due to project activities.
	Source 4: Soil organic carbon (SOC)	CO2	Yes	It is expected that there will be a significant increase in this carbon pool due to the project activity

3.4 Baseline Scenario

The combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities (Version 01) was used. Below are the steps that were followed to identify the baseline and assess the additionality of the project:

Step 0. preliminary screening based on the starting date of the A/R project activity;

Step 1. identification of alternative scenarios;

Step 2. barrier analysis;

Step 3. investment analysis (not conducted); and

Step 4. common practice analysis

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

Although he project start date is May 16, 2016, a Landsat 8 multispectral satellite image was downloaded, dated towards the end of December 2013. This period was selected considering that images from 2015 and 2014 were not clear enough to make the classification due to the presence of clouds. Considering that, the alternative to ensure the proper identification of the vegetal cover of the land at the initial date of the project, was this date.
The image has a spatial resolution ranging from 15 m to 100 m, covering an area of 185 km * 185 km and over time revisited the same point on earth for 16 days. This image is provided by the United States Geological Survey (USGS) and can be viewed and downloaded free of charge online at the link: https://earthexplorer.usgs.gov/. The Landsat 8 image with which we are working has a spatial resolution of 30 m.

The image was consulted on February, 2020 (details are provided in the Table 23), obtaining the multispectral image shown in Figure 22 22.

Table 23. Landsat image information

Number	Satellite	Collection	Path	Row	Date
1	LC08	L1TP	201	54	24/12/2013

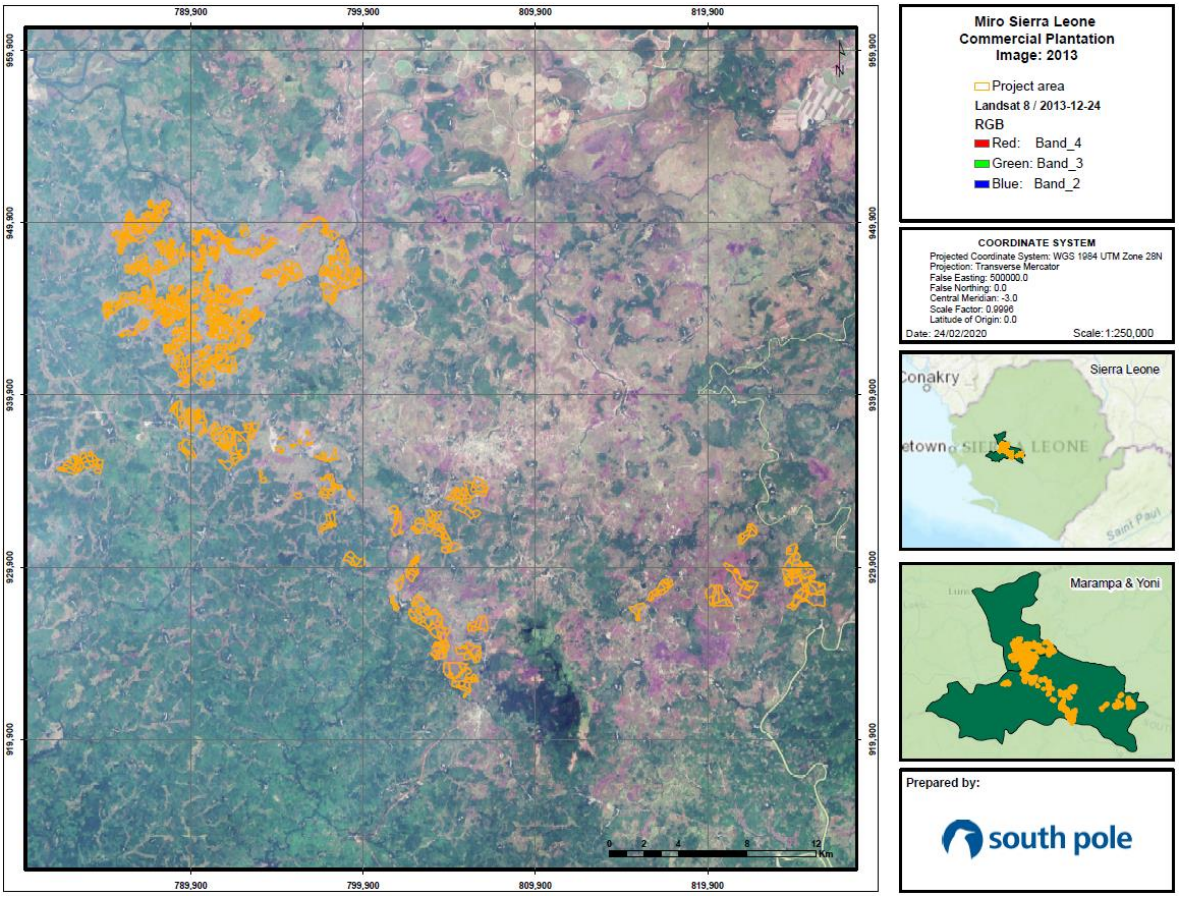


Figure 22. Landsat Image 24/12/2013 and eligible project area (in orange)

For classifying the land cover was defined between 4 and 54 training areas, randomly distributed in the cropped image. Land cover classes of the training areas and the number of training areas per class are presented in the next table:

Table 24. Land cover classes for the training.

Type of land	Number
Forest land	50
Cropland	20
Grassland	41
Settlements	9
Wetlands	20
Total	140

For evaluating the accuracy of the calculations, 250 control points were randomly established, and a confusion matrix was developed. The result was an accuracy of 94%, as shown in Table 25:

Table 25. Accuracy assessment

Class	Forest land	Cropland	Grassland	Total	Precision
Forest land	63	0	3	66	95.45%
Cropland	0	0	1	1	0.00%
Grassland	9	2	172	183	93.99%
Total	72	2	176	250	0.00%
Precision	87.50%	0.00%	97.73%	0.00%	94.00%

From this analysis and as a result of the classification, the following table shows the type of land cover (Figure 23) was identified in the baseline scenario:

Table 26. Landcover in the baseline scenario for the planted area

Landcover	Area (ha)	Area (%)
Forest land	888.61	15.87%
Cropland	16.22	0.29%
Grassland	4,696.16	83.85%
Total	**5,600.99**	**100%**

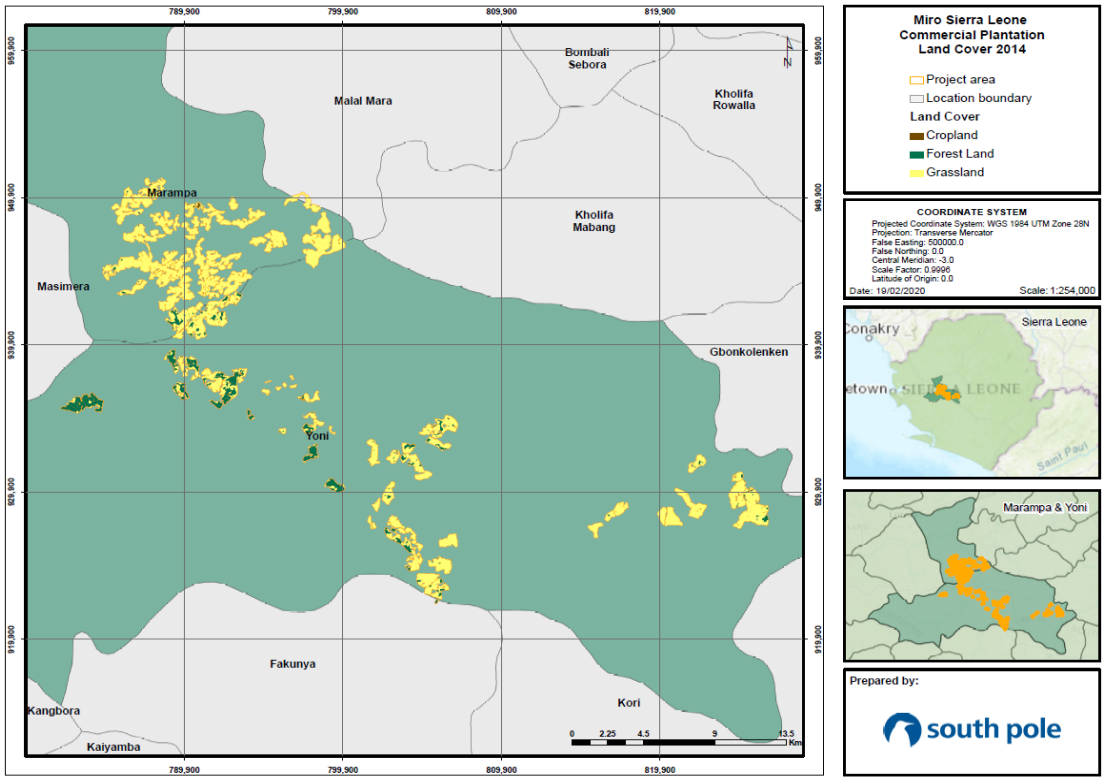


Figure 23. Land cover for the project area in 2014

It can be concluded that the baseline scenario before the start of the project activities was predominantly grassland areas (84%), and forest areas (16%) that are not under the eligible areas. The complete report can be consulted in the supporting documents[64].

Step 1: Identification of alternative land-use scenarios to the proposed project activity

With this step, alternative land-use scenarios were identified for the proposed activities of the project. The baseline scenario was identified, through the following sub-steps.

Substep 1a: Identification of credible alternative land-use scenarios to the proposed project activity

Alternative land-use scenarios were identified according to the proposed project activities, which could be defined as a baseline scenario. In addition to this, historical land uses, trends in the economic sectors and economic activities that take place in the region of the project area were considered

Sierra Leone is a country rich in natural resources such as minerals and fertile arable lands for agricultural development. However, the socio-economic condition has been one of the most critical in the world, as a consequence of the civil war that lasted 10 years, from 1991 to 2002. Two outcomes of this sad event were that the trained labour was forced to displace to other countries and also an important part of the country's infrastructure was destroyed. Additionally, the country was affected by an epidemy of the Ebola Virus Disease (EVD) in 2014, which killed approximately 60,000 people, mostly from the adult population. Given that, since 2015 the country has been in a process of economic recovering supported by the investment of international entities such as the Economic Community of West African States (ECOWAS), United Nations (UN), and the British Government, among others.

The economic activity in Sierra Leone is dominated by natural resource extraction and subsistence agriculture[65]. Given that, the credible alternative land-use scenarios which would be present in the absence of the project and which are described below, are:

- Agricultural household
- Mining
- Afforestation/Reforestation activities without being registered as the A/R project activity in VCS

Alternative scenario 1: Agricultural household

The agriculture sector is crucial for Sierra Leone's economy because it has contributed to approximately 55% of Gross Domestic Product (GDP) between 2010 and 2018[66] and it has employed on average the 60% of the population between the same period. Given the negative consequences of the civil war and the EVD epidemy, Sierra Leone has shown a food deficit and despite there has been an increase in the extension of the production of staple crops, there has not occurred an improvement in the quality of

[64] Supports/2_Estimations/eligibility
[65] Supports/1_PDD/Annex/Library/ National_agriculture_development_plan_2010_2030
[66] Supports/1_PDD/Annex/Library/4.2_World_Development_Indicators

production. For this reason, the country has a deficit in terms of food security and must import some of its main staple foods from international or regional markets[67].

According to The Republic of Sierra Leone[68] the agricultural development represents the most important way to solve the poverty and food insecurity in the country since it has the potential to produce wealth, employment, and trigger industrialisation and services. Agricultural households are defined as one in which at least one family member is involved in crop farming, livestock production, or fishery activity. It represents the most important source of subsistence for the rural population that represents two-thirds of the country's population (population in 2018: 7,650,154). In this type of production, most of the products are produced for auto consumption and a small proportion is sold in the markets, with a contribution of 31% of the GDP[69].

According to Statistics Sierra Leone[70], more than 85% of agricultural households were engaged in crop production including food crops, tree crops, and horticultural crops; approximately 73.6% were involved in animal husbandry and at a lower level, 33.6% of the households were involved in fishery activities. From the districts in Sierra Leone and the districts in which the project area is located, Tonkolili, Moyamba, and Port Loko, has the largest number of agricultural households with crop farming, animal husbandry, and fishery in comparison with the other districts in Sierra Leone.

Approximately 57.9% of the households are engaged in agricultural production with more of the households in the Northern and Southern regions. Kailahun district recorded the highest concentration of agricultural households, followed by Kenema, Bombali, and Tonkolili. The most common food crops are rice, cassava, maize, millet, sorghum, sweet potato, and groundnut. The average extension of the smallholder farmer's land is lies between 0.5 to 2.0 hectares and approximately 85% of farmers grow rice, which makes it the most important crop in the country followed by cassava[71].

In the districts where the project area is located, the most common production system consists of rice, tubers, edible oil (oil palm) for cooking, fish for auto consumption and livestock, and milk. Below a brief description of these production systems.

- *Rice*

Rice is produced predominantly by small-scale farmers[71], through different production systems. In the upland farms, a slash and burn subsistence represents almost 60% of the total production; Inland valley swamps, which is a section of lowland areas where flooded rice production is practiced, represents the 25% to 30% of the production; while *bolilands* are large flat lowland and riverine grasslands and mangrove swamps, which represent almost 10% of the total production.

[67] Supports/1_PDD/Annex/Library/Sierra Leone Staple Food Market Fundamentals 2017
[68] Supports/1_PDD/Annex/Library/ National_agriculture_development_plan_2010_2030
[69] Supports/1_PDD/Annex/Library/Federal Ministry for Economic Cooperation and Development (BMZ),2011
[70] Supports/1_PDD/Annex/Library/Statistics Sierra Leone, 2017
[71] Supports/1_PDD/Annex/Library/Sierra_Leone_Landscape_analysis_USAID_2017

The production of rice has had a significant rise in the production rate since the 1990s, when the country imported over 75% of its consumption requirements, while at the end of the civil war in 2002 the country experienced an deficit of its supplies which has continued growing until the present (Figure 24 24).

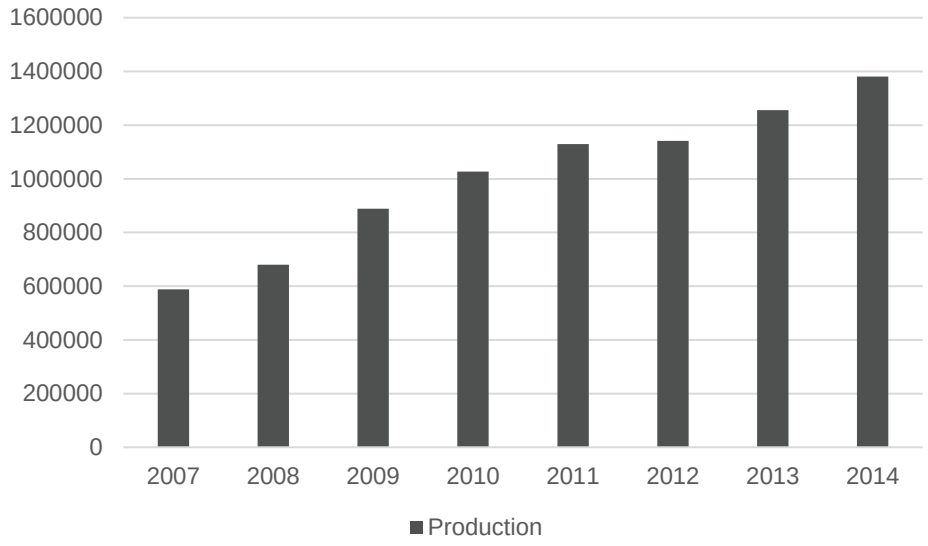


Figure 24. Rice production in tonnes between 2007 and 2014

Source: USAID 2017.

- *Tubers*

Several types of tubers are produced in Sierra Leone. After rice, cassava is the most important source of calories and it represents a product of income generation for the households. Besides the local consumption, cassava also has industrial uses for animal feed, as organic fertiliser and as ethanol biofuel. After this, sweet potato is the second most important tuber due to its relevance as food and money. Its production occurs mainly in places where the cassava production is low and is limited by the environmental conditions of some regions of the country[72].

After the civil war, the production of cassava and sweet potato increased, specifically for cassava production which changed the production rate from 5-6 Mt/ha in the mid-2000s to 10 Mt/ha between 2010 and 2014 using local varieties (Figure 25 25). In the districts where the project area is Tonkolili, Moyamba, and Port Loko, the production of cassava in 2014 was approximately between 50,000 Mt to 250,000 Mt, while the production of sweet potato was for the same year between 9,000 Mt to 15,000 Mt (Figure 26).

[72] Supports/1_PDD/Annex/Library/Sierra Leone Staple Food Market Fundamentals 2017

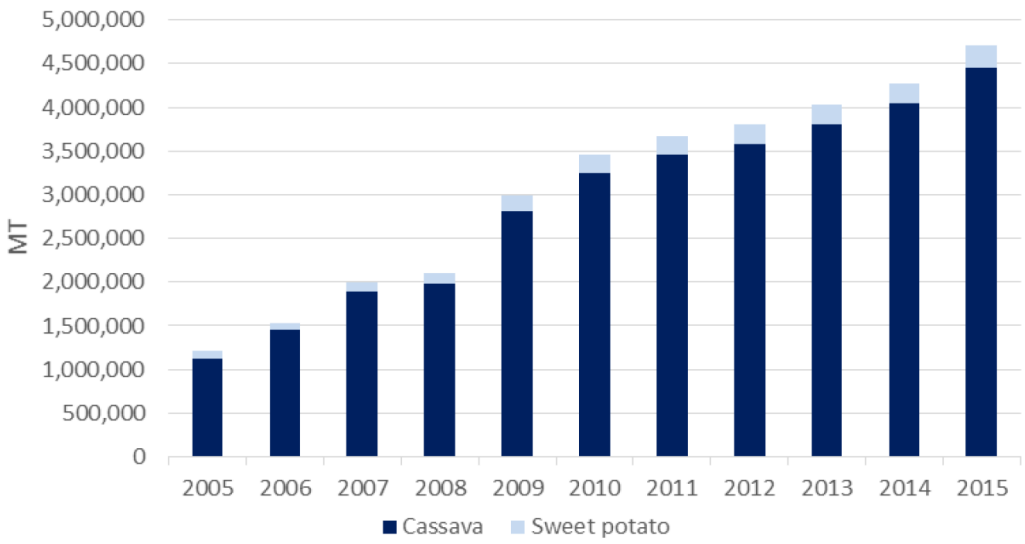


Figure 25. Cassava and sweet potato production in MT between 2005 and 2015

Source: USAID, 2017

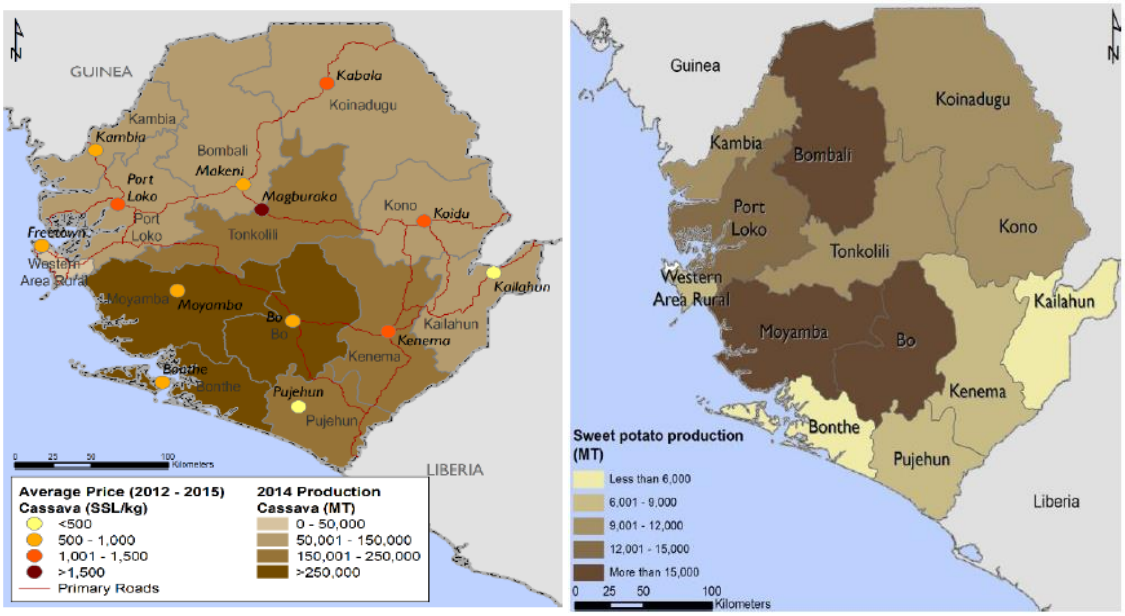


Figure 26. Left image: Cassava production in Mt by district, average prices (SSL/Kg) in 2014. Right image: Sweet potato production by district in Mt in 2014.

Source: USAID, 2017

- *Edible oil*

Oil palm trees grow throughout Sierra Leone, in natural ecosystems and production systems. Although there are several edible oils produced and consumed in Sierra Leone, crude palm oil (CPO) is the most

important and plays an important role for rural economy because is used for cooking and is a source of income[73]. For instance, in Tonkolili it is not as important as a source of income as it is in parts of Moyamba and Port Loko (Figure 27), but it is more important for cooking and household uses.

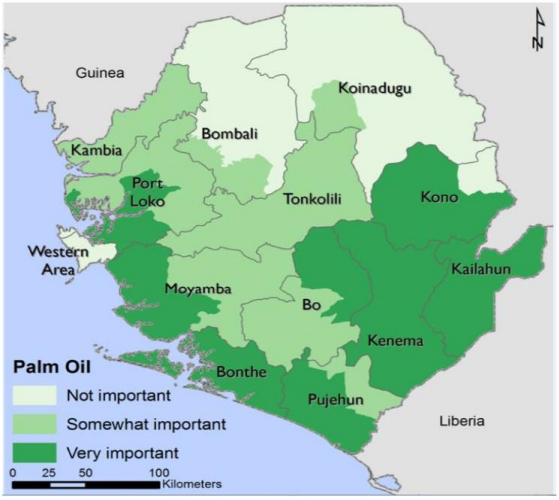


Figure 27. Importance of palm oil to household incomes by livelihood zone.

Source: USAID, 2017

The local production of oil palm has increased over the years (Figure 28 28) as well as the importation of oil palm, because this crop has been considered by the Government as a source of rural development. For that reason, the Government has promoted investment from international companies in the territory.

[73] Supports/1_PDD/Annex/Library/Sierra Leone Staple Food Market Fundamentals 2017

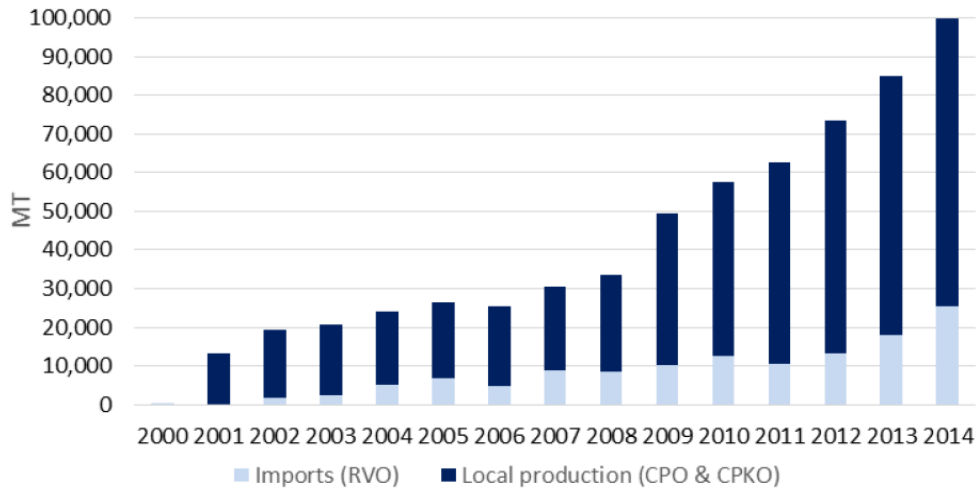


Figure 28. Annual palm oil production and edible oil imports from international market in Mt between 2000 and 2014.

Source: USAID, 2017

- *Fish*

Fish is almost exclusively used for human consumption in Sierra Leone. Over 95% of the fish sold across the country is dried or smoked. Fresh fish is valued and consumed, particularly near the harvesting and inland areas and it is less available across the country due to its high perishability and limited cold chain capacity along with the marketing system[74].

- *Livestock and milk*

Livestock production is an important activity among the rural and peri-urban population in Sierra Leone and plays an important role in asset accumulation and household savings. Approximately 92% of farming households are engaged in some form of poultry, sheep, goat, and cattle-rearing activities. Most of the livestock production in Sierra Leone is small-scale, extensively using traditional rearing practices. In the districts where the project area is located, the production of poultry and small ruminant is relevant since it occupies the third level in the amount of national population (Figure 29)[74].

[74] Supports/1_PDD/Annex/Library/Sierra Leone Staple Food Market Fundamentals 2017

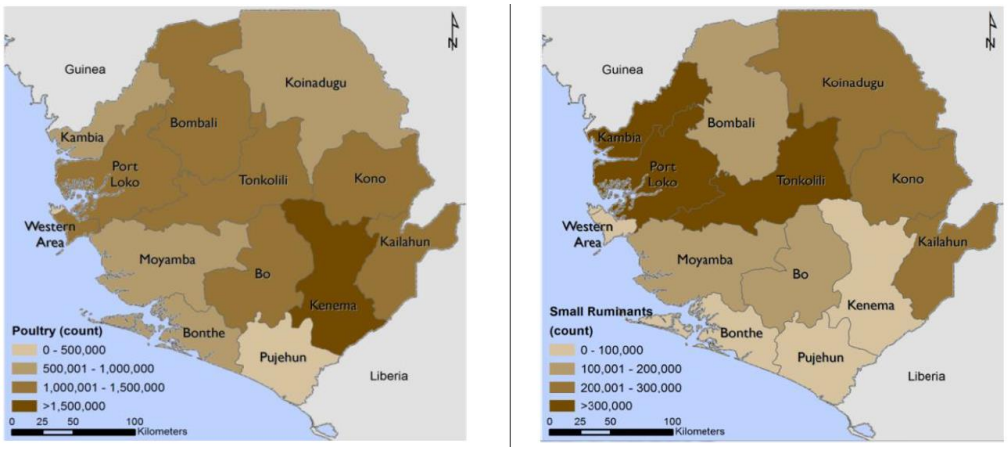


Figure 29. Left image: Poultry population by district in 2014.
Right image: Small ruminant (goats and sheep) population by district in 2014.
Source: USAID, 2017

Alternative scenario 2: Mining

Sierra Leone is a rich country in geological resources with minerals such as diamond, rutile, bauxite, gold, iron, and more, plus, oil and gas deposits. From these resources, diamond and gold have been extracted in an industrial and artisanal way and represents one of the most important sources of export revenue, while in the case of rutile and bauxite, these are extracted solely by large-scale mining companies[75].

- *Artisanal mining*

Artisanal mining activities contributes to the livelihoods of a considerable portion of the population in northern and eastern Sierra Leone. The lack of viable livelihood opportunities after the civil war has meant that many individuals and communities have returned to informal gold or diamond mining, as a source of income in their efforts to combine food security and income[76].

According to Sierra Leone's Ministry of Mines and Mineral Resources, the livelihood of more than half a million people in the country depend on small-scale and artisanal mining activities, which also generates revenue for the Government and an appreciable amount of economic activity beyond, which is directly connected to the minerals recovered[77].

Artisanal gold and diamond mining activities can overlap in the workforce that they both attract since many of diamond sands contain gold and are subsequently re-washed by women to find the gold. In the Tonkolili District, where the majority of the project lands are located, there are a high number of gold deposits, the artisanal mining has been practiced in five ways, 1) self-supported informal miners, 2)

[75] Supports/1_PDD/Annex/Library/Cartier,L &Burge, M, 2011
[76] Supports/1_DD/Annex/Library/Cartier,L &Burge, M, 2011
[77] Supports/1_PDD/Annex/Library/Mining Journal, 2018

informal miners that are supported, 3) miners that operate on licensed lands and who are paid a daily wage, 4) miners that operate on licensed lands and who are paid a share, and 5) groups of informal miners who have made informal arrangements to can work on larger deposits (such as when a river is banked)[76].

- *Industrial mining*

Between 2012 and 2014, the mining sector contributed 22% to the GDP, 72% to real GDP growth, and accounted for 83% of exports, which attracted the investment of international companies to the main iron gold deposits, one of them is located in Tonkolili (Figure 30). However, iron gold prices dropped after 2014 and those companies stopped their production. Despite this situation, mining in Sierra Leone continues with the exploitation of other minerals as bauxite, diamond, and titanium.

This sector has had a significant influence on the country's development since mining is considered with agriculture, the main sources of rural development for the country. Thus, mineral exploitation continues working and providing economic benefits to the country (Figure 31) and in the case of gold production, it has recovered over the years.

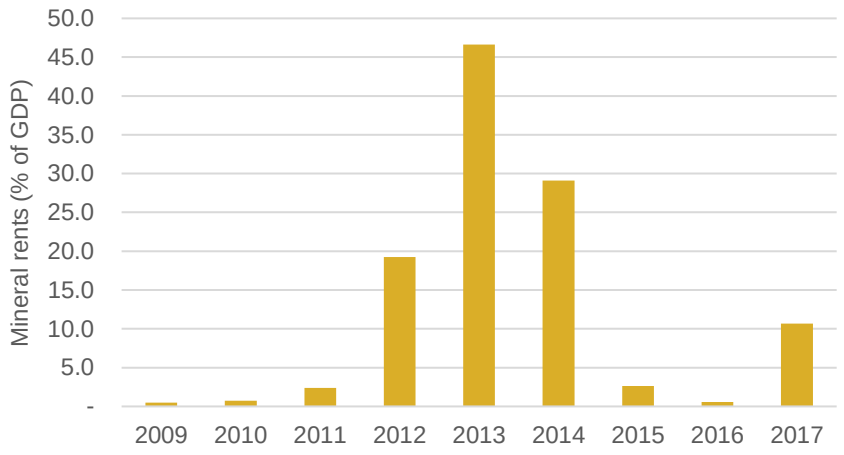


Figure 30. Mineral rents (% of GDP) in Sierra Leone between 2009 and 2017.

Source: World Bank

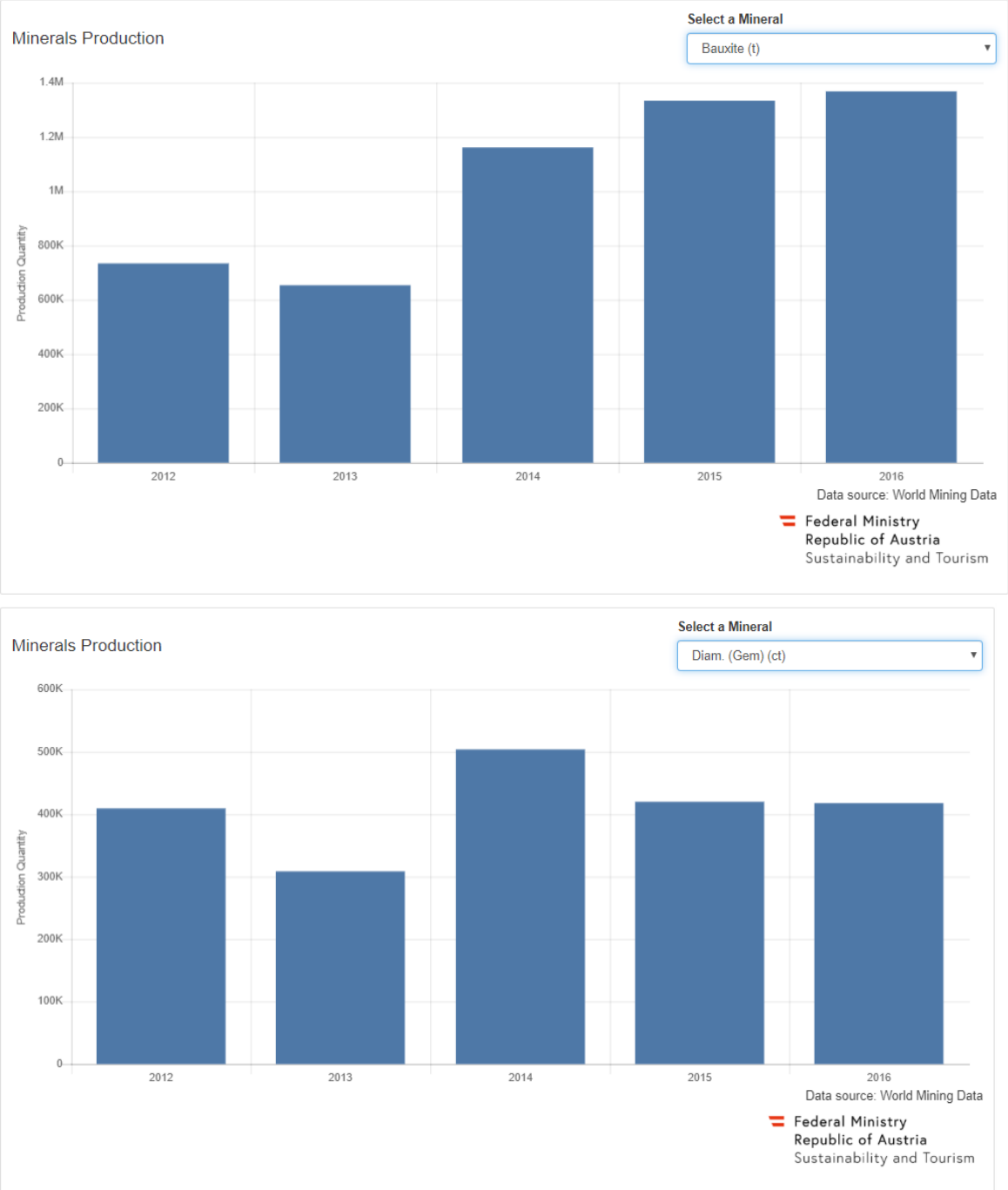
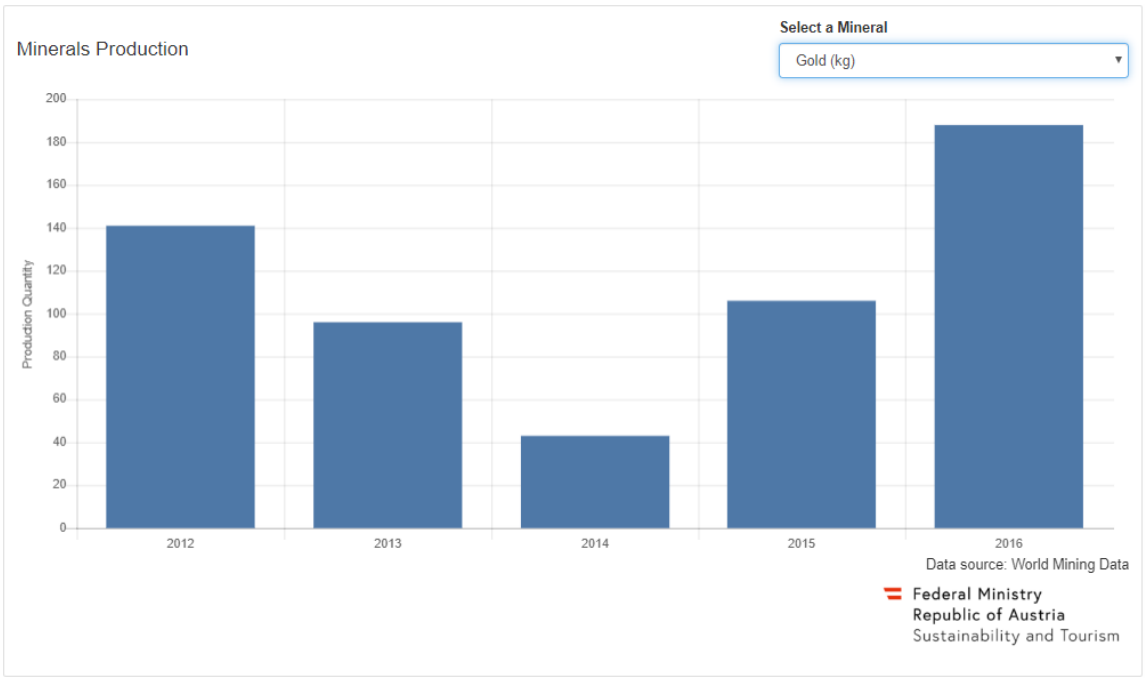


Figure 31. Bauxite and Diamond between 2012 and 2016.

Source: World Bank, 2017



Source: World Bank, 2017

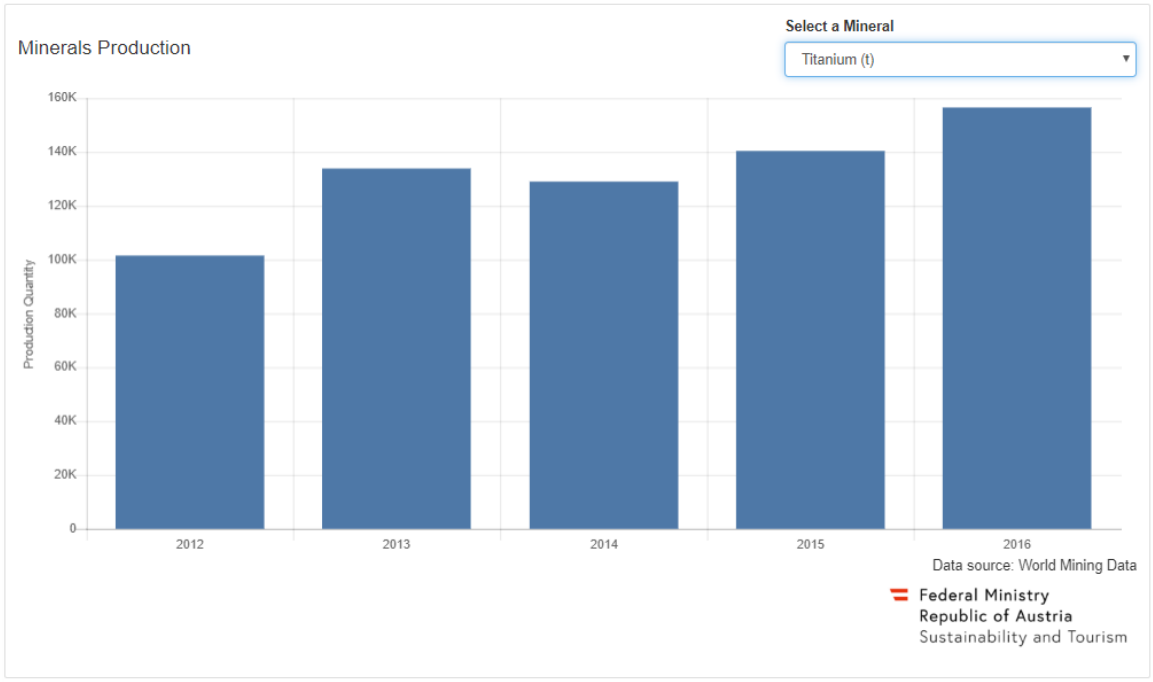


Figure 32 Titanium and Gold production between 2012 and 2016.

Source: World Bank, 2017.

Alternative scenario 3: Afforestation/Reforestation activities without being registered as the A/R project activity in VCS

In Sierra Leone, the forestry sector does not represent the main source of economic income for the country. After livestock, this is the second sector with the lowest contribution to the national GDP and between 2001 and 2008[78], it decreased by 50% ().

Despite reforestation being considered by the Government in 2009 as one of the activities to promote the inversion of the private sector in the country[79], there has not been relevant progress since there are no more than 10 reforestation projects in the country[80,81, 82]. Taking that into account and considering that Sierra Leone is recovering from the war and Ebola epidemic, the forestry sector has not been able to grow because of the lack of technological development and financial policies to support its growth.

For the reasons mentioned above, private companies investing in Sierra Leone have to cover additional costs that they would not have to cover if they were in a different country, such as the building of road networks, technological development of forest species, infrastructure and facilities for the employees as well as specific forestry training, since local workers are mainly trained to develop agricultural or mining activities. Besides this, companies must also invest in efforts to conserve a good relationship with the local communities to diminish the social risks, since a portion of the communities disagree with the land tenure process and the needs of the companies on expanding project areas.

Large scale foreign investment is perceived as a risky activity, which if not correctly managed, could increase poverty, food insecurity, and affect rural livelihoods and social cohesion. For these reasons, this type of investment could be a source of social conflict and could bring negative impacts to local communities[83].

[78] No recent references were found, since usually this sector is merged with agriculture in GDP analysis.
[79] Supports/1_PDD/Annex/Library/ National_agriculture_development_plan_2010_2030
[80]Supports/1_PDD/Annex/Library/World Agroforestry Center, 2016
[81] http://www.fao.org/sierra-leone/news/detail-events/en/c/896456/ Saved in Supports/1_PDD/Annex/Library/ Promoting tree planting to protect the environment _FAO in Sierra Leone
[82] https://www.developafrica.org/reforestation-sierra-leone-sustainable-development-goal-13 Saved in Supports/1_PDD/Annex/Library/Reforestation_in_Sierra_Leone_SDG#13_Develop_Africa
[83] Supports/1_PDD/Annex/Library/Land_and_conflict_in_Sierra_Leone

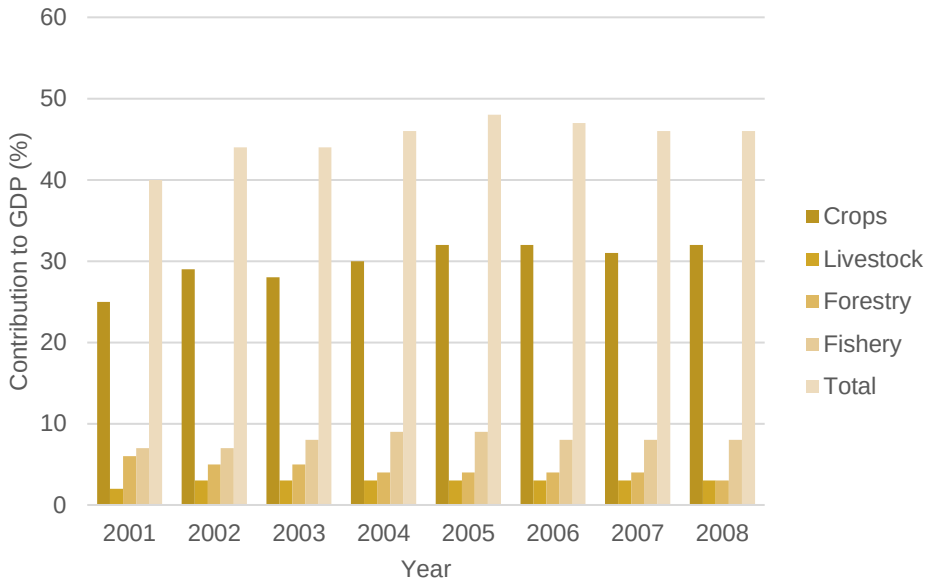


Figure 33. Contribution of the agricultural subsector to the national GDP in percentage (%).

Source: Statistics of Sierra Leone.

Miro Forestry Developments Limited intends to develop a commercial reforestation project of approximately 12,000 ha. Overall, economic activities that include commercial reforestation must make a large initial investment to establish the plantation and recurrent investments for its maintenance. Although the economic profits are high, the risk is also high. Thus, the relationship between investment decision and the covariant risk present in rural areas of developing countries, indicates that in the presence of high risk, investment in delayed investment recovery options is discouraged.

Therefore, the project activity without being registered as A/R project in VCS could have a high risk for reaching the goals of the Company. In the financial analysis of the Company's operations in Sierra Leone, the return of the investment is expected in 10 years from 2019. The risk of the capital invested according to the negative cash flows in the project's life horizon is close to US$ 28.8 million and the project's NPV to US$ 38.8 million. So, the financial return risk is 74.4%. The risk that could be lower if Miro Plantations has additional direct incomes.

As mentioned before, a high level of risk could threaten the environmental, economic, and social goals of the project. Also, this situation has negative implications for the local communities, since reforestation projects represent a source of employment and training opportunities that could diversify the economic activity in the Chiefdom. In its effort to develop a sustainable reforestation project, Miro Plantations have invested in social matters, as it has built schools, employed more than 1,000 local

inhabitants, of which 17% are women, and it has trained their employees in forestry techniques[84,85,86]. However, the investment in social topics has not been constant over the years since the Company cannot designate an annual fixed percentage of its revenues.

Outcome of Substep 1a:

Alternative land-use scenarios that would have occurred on the land within the project boundary of the project:

- Agriculture
- Artisanal mining
- Industrial mining
- Afforestation/Reforestation activities without being registered as the A/R project activity in VCS

Substep 1b: Consistency of credible land-use scenarios with enforced mandatory applicable laws and regulations

Due to the richness of mineral sources and thanks to the physical and climate conditions of Sierra Leone, mining and agriculture (crops, fishery, livestock, and forestry) have been the main economic activities of the country. After the socio-economic crisis the country suffered from the civil war and Ebola epidemic, the Government has promoted the development of these economic sectors.

Agriculture development is a top priority for the Government of Sierra Leone, which is divided into household agriculture, cash crops, fishery, forestry, and livestock. Thus, several policies promote the growth of this sector. For instance, it represents one of the five priorities in the 2008 Agenda for Change (2nd Poverty Reduction Strategy Paper)[87]; there is a National Sustainable Agriculture Development Plan (NSADP) for 2010 – 2030[88] in which a Small-holder Commercialisation Program was prioritised for national implementation as the component with the highest impact on food security and income for a vulnerable population.

To support the Sierra Leonean agriculture development, the Government signed several acts and strategies: 1) the Comprehensive African Agriculture Development Programme (CAADP); the Local Government Act, and Decentralisation Policy which transfers power to local communities and enhances service delivery to farmers through providing technical and financial resources; 2) the Private Sector Development Strategy that impacts agriculture as it attempts to improve infrastructure, legal and

[84] Supports/1_PDD/PO_Information/Annual_Reports/Miro Forestry – 2018 Annual Report (LowRes)
[85] Supports/1_PDD/PO_Information/Annual_Reports/Miro Forestry – 2017 Annual Report
[86] Supports/1_PDD/PO_Information/Annual_Reports/Miro Forestry – 2016 Annual Report
[87] Supports/1_PDD/Annex/Library/ agenda_for_change
[88] Supports/1_PDD/Annex/Library /National_agriculture_development_plan_2010_2030

regulatory framework, access to finance, among others; and 3) the National Export Strategy and Youth Agricultural-Farm Scheme, designed to promote youth employment in rural areas[89].

Regarding forestry sector, the Forestry Policy was published in 2010, which promoted: 1) the establishment, expansion, and management of community forest for economic benefits and forest ecosystem health; 2) the establishment, expansion and sustainable management of private forests; 3) the public awareness of the importance of sustainable management of forest resources; and 4) stakeholder education related to the technical management of forest resources. Furthermore, there are institutional arrangements and legal frameworks that support these policies, as Forestry Development, Exploitations and Trade Reforms, Land Lease rent and Royalties and the Afforestation Fund into which all reforestation and training fees levied on timber, and transport fees on select timber and NTFP are paid[90].

On the other hand, the legislative framework for the mineral sector which includes artisanal mining, small scale mining, and large-scale mining, is provided by the Mines and Minerals Act of 2009 and the Petroleum Regulatory Act 2014. Also, the country is committed with the African Vision Mining (AMV) to develop and use mineral resources to boost social and economic development across the continent[91].

Outcome of Substep 1b:

The land-use scenarios identified in this substep, follow all mandatory applicable legal and regulatory requirements. Therefore, the alternative scenarios are:

- Agricultural households
- Artisanal mining
- Industrial mining
- Afforestation/Reforestation activities without being registered as the A/R project activity in VCS

Step 2: Barrier analysis

With this step, barriers were identified, and the land-use scenarios identified in sub-step 1b were assessed to determine which were not prevented by these barriers.
Substep 2a: Identification of barriers that would prevent the implementation of at least one alternative land use scenarios.

- **Political barriers**

  Historical crisis**:** Sierra Leone has been one of the countries with high levels of corruption which has affected social, economic, and environmental aspects of the country. Corruption tends to lead to a lower growth, hampering both private and government investment spending, and inhibiting the efficiency of public sector[92]. After the civil war and the Ebola epidemic, the country continues to

[89] Supports/1_PDD/Annex/Library /Federal Ministry for Economic Cooperation and Development (BMZ), 2011
[90] Supports/1_PDD/Annex/Library/FAO,2010
[91] Supports/1_PDD/Annex/Library/ Mining_UNDP in Sierra Leone_2014
[92] Supports/1_PDD/Annex/Library/ D´Agostino, Dunee, & Pieroni, 2016

face the daunting challenge of enhancing transparency in managing its natural resources and creating a fiscal space for development; This is the reason why problems of poor infrastructure and widespread rural and urban impoverishment persist despite remarkable strides and reforms[93].

Corruption: Despite the giant effort of the national Government and development partners to promote the private sector developments, corruption in the country and within the small and medium enterprises sector has reduced enterprise growth, efficiency, and economic development[92]. The same research found that corruption is negatively correlated to productivity and has negatively affected the employment rate in the country. As a result, corruption promotes instability in the country and stops the country from developing, thus, the reduction of poverty. Additionally, corruption has made investments of private and international large companies difficult, which has increased the inequality of the country.

In Sierra Leone the civil war destroyed most of the country's infrastructure. Thus, rebuilding tasks have represented a big challenge for the Government given the effort that it implies. The lack of infrastructure is considered as an obstacle for the economy development and it has been represented by a poor road, electricity, water/sanitation and transport network, as well as security problems, and instability in the finance sector.

Lack of technology development: Technology development has not been affordable due to the low economic returns from commodities. This explains that agricultural activities as land preparation, cropping, harvesting, and threshing has been developed in a rudimentary, expensive and low productive way. There has not been any technological improvements in seeds, a facility to process the harvested products, nor mechanic machinery to ensure that farmers can benefit from sales of their final products[94].

Lack of infrastructure: The lack of technology is correlated with the lack of infrastructure, which directly influences the lack of economic development in rural areas. There is a general lack of rice mills, feed mills, rural roads, transportation, markets, irrigation systems, sea and inland ports and landing sites for fisheries, which have undoubtedly inhibited agricultural growth because it limits opportunities for marketing products and monetising the rural economy[94]. The lack of road and transport systems generates higher costs of product transportation. The landing sites are poorly developed, and the fishery harbours requires extensive rehabilitation. The percentage of irrigated land is minimum even when the irrigation permits higher value-added crop production - especially during the dry season. This reduces vulnerability to drought and climate change, and generally increases productivity. The use of technology for water conservation or drainage is low and the potential for irrigation remains largely unexploited[94].

During 2011, the African Development Bank[95] analysed and identified measures which should be prioritised to reinforce national stability and mitigate threats to political stability. These measures

[93] https://www.worldbank.org/en/country/sierraleone/overview
[94] Supports/1_PDD/Annex/Library/ National_agriculture_development_plan_2010_2030
[95] Supports/1_PDD/Annex/Library/African Development Bank 2011

consisted of promoting development strategies and investing in infrastructure for the future of the country. Within the infrastructure's necessities, the most important key necessities selected as a priority were: agricultural crop production, Information and Communication Technology (ICT), and development of industrial mineral infrastructure corridors. However, despite the effort of the Government, the country continues to face the daunting challenge of enhancing transparency in managing its natural resources and creating fiscal space for development, the reason why problems of poor infrastructure and widespread rural and urban impoverishment persist despite remarkable strides and reforms.

- **Barriers relating to land tenure, ownership, inheritance, and property rights**

The project area is located in a land which overlaps statutory and customary law, as it allows the land acquisition through leaseholds by non-native people or international companies with previous authorisation of local chiefdoms.

This customary land tenure system has been a source of conflict in rural areas, given that there is a lack of land administration with inaccurate records, there had been also corrupt land adjudication processes, competing claims of land ownership and disputes over boundaries, which produces fear amongst the rural population to lose property rights. Besides, the landowning lineages which domain the rural land in Sierra Leone has been an inequitable and inefficient land system that works in most of the cases in favour of both urban and rural elites and, allows them to retain political and economic privilege[96].

- **Financial barriers**

The investment in reforestation projects in a country such as Sierra Leone requires a company to take a risk, which could produce positive or negative results. There are two possible scenarios to consider and analyse (Table 27). The first scenario is where no additional income is derived from the main activity, so the project risk is 74.4%, while the second scenario considers the income from the sale of VERs, and the risk is 67.9%. The risk difference between both scenarios is mainly because the investment risk decreased. Therefore, the VER scheme represents an opportunity to add restoration actions and to comply with desirable environmental objectives, according to the incentive to expand reforested areas, as a result of the reduction of the financial return risk for investors.

Table 27. Financial indicators for analysing barriers

Financial indicators	Before VERs	After VERs	Difference
NPV	$38,822,747	$40,804,130	$1,981,382
Risk investment	$28,877,610	$27,699,339	$1,178,271
Risk / Return (RR)	74.4%	67.9%	-6.5%

[96] Supports/1_PDD/Annex/Library/Land_and_conflict_in_Sierra_Leone_2013

Payback period	10	9	-1

Source: Project Developer, 2019.

When analysing the variables most related to the increased risk of financial return, the quantities of timber produced, and the direct cost of production were considered. A sensitivity analysis was carried out concerning these parameters and it was also considered to estimate changes in the discount rate assuming risk adjustment scenarios. Table 28 shows the percentual variations in each of these parameters according to three pre-established scenarios: positive, moderate, and pessimistic.

In the positive scenario, it is assumed that the variation of the parameters favours and improves the Company's cash flow and the RR indicator for which it is estimated that the Company complies with 100% of its production plan. Therefore, the variation of the amount is 0%, in turn, it is assumed that the direct costs of production decreases by 5% and the discount rate decreases by 33.3% going from 15% in the reference scenario to 10% in the positive scenario. In other words, the discount rate represents minimum profitability required by the Company according to what is observed in other investment alternatives in the market, showing that if the discount rate is reduced, the opportunities for high profitability in other reference projects are reduced.

In the moderate scenario, it is assumed that the change in parameters has a negative but not very large impact on the Company's cash flow and on the RR indicator, for which it is assumed that the quantities produced decreased by 5%, direct production costs increase by 5%, and the discount rate increases by 33.3%, going from 15% in the reference scenario to 20% in the moderate scenario.

Finally, the negative scenario assumes that the variation in the parameters has more pronounced negative effects on the Company's cash flow and a significant deterioration in the RR indicator, for which it is assumed that the quantities produced decreases by 10%, direct production costs increase by 10% and the discount rate increases by 66.6% from 15% in the reference scenario to 25% in the negative scenario.

Table 28. Variations in parameters by scenario

Variable	Positive Scenario	Moderate scenario	Pessimistic scenario
Variation timber production	0%	-5%	-10%
Total direct costs assumed	-5%	5%	10%
Discount rate	-33.3%	33.3%	66.6%

Source: Project Developer, 2019.

Analysis of variations in the quantities of timber produced

The results[97] show that in the positive scenario, by meeting the projected production of 100% the RR indicator without VERs is 74.4% and with VERs the RR indicator decreases by 6% to 67.9% (Table 28). In the moderate scenario, a 5% decrease in timber production leads to an RR of 139.5% without VERs and a RR of 123.7% with VERs, that is, a difference of 16% in both cases.

In the pessimistic scenario, a 10% decrease in the quantities produced leads to an RR without VERs of 503.7% which is 123% higher than the scenario with VERs 380.9%. This shows the strong sensitivity of the variable quantity of timber produced on the RR indicator and especially when the VERs are not considered, so it can be concluded that having the VERs greatly alleviates the RR indicator.

Analysis of variations in direct production costs

Regarding the direct production costs variable and its impact on the RR indicator without VERs in each of the three scenarios, this is greater than with VERs. For the positive scenario the RR indicator without VERs exceeds the RR indicator with VERs by 5%. In the moderate scenario it exceeds RR indicator by 8%, and in the negative scenario it exceeds RR indicator by 11%. As the scenario becomes more unfavourable for the Company in the face of increasing costs, the RR indicator becomes much higher, thus, widening the gap with respect to the case without VERs.

Analysis of changes in the discount rate

For its part, the RR indicator is very sensitive to variations in the discount rate, the worst case being the negative scenario where a 33.3% increase in the discount rate (from 15% in the base scenario to 25% in the negative scenario) leads to a variation in the RR indicator to levels of more than 200%. In the moderate scenario the gap between the two cases, with and without VERs is 25% and in the positive scenario the gap is 2%.

The above shows that in the face of variations, that negatively affect the operation of the Company, either of smaller quantities of timber produced or an increase in production costs, the financial indicators are very sensitive and the risk of return increases, in greater proportion than the variations in quantities and costs. The results obtained in each of the scenarios mentioned above are shown below (Table 29).

[97] The calculations were made using commercially sensitive information, non-available for general public. Nevertheless, it can be provided if VVB or VERRA requires it.

Table 29. Results of the sensitivity analysis

Variable	Risk return (RR)	Positive Scenario	Moderate Scenario	Pessimistic Scenario
Amount of timber produced	Before VERs	74.4%	139.5%	503.74%
	After VERs	67.9%	123.7%	380.95%
Total direct costs assumed	Before VERs	61.71%	91.1%	114.1%
	After VERs	56.51%	82.7%	102.7%
Discount rate	Before VERs	31.91%	193.22%	883.8%
	After VERs	29.68%	168.42%	618.9%

Source: Project Developer, 2019.

Investment decisions for the extension of the forestry project also consider the covariant risk. This refers to all the events mentioned, that could lead to a reduction in plantations and therefore in the amount of timber produced, having a direct influence on the risk of financial return. The probability of the occurrence of these events become much more evident when the climate risks of the reference area are analysed.

- **Climatic condition barriers**

Sierra Leone has a high vulnerability to hazardous climate conditions[98], such as extreme heat and forest fires. The danger of extreme heat is classified as high according to the available information (Think Hazard[99], 2019). This means that prolonged exposure to extreme heat is expected to occur at least once in the next five years. The danger of forest fires is classified as high according to the information available. This means that there is more than a 50% probability of favourable weather conditions for a major forest fire that could cause loss of life and property each year. However, due to the limited presence of strong financial institutions in the rural sector that allow the transfer of climate risk to third parties (Karlan, Osei, Osei-Akoto, & Udry, 2014), the possibility of unfavourable events for agricultural and silvicultural activities may discourage investment. This is most evident when a large initial investment is required and the return period for the investment is long.

The presence of high covariant risks also affects the activities developed within the framework of the emission reduction project. When an unfortunate climatic event occurs, not only the plantations are affected but also the livelihoods of the surrounding communities. This is because the opportunity cost of maintaining current conditions increases, which translates into increased risk of financial return. The possibility of having income from the marketing of VERs in the forest plantation project will help to reduce the financial risk, encourage the expansion of operations, and will allow the Company to face the covaried risks, along with supporting the neighbouring communities when they occur, so the carbon reserves are not affected as a measure to solve unfortunate climate changes.

[98] See https://www.coface.com/Economic-Studies-and-Country-Risks/Sierra-Leone
[99] See http://thinkhazard.org/en/report/221-sierra-leone/WF

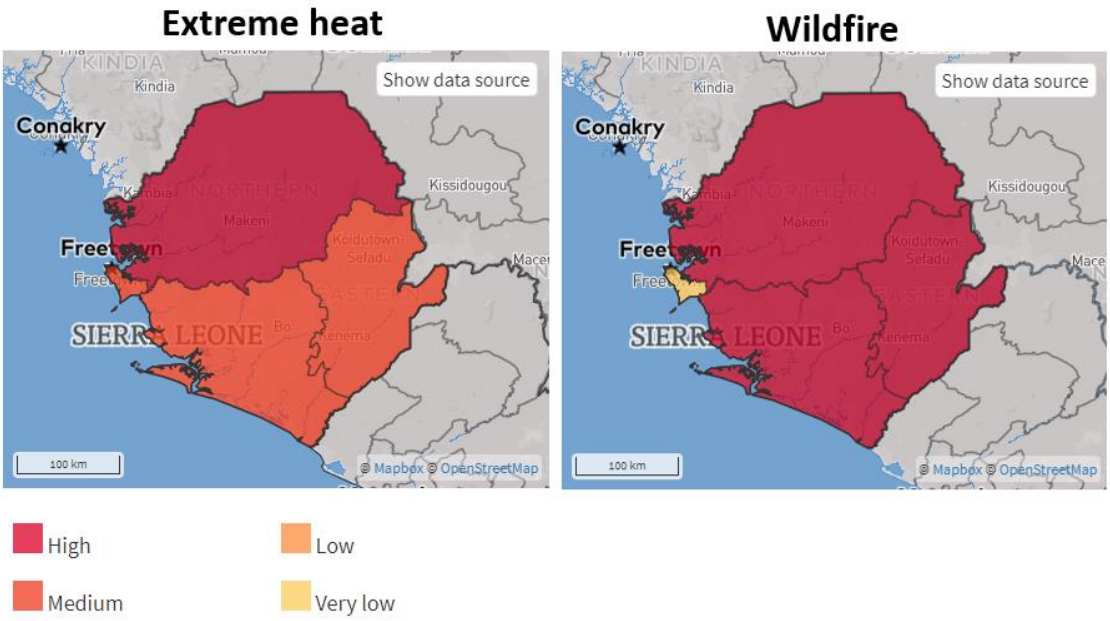


Figure 34. Heat risk in Sierra Leone (*Source: Think Hazard, 2019)*[100]

➢ Economic barriers

In the last decade of the 20th century, Sierra Leone was plunged into a civil war. In 2002, with the support of the international community, the civil war ended. The UN International Peace Mission announced the end of hostilities in 2002, and free elections were held in 2002. However, despite the end of the war, the socio-economic problems that caused the instability, are still present in Sierra Leone, and some analysts fear a resurgence of violence. Some of these problems are low economic growth in relation to the country's needs, unemployment, and extreme poverty.

For 2019 a growth of 4.8% is expected according to data from the World Bank, driven by increased activities in agriculture and construction as well as the resumption of iron production and exports. Growth in these labour-intensive sectors could make a dent on poverty which remains widespread in the country (more than half of the population live in poverty, according to the latest Sierra Leone Integrated Household Survey (SLIHS)) [101]. Growth in these sectors, in a context of high incidence of poverty, puts pressure on land use for conservation and plantation forestry.

In Sierra Leone it is hard for small and medium-sized enterprises to access credit. The World Bank's Doing Business 2020 Report[102] ranked Sierra Leone at 165 out of 190 economies for "getting credit". The category was assessed by reference to (a) movable collateral laws (the strength of legal rights of borrowers and lenders in secured transactions) and (b) credit information systems (the

[100] https://thinkhazard.org/es/report/221-sierra-leone

[101] See https://www.worldbank.org/en/country/sierraleone/overview#1

[102] See http://documents.worldbank.org/curated/en/784291575365792406/pdf/Doing-Business-2020-Comparing-Business-Regulation-in-190-Economies-Economy-Profile-of-Sierra-Leone.pdf

sharing of credit information). The lending interest rate in Sierra Leone was reported at 17.92% in 2017, according to the World Bank. Access to credit is a major barrier to the forestry project because it limits the possibilities of financing additional reforestation activities, which have a considerable payback period (Table 30).

Table 30. Getting credit in Sierra Leone

Indicator	Sierra Leone	Sub-Saharan Africa	OECD[103] High Income	Best Regulatory Performance
Strength of legal rights index (0-12)	5	5.1	6.1	12 (5 Economies)
Depth of credit information index (0-8)	0	3.9	6.8	8 (53 Economies)
Credit registry coverage (% of adults)	2.1	8.3	24.4	100 (2 Economies)
Credit bureau coverage (% of adults)	0	11	66.7	100 (14 Economies)

Source: The World Bank's Doing Business 2020 Report, 2019[99].

As a conclusion, the identified barriers and the key aspects presented in each one is summarised in the following table:

Table 31. Barriers analysis summary

Identified Barrier	Key points
Political barriers	Corruption Historical condition (Ebola disease, civil war) Lack of technology development Lack of infrastructure
Barriers relating to land tenure, ownership, inheritance, and property rights	Customary land tenure system Lack of land administration with inaccurate records Corrupt land adjudication processes
Financial barriers	High sensitivity to variation in timber production when no VER income is involved
Climatic condition barriers	High vulnerability to extreme heat

[103] Organisation for Economic Co-operation and Development

Substep 2: Elimination of land use scenarios that are prevented by the identified barriers

In Table 32, below, the alternative land use scenarios and the barriers they face are presented:

Table 32. Alternative scenarios and barriers identified

Alternative scenario	Identified Barriers
Agricultural households	None of the barriers identified. Government: This activity does not face any barrier since it has been developed as part of a rural population tradition. For this reason, people can execute it without a problem if the Government corruption continues. In addition, as it has been practiced in an artisanal way and mostly for self-consumption purpose, people do not require technology or infrastructure since they are used to managing it in that way. Technology: Infrastructure, technology, and Government support, could improve the production conditions of crops. However, the current characteristics of the production has remained and most probably people can continue producing their food in the same way. Land tenure: Regardless of the land, the rural population does not have any issues with land tenure, since the districts where the project area is located remains a customary land tenure type. The Paramount Chiefdoms can lease part of the land, but they are not allowed to lease the whole territory, also, they must consider the opinion of the local leaders.
Industrial mining	All the barriers described in the Substep 3a. Technology: this activity requires infrastructure for its exploitation. Given the lack of infrastructure and technology development in Sierra Leone, international companies must face a high risk of investment in a country characterised by corruption, political and economic instability. The reason why these characteristics are considered as limitations for this sector as they produce fear for private investors. Land tenure: In addition, land tenure is another limitation since, in the same case of the project activity scenario, the investor must negotiate with the Paramount Chief lessees, which represent an additional cost for the project and additional risk since it is possible in the case of a bad relationship with the local communities that they would act against the mining.
Artisanal mining	None of the barriers identified. Similar to an agricultural household, artisanal mining does not face any of the mentioned barriers. This is because this activity is part of the tradition of local communities, which have been used to this practice for many years. In addition, the execution of this activity does not require a technological machinery or a complex infrastructure, instead, people require basic instruments. In addition, this activity represents a source of income that is produced when crop production is low due to

	climate conditions. Also, artisanal mining is one of the most common activities developed by the younger generations, which represents a large proportion of the total population. This activity does not require an inversion and is practiced in a rudimentary way.
Afforestation/Reforestation activities without being registered as the A/R project activity in VCS	Economic and financial barriers during the initial stages, due to increased risks and high sensitivity of timber production variations.

Outcome from sub-step 2b:

According to the analysis, the potential baseline scenarios are reduced to those that do not face barriers:

1. Agricultural household
2. Artisanal mining

Sub-step 2c. Determination of baseline scenario

The most plausible scenarios which would occur in the absence of the project, are agricultural households and artisanal mining since they are the most plausible economic activities people are used to developing. These ancient activities have been learnt as part of the local traditions and represent the main source of incomes for the rural population, providing a basic livelihood. Nevertheless, these activities have not been supported by the Government, which has been strongly promoting an industrial economy based on cash crops and large-scale mining.

In the case of agricultural households, in the districts where the project area is located, the land tenure is customary, where the families continue to grow and have enough land to develop farming activities for food consumption, and generate some income when the production allows to sell the surplus products in the market. Agriculture is the main activity to food security in the country.

Regarding artisanal mining, this is a common activity developed by a young population and women for a specific step in the exploitation of gold. People are used to alternate activities according to the climate conditions, for example, during the months when rice production is low, people spend time in artisanal mining to find a balance in their household's economy.

Step 3: Investment analysis

The investment analysis was not carried out. **Step 4: Common practice analysis**

The forestry sector has not been one of the main economic sectors in Sierra Leone, so it has not been included in the main Government policies to diminish poverty and increase food security among the rural population. For instance, in the National Agricultural Development Plan[104] and Population and Housing Census[105], this sector does not represent the main goal of the Government neither does this sector appear as a strategic economic sector for the country.

Besides the lack of policies to promote the development of the forestry sector, the lack of road infrastructure, the land tenure system and the lack of workforce in the forestry sector has made companies interested in investing in Sierra Leone, should they invest large amounts of money to fill the gaps. This is not that common, considering the socio-economic situation of the country, which has been characterised by the political and economic instability. That is why some companies are afraid of taking this risk. As a consequence and according to World Agroforestry Centre[106], there are four carbon projects in Sierra Leone, one of these is an REDD+ project while the other projects are AR and ALM projects, with just one project registered in the VCS project database - the REDD+ project. Thus, it is possible to conclude reforestation projects are not considered as a common practice within the country.

3.5 Additionality

The additionality of the project was performed using the combined tool to identify the baseline scenario and demonstrate additionality in A/R VCS project activities (Version 01). See section 3.4 for more details.

3.6 Methodology Deviations

No methodology deviations were applied.

4 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The methodology "AR-ACM0003 A/R Large scale Consolidated Methodology: Afforestation and reforestation of lands except for wetlands (Version 2.0)" was considered.

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

[104] Supports/1_PDD/Annex/Library/National_agriculture_development_plan_2010_2030
[105] Supports/1_PDD/Annex/Library/Census_Agriculture_Report_2015
[106] Supports/1_PDD/Annex/Library/World Agroforesty Center, 2016

Where:

$\Delta C_{BSL,t}$ = Baseline net GHG removals by sinks in year t; t CO2-e

$\Delta C_{TREE\_BSL,t}$= Change in carbon stock in baseline tree biomass within the project boundary in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO2-e

$\Delta C_{SHRUB\_BSL,t}$= Change in carbon stock in baseline shrub biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO2-e

$\Delta C_{DW\_BSL,t}$= Change in carbon stock in baseline dead wood biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO2-e

$\Delta C_{LI\_BSL,t}$= Change in carbon stock in baseline litter biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO2-e

Considering that the biomass distribution over the project area is not homogeneous, a landcover stratification was carried out:

The initial project area of 5,600.99 ha, at the end of the year 2013, included 888.61 ha of forest land, which is equivalent to 15.87% of the total project area. The grassland occupied the largest proportion with 4,696.16 ha, equivalent to 83.85% of the total area. The rest of the area is covered by cropland, equal to 0.29% of the project area (Table 33).

Table 33. Landcover categories at the baseline scenario.

Land Use Land Cover 2014	Area (ha)	% of area
Forest Land	888.61	15.87%
Cropland	16.22	0.29%
Grassland	4,696.16	83.85%
Total	**5,600.99**	**100%**

As a next step, 888.61 ha of forest land is taken and cartographically intersected with the 4,713.30 ha of eligible area, obtaining 227.72 ha that doesn't meet the eligibility criteria. The following table shows the result of crossing between layers.

Table 34. Intersection between eligible areas and forest land

Eligibility	Period	Land Use Land Cover 2013	Area (ha)
Eligible	2006 - 2016	Forest Land	46.64
Eligible	2007 - 2017	Forest Land	134.60
Eligible	2008 - 2018	Forest Land	7.31

Eligibility	Period	Land Use Land Cover 2013	Area (ha)
Eligible	2009 - 2019	Forest Land	39.16
Total			**227.72**

The 227.72 ha were reclassified and became ineligible areas, obtaining the partial eligibility layer:

Table 35. Forest land discounts

Period	Initial eligibility (ha)	Discounted areas	Partial eligibility (ha)
2006 - 2016	839.49	46.64	792.85
2007 - 2017	1,121.34	134.60	986.74
2008 - 2018	1,456.30	7.31	1,448.99
2009 - 2019	1,296.17	39.16	1,257.01
Total	**4,713.30**	**227.71**	**4,485.59**

WETLANDS ANALYSIS

It were identified 497.16 ha of wetlands in the project area, with Marshes being the category that occupies the most area (Table 36).

Table 36. Wetlands in the project area

Code	Wetland category	Area (Ha)	% of area
0	No wetlands	5,103.83	91.12%
30	Swamps - Incl. bogs	84.19	1.50%
80	Marshes	378.82	6.76%
100	Marshes - Wet meadows	34.16	34.16%
Total		**5,600.99**	**100%**

Finally, the 497.16 ha of wetland were cartographically intersected with the 4,485.59 ha of the partial eligibility layer, obtaining a total of 465.03 ha that don't meet the eligibility criteria. The result of the cross between layers is shown in Table 37.

Table 37. Intersection between eligible areas and wetlands

Eligibility	Period	Code	Wetland category	Area (Ha)
Eligible	2006 - 2016	30	Swamps - Incl. bogs	29.48
Eligible	2006 - 2016	80	Marshes	181.47
Eligible	2007 - 2017	30	Swamps - Incl. bogs	19.75
Eligible	2007 - 2017	80	Marshes	66.68

Eligibility	Period	Code	Wetland category	Area (Ha)
Eligible	2007 - 2017	100	Marshes - Wet meadows	22.05
Eligible	2008 - 2018	30	Swamps - Incl. bogs	17.95
Eligible	2008 - 2018	80	Marshes	63.11
Eligible	2008 - 2018	100	Marshes - Wet meadows	9.57
Eligible	2009 - 2019	30	Swamps - Incl. bogs	12.41
Eligible	2009 - 2019	80	Marshes	41.37
Eligible	2009 - 2019	100	Marshes - Wet meadows	1.21
Total				**465.03**

The 465.03 ha were reclassified and became ineligible areas, obtaining a preliminar layer of eligibility (Table 38).

Table 38. Preliminar eligibility

Period	Partial eligibility (ha)	Wetland discounts	Final eligibility (ha)
2006 - 2016	792.85	210.94	581.91
2007 - 2017	986.74	108.47	878.27
2008 - 2018	1,448.99	90.63	1,358.36
2009 - 2019	1,257.01	54.99	1,202.02
Total	**4,485.59**	**465.03**	**4,020.56**

From this analysis, it can be concluded that the preliminary eligible area included cropland and grassland (nor wetlands nor forests). For identifying the proportion of each category, the layers of eligible area, cropland and grassland were intersected, with this final result (Table 38):

Table 39. Preliminar landcover stratification at the baseline scenario

Land cover	Cropland	Forest Land	Grassland	Total
Area (ha)	**14,69**	**0,00**	**4.005,86**	**4.020,55**

Taking into account that Grassland is a type of herbaceous vegetation, and according to the methodology (Section 5.5 paragraph 14) “GHG emissions resulting from removal of herbaceous vegetation, combustion of fossil fuel, fertilizer application, use of wood, decomposition of litter and fine roots of N-fixing trees, construction of access roads within project boundary, and transportation attributable to the project activity shall be considered insignificant and therefore accounted as zero.

With regards Cropland, as the project developer cannot assure the non-displacement of this agriculture, such area has been excluded from the project area.

Table 40. Final landcover stratification at baseline scenario

Land cover	Cropland	Forest Land	Grassland	Total
Area (ha)	**0**	**0**	**4.005,86**	**4.005,86**

As a conclusion, considering that the only landcover at the baseline is Grassland, the baseline emissions can be considered as zero.

Taking into account the above-mentioned statement, and in order comply with Section 3.2.4 of the VCS Standard, v4.1, which states that for ARR projects "the project area shall not be cleared of native ecosystems within 10 years of the project start date", an additional analysis was performed.

Project area Grassland land cover is the result of historical deforestation and degradation of the area caused by agricultural and mining activities. This statement can be supported by the Environmental and Social Impact Assessment ESIA study, submitted along with the supporting documentation.

In this study, it is indicated that there is a very limited tree cover over the project area, save for sporadic sacred groves near villages, the entire area has suffered heavily from slash and burn agriculture and charcoal production for local consumption as well as for sale in the local cities.

"For these reasons, and originally to profit from high-value indigenous hardwood sales, Sierra Leone has suffered some of the worst deforestation in West Africa, many estimating it to be over 90% within the last 100 years." In the same study, it is stated in section 4.6.3 Vegetation, "About 75% of the project area is covered by farm bushes, with vast areas characterized by thick secondary undergrowth, believed to have been part of the Tropical Rainforest, but having been subjected to clearing, burning and tree cutting for several years"

In the same line, different sources confirm the statement of original forest vegetation in the country:

- **Terrestrial Ecoregions of the World (WWF 2012):** According to this source[107], the project area falls completely in the ecoregion Western Guinean Lowland Forest indicated in the map as Tropical and Subtropical Moist broadleaf forest, as presented in the next figure:

[107] https://www.worldwildlife.org/publications/terrestrial-ecoregions-of-the-world

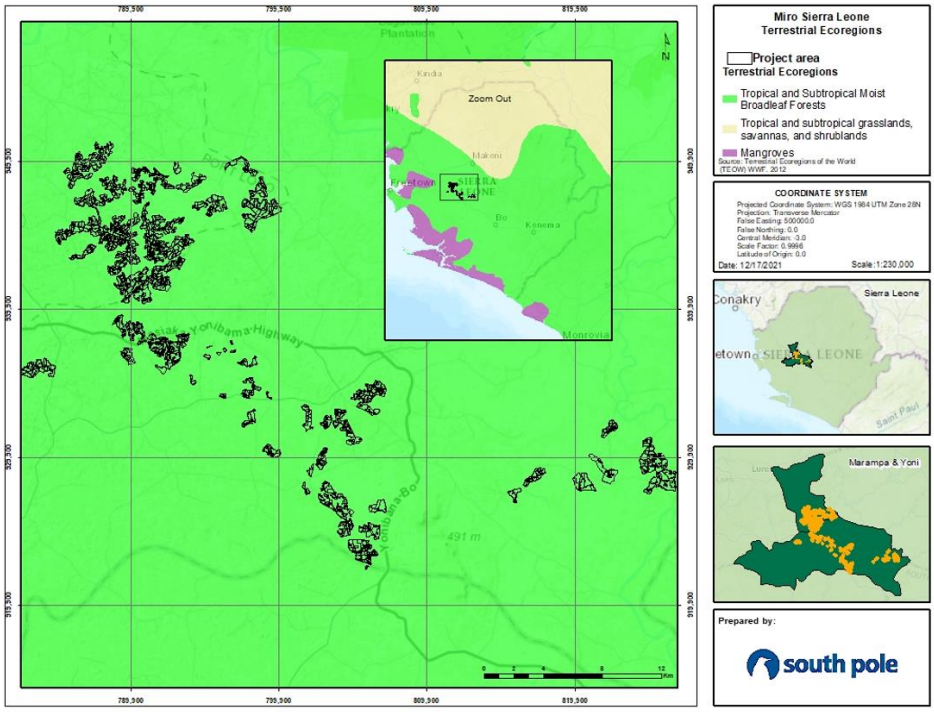


Figure 35. WWF Terrestrial Ecoregions in Sierra Leone

- **Global ecological zoning for the global forest resources assessment - FAO 2000[108]:** This assessment includes country-level information based on existing forest inventory data, regional investigations of land-cover change processes, and a number of global studies focusing on the interaction between people and forests. For Africa, this source[109] indicates two main forest categories covering the entire country are Tropical rainforest and Tropical moist deciduous forest. This is shown in the next figure:

[108] https://www.fao.org/3/ad652e/ad652e00.htm#TopOfPage

[109] https://www.fao.org/3/ad652e/ad652e19.htm#P4052_238205 saved in PDD supporting documents/Annex/FAO Ecological Zoning

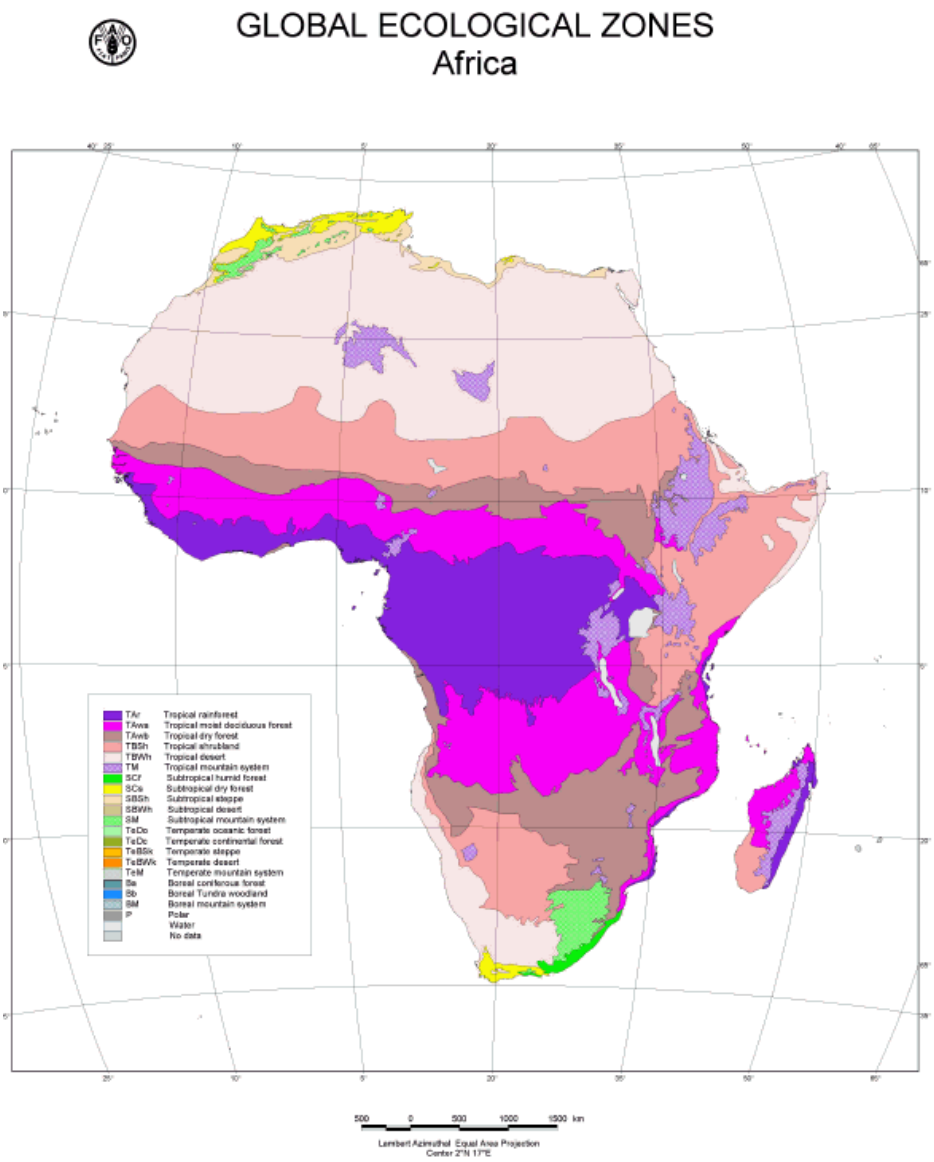


Figure 36. FAO Global Ecological zones in Africa

Considering the elements referenced above, it can be concluded that the grasslands in the baseline scenario are the result of natural forest degradation and do not correspond to a grassland natural ecosystem. Thus, the project complies with Section 3.2.4 of the VCS Standard, v4.1 states that for ARR projects “the project area shall not be cleared of native ecosystems within 10 years of the project start date”.

4.2 Project Emissions

The net estimate of carbon removals was made for the entire plantation eligible area for the 30 years of the crediting period. Following Section 5.5 of the methodology AR-ACM0003 A/R "Large scale

Consolidated Methodology: Afforestation and reforestation of lands except wetlands (Version 2.0)", using the following equation:

$\Delta CACTUALt = \Delta Cp,t - GHGE,t$

Where;

$\Delta CACTUALt$ Net current of GHG removal by reservoirs, in year *t*; tCO_2e.

$\Delta Cp, t$ Change in the carbon stock of the selected reservoirs in the project, in year *t*; tCO_2e.

$GHGE, t$ Increase in non-CO_2e GHG emissions in the limit of the project area as a result of the implementation of the project activities, in year *t*, according to the procedure presented in the Tool.

STRATIFICATION AREA

According to the "AR-ACM0003 A/R Large-scale Consolidated Methodology: Afforestation and reforestation of lands except wetlands (Version 2.0)", if biomass distribution over the project area is not homogeneous, stratification should be carried out to improve the precision of the biomass estimation. Different stratifications may be appropriate for the baseline and project scenarios in order to achieve optimal precision of the estimation of net GHG removals by sinks. In particular, the actual net GHG removals by sinks for the stratification of ex-ante estimations are based on the project planting schedule plan. In the case of project area of first instance, stratification is included in the year of establishment of the project area per tree species (Table 41).

Table 41 Stratums for Net GHG emission reductions and removals

Name	Specie	Year	Area (Ha)	Stratum ID
Aman	*Acacia mangium*	2016	205,31	1,1
Corymbia	*Corymbia citriodora*	2016	63,79	1,2
Eucalyptus	*Eucalyptus pellita*	2016	275,63	1,3
Gmelina	*Gmelina arborea*	2016	21,91	1,4
Other sp	*Other sp.*	2016	13,01	1,5
Acacia	*Acacia mangium*	2017	134,39	2,1
Corymbia	*Corymbia citriodora*	2017	51,53	2,2
Eucalyptus	*Eucalyptus pellita*	2017	529,43	2,3
Gmelina	*Gmelina arborea*	2017	127,49	2,4
Teak	*Tectona grandis*	2017	19,44	2,5
Other sp	*Other sp.*	2017	15,48	2,6
Acacia	*Acacia mangium*	2018	88,75	3,1
Corymbia	*Corymbia citriodora*	2018	113,13	3,2

Name	Specie	Year	Area (Ha)	Stratum ID
Eucalyptus	*Eucalyptus pellita*	2018	1032,86	3,3
Gmelina	*Gmelina arborea*	2018	60,38	3,4
Teak	*Tectona grandis*	2018	3,84	3,5
Other sp	*Other sp.*	2018	56,06	3,6
Acacia	*Acacia mangium*	2019	242,47	4,1
Corymbia	*Corymbia citriodora*	2019	18,95	4,2
Eucalyptus	*Eucalyptus pellita*	2019	755,81	4,3
Gmelina	*Gmelina arborea*	2019	135,97	4,4
Teak	*Tectona grandis*	2019	37,80	4,5
Other sp	*Other sp.*	2019	2,45	4,6
			4005,86	

Additionally, there were included the future areas to be established (Table 42):

Table 42. Future plantation

Year	*E. pellita* (ha)	*A. mangium*	*G. arborea*	Total
2020	900	150	450	1500
2021	900	150	450	1500
2022	900	150	450	1500
2023	900	150	450	1500
2024	900	150	450	1500
2025	900	150	450	1500
TOTAL	5400	900	2700	9000

The species *Corymba citriodora, Tectona grandis* and Other sp will be no planted in the future years.

REMOVALS BY SINKS

The quantification of project emissions and/or removals was calculated following Section 5.5 of the AR-ACM0003 Methodology "A/R Large-scale Consolidated Methodology Afforestation and reforestation of lands except wetlands".

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

Where:

$\Delta C_{ACTUAL,t}$ Actual net GHG removals by sinks, in year *t*; tCO_2e

$\Delta C_{P,t}$ Change in the carbon stocks in the project, occurring in the selected carbon pools, in year *t*; tCO_2e

$GHG_{E,t}$ Increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year *t*, as estimated in the Tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; tCO_2e

And,

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

Where:

$\Delta C_{TREE\_PROJ,t}$ Change in carbon stock in tree biomass in project in year *t*, as estimated using the Tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; tCO_2e.

$\Delta C_{SHRUB\_PROJ,t}$ Change in carbon stock in shrub biomass in project in year *t*, as estimated using the Tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; tCO_2e.

$\Delta C_{DW\_PROJ,t}$ Change in carbon stock in dead wood in project in year *t*, as estimated using the Tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; tCO_2e.

$\Delta C_{LI\_PROJ,t}$ Change in carbon stock in litter in project in year *t*, as estimated using the Tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; tCO_2e.

$\Delta SOC_{AL,t}$ Change in carbon stock in SOC in project in year *t*, in areas of land meeting the applicability conditions of the Tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities", as estimated in the same tool; tCO_2e.

Estimating carbon stock in trees at given point in time.

To estimate the carbon stock in tree biomass at a given point in time, the Tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities AR-TOOL14 (Version 4.1)" was used. According to Section 8.2 of this Tool, this method is used for ex-ante estimation of the carbon stock in tree biomass.

Step 1. Volume estimation

Although information about models for predicting trees volume values from age of plantation is scarce for the species of the project activity, it is conservative to use yield values from the project data of the expected average net increment in volume (MAI) for industrial processing. The MAI values are more suitable for the species presented in Table 43 .

Table 43. Average MAI data per specie

Specie	MAI	Source
Eucalyptus	20.0	(Mattia & Sesay, 2020)(Yepes, y otros, 2011)Protocol for national and subnational biomass-Carbon estimation in ColombiaTable 11.
Acacia	26.0	(Yepes, y otros, 2011)Protocol for national and subnational biomass-Carbon estimation in Colombia. Table 11.
Corymbia	16.0	FAO - Forest Resources of Tropical Africa[110] (The MAI value employed is an average between 12 and 20 m3/ha/yr)
Gmelina	13.7	(UST, 1994). Growth and biomass production of Gmelina arborea in conventional plantations in Ghana. Ghana Journal of Forestry, 1, 5.
Teak	10.3	(Mattia & Sesay, 2020).Ground Forest Inventory and Assessment of Carbon Stocks in Sierra Leone, West Africa. In Natural Resources Management and Biological Sciences.
Other Species	6,8	Project data

Ex-ante or projected estimations were made based on existing literature. There is not much public written literature of growing plantation in Sierra Leone, thus, the growth rate employed was selected for other countries, considering similarities in the climatic conditions.

Step 2. Biomass estimation

The estimation of standing tree biomass for each stratum was calculated according to Equation 13 of the AR-TOOL14 and Equation 5 of the Appendix 1 from the AR-TOOL14:

$$B_{tree} = A \times b_{tree}$$

B_{TREE} = Tree biomass in the tree biomass estimation strata; t d.m.

A = Sum of areas of the tree biomass estimation strata; ha

b_{TREE} = Mean tree biomass per hectare in the tree biomass estimation strata; t d.m. ha-1

And,

$$b_{TREE} = [V_{TREE} \times D \; x \; BEF_2] \times (1 + R)$$

[110] http://www.fao.org/3/ad909e/ad909e00.htm

b_{TREE} = Mean tree biomass per hectare in the tree biomass estimation strata; t d.m. ha-1

V_{tree} = Mean tree volume per hectare in the tree biomass estimation strata; m^3 ha-1. For this case, it will be the MAI value of each species multiplied by the respective year of plantation establishment.

D = Basic wood density; t m-3

BEF_2 = Biomass Expansion Factor; dimensionless

R = Root-to-shoot ratio; dimensionless

Step 3: Mean carbon stock in terms of CO_2e

The conversion of the standing tree biomass for each stratum in term of carbon units was calculated according to Equation 12 of the AR-TOOL14:

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

C_{TREE} = Carbon stock in trees in the tree biomass estimation strata; tCO_2e

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

B_{TREE} = Tree biomass in the tree biomass estimation strata; t d.m.

Carbon in deadwood and litter was calculated using Equations 9 and 15 of the Tool "A/R Tool 12: Estimation of carbon stocks and change in carbon stocks in dead Wood and litter in A/R CDM projects activities" of the AR-ACM0003 Methodology. This accepts the use of a conservative default value, which relates to the carbon content (in deadwood and litter) as a percentage of the total carbon in the tree's biomass.

$CDW,i,t = CTREE,i,t \; x \; DFDW$

Where,

$\boldsymbol{CTREE}, \boldsymbol{i}, \boldsymbol{t}$ Carbon stock in the biomass of trees in stratum *i* at a time point in year *t* (tCO_2e).

Conservative default value expressing carbon stock in deadwood as a percentage of carbon stock in tree biomass (tCO_2e).

$CLI,i,t = C_{TREE,i,t} \; x \; DF_{LI}$

Where,

$\boldsymbol{CLI}, \boldsymbol{i}, \boldsymbol{t}$ Leaf litter carbon stock in stratum *i* at a time point in year *t* (tCO_2e).

$\boldsymbol{CTREE, i, t}$ Carbon stock in the biomass of trees in stratum *i* at a time point in year *t* (tCO_2e).

The conservative default value that expresses the carbon stock in the litter as a percentage of the carbon stock in the tree biomass (tCO_2e).

Soil organic carbon (SOC) was calculated using Equations 1, 2, 6, and 8 of the "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" of the AR-ACM0003 Methodology.

$SOCInitial,i = SOCRef,i\ x\ fLU,i\ x\ fMG,i\ x\ fIN,i$

Where,

$\boldsymbol{SOCInitial}$, Soil organic carbon stock at the start of the project activity in stratum *i* of the soil areas (tC/ha).

$\boldsymbol{fLU}$, $\boldsymbol{i}$ Relative factor of change of stock for land use at baseline in stratum *i* of soil areas (dimensionless).

$\boldsymbol{fMG}$, $\boldsymbol{i}$ Relative factor of change of the stock for the management regime in the baseline in the stratum *i* of the soil areas (dimensionless).

$\boldsymbol{fIN}$, $\boldsymbol{i}$ Relative factor of change of the stock for the regime of reference inputs in stratum *i* of the soil areas (dimensionless).

$\boldsymbol{SOCRef}$, $\boldsymbol{i}$ Reference to the soil organic carbon stock (SOC) corresponding to the reference of native soil condition by climatic region and soil type applicable to stratum *i* of the soil areas (tC/ha).

$SOC_{LOSS},i = SOC_{INITIAL}$, i*0.1

Where:

SOCLOSS, *i* SOC loss is caused by disturbances attributable to the AR project activity, in stratum *i* of the soil area; tC/ha.

0.1, Approximate proportion of SOC loss within the first five years from the year of preparation.

The values of $SOC_{Ref,i}, f_{LU,i}, f_{MG,i}, f_{IN,i}$, are taken from Tables 3 and 6 of the Tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities". The values taken are consistent with the type of soil and the management in the baseline of the project.

The project did not use machinery for silvicultural activities, therefore, there was no disturbance in the soil. Thus, carbon loss is accounted for as follows:

$$SOC_{LOSS,i} = 0$$

$$dSOC_{t,i} = \frac{SOC_{Ref,i} - (SOC_{INITIAL,i} - SOC_{LOSS,i})}{20\ years}$$

Where:

dSOCt, Rate of change in the SOC stock in stratum *i* of the soil areas, in year *t*; tC/ha * year.

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

Where:

ΔSOCAL, *t* Change in the SOC stock in the soil areas that meet the applicability conditions of this tool, in the year; tCO_2e.

Ai Area of stratum *i* of soil areas; ha.

Soil disturbance attributable to project activity was accounted to be greater than 10% of the area of the stratum:

$$SOC_{LOSS,i} = SOC_{initial,i} \times 0.1$$

The rate of change in SOC stock in a project scenario until the steady-state is reached is estimated as follows:

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

$dSOC_{t,i}$ The rate of change in SOC stock in stratum *i* of the areas of land. in year *t*; t C ha-1 yr-1

$SOC_{REF,i}$ Reference to SOC stock that corresponds to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation normally forest) by climate region and soil type applicable to stratum *i* of the land area; t C ha-1

$SOC_{INITIAL,i}$ SOC stock at the beginning of the A/R CDM project activity in stratum *i* of the land area; t C ha-1

$t_{PREP,i}$ The year in which first soil disturbance takes place in stratum *i* of the land area

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

t 1. 2. 3. … years elapsed since the start of the A/R CDM project activity

The application of these equations results in an estimated rate of 0.3 tC ha yr-1 in soil organic carbon (SOC).

The change in SOC stock for all the strata of the land area, in year *t* is calculated as indicated in Equation 8 of the Tool.

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

$\Delta SOC_{AL,t}$ = Change in SOC stock in areas of land meeting the applicability conditions of this tool. in year *t*; tCO_2e

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

$dSOC_{t,i}$ = The rate of change in SOC stocks in stratum *i* of the areas of land; t C ha-1 yr-1

i = 1. 2. 3. … strata of areas of land; dimensionless

Calculation of VERs

According to the standard requirements, for those projects where harvesting practices is contemplated on project activities, the loss of carbon due to harvesting shall be include in the quantification of the project emissions. Due to the project activities contemplate an increment on project area with different rotation periods per specie, the long-term average (LTA) GHG benefit was calculated as follows:

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

Where:

LA The long-term average GHG benefit

PEt The total to-date GHG emission reductions and removals generated in the project scenario (tCO_2e). Project scenario emission reductions and removals shall also consider project emissions of CO_2, N_2O, CH_4 and leakage.

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

t Year.

n Total number of years in the established time-period

The procedure to calculate *PEt* and *BEt* parameters is explained in Section 3.2.4 of this document. In the case of *BEt*, it is accounted as zero as explained in Section 3.2.1. The *LA* estimated for the project is shown inTable 43, which is reached in 2026 .

4.3 Leakage

As indicated in Section **Error! Reference source not found.**, leakage is not expected to occur in the project area due to the project activities, since there will be no displacement of agricultural activities nor grazing activities, so it is deemed to be zero. Thus, it is not included in the calculations.

4.4 Estimated Net GHG Emission Reductions and Removals

The anthropogenic net removal of GHG by the reservoirs was estimated according to Equation 5 of the AR-ACM0003, as presented below:

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

Where:

$\Delta_{CAR-CDM,t}$: Net anthropogenic removal of GHG by reservoirs, in year *t*; tCO_2e

$\Delta_{CACTUAL,t}$: Net current GHG removal from reservoirs, in year *t*; tCO_2e

$\Delta_{CBSL,t}$: Net GHG removals by reservoirs at baseline, in year *t*; tCO_2e

L_{Kt} : GHG emissions due to leaks, in year *t*; tCO_2e. In this case, is deemed to be zero, as indicated in sections 1.17,4.1 and 4.3 Since the baseline removals and emissions due to leaks were considered to be zero, net anthropogenic removals are expressed according to the formula:

$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t}$ –That is equal to

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

After applying the Long-term Average discounts due to regular harvest, the project expects to reduce 1,910,174 tCO_2 during the entire crediting period, without taking into account the risk buffer. The Long-term Average is expected to be reached on the year 11 (Year 2026) of the project (Table 44):

Table 44. Estimated net GHG emission reductions or removals

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2016	0	179	0	179
2017	0	24.075	0	24.075
2018	0	50.673	0	50.673

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2019	0	94,350	0	94,350
2020	0	135,278	0	135,278
2021	0	179,178	0	179,178
2022	0	224,199	0	224,199
2023	0	269,773	0	269,773
2024	0	315,492	0	315,492
2025	0	361,254	0	361,254
2026	0	253,037	0	253.037
2027	0	0	0	0
2028	0	0	0	0
2029	0	0	0	0
2030 - 2045	0	0	0	0
Total	0	1,907,488	0	1,907,488

5 MONITORING

5.1 Data and Parameters Available at Validation

The data and parameters used in the quantification of project removals are shown below. Most of the parameters were defined based on the environmental and climatic conditions described in Chapter 1.12 Project Location.

Data / Parameter	*Root to shoot ratio for mixed tropical broadleaf species (R_{mix})*
Data unit	*N/A*
Description	*Converts the above-ground biomass to the above- and belowground biomass*
Source of data	*IPCC "Good Practice Guidance for LULUCF". 2003. Table 3A.18*
Value applied:	*0.42*
Justification of choice of data or description of measurement methods and procedures applied	*Conservatively chosen for primary tropical/subtropical moist forest.*
Purpose of Data	*Calculation of project emissions.*
Comments	*N/A*

Data / Parameter	*Biomass expansion factor (BEF)*
Data unit	*N/A*
Description	*Converts trunk biomass to total above and belowground tree biomass.*
Source of data	*IPCC 2003, Good Practice Guidance for Land Use, Land-Use Change, and Forestry*[111]*.*
Value applied:	*1.5*
Justification of choice of data or description of measurement methods and procedures applied	Tropical, broadleaf, over bark.
Purpose of Data	*Estimate belowground biomass.*
Comments	*N/A*

[111] https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf

Data / Parameter	*Carbon fraction*
Data unit	*N/A*
Description	*Tonnes of carbon per tonne of biomass dry matter.*
Source of data	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*[112]*. Table 4.3.*
Value applied:	All species: 0.47
Justification of choice of data or description of measurement methods and procedures applied	*It is used for tropical broadleaf whole tree part calculation.*
Purpose of Data	*Calculation of project emissions*
Comments	*N/A*

Data / Parameter	$SOC_{REF,i}$
Data unit	*tonne C ha*$^{-1}$
Description	*Reference soil organic carbon stock*
Source of data	*CDM_AR_tool_16."Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities". Version 01.1.0*
Value applied:	*56*
Justification of choice of data or description of measurement methods and procedures applied	*Tropical, moist. Average (HAC and LAR) for the tropical forest as PP project lies on the border of the moist forest zone.*
Purpose of Data	*Baseline estimations.*
Comments	*N/A*

[112] https://www.ipcc-nggip.iges.or.jp/public/2006gl/

5.2 Data and Parameters Monitored

Data / Parameter	*DBH (Diameter breast height)*
Data unit	*Centimetres (cm)*
Description	*Diameter of the tree at 1.37 m*
Source of data	*Measured by the project proponent*
Description of measurement methods and procedures applied	*Is measured in temporal sample plots, see Chapter 5.3 of this PDD for elaboration*
Frequency of monitoring/recording	*According to the management objectives shown on the monitoring plan (Chapter 5.3).*
Value applied:	*Variable*
Monitoring equipment	*Masser Excalliper II*
QA/QC procedures applied	*Microforest platform database check, outlier's revision, and measurement approval, according to the enumeration procedure.*
Purpose of data	*Calculation of project emissions/reductions*
Calculation method	*N/A*
Comments	*N/A*

Data / Parameter	*Ht (Height)*
Data unit	*Meters (m)*
Description	*Total height of the trees.*
Source of data	*Measured by the project proponent*
Description of measurement methods and procedures applied	*Is measured in temporal sample plots, see Chapter 5.3 of this PDD for elaboration.*

Frequency of monitoring/recording	*According to the management objectives shown on the monitoring plan (Chapter 5.3).*
Value applied:	*Depending on age between 0.5 m and 30 m.*
Monitoring equipment	*Vertex IV Hypsometer: accuracy +/-10 cm.* *Measuring tape: Accuracy +/- 1 cm*
QA/QC procedures applied	*Microforest platform database check, outlier's revision, and measurement approval, according to the enumeration procedure.*
Purpose of data	*Calculation of project emissions/reductions*
Calculation method	*N/A*
Comments	*N/A*

Data / Parameter	Plot location
Data unit	*Latitude, Longitude*
Description	*Plots location coordinates.*
Source of data	Project proponent measurements
Description of measurement methods and procedures applied	*The geographic coordinate of each monitoring plot.*
Frequency of monitoring/recording	*According to the management, objectives showed on the monitoring plan (Chapter 5.3).*
Value applied:	*Variable.*
Monitoring equipment	*GPS of the calliper with an accuracy of 0.5 m.* *GPS navigator.*
QA/QC procedures applied	*Internal audit, according to the data quality steps, described in Chapter 5.3.*
Purpose of data	*Sampling error*
Calculation method	*Direct measurement*
Comments	*N/A*

Data / Parameter	*Plot area A_{plot}*
Data unit	*Square metres (m^2)*
Description	*Total area of sample plots*
Source of data	*PP field monitoring*
Description of measurement methods and procedures applied	*Plot area is measured to guarantee quality and accuracy in the estimations.*
Frequency of monitoring/recording	*According to the management, objectives showed on the monitoring plan (Chapter 5.3).*
Value applied:	*300 m^2 (9.8 m)*
Monitoring equipment	*Vertex IV Hypsometer: accuracy +/-10 cm.*
QA/QC procedures applied	*Internal audit, according to the data quality steps, described in Chapter 5.3.*
Purpose of data	*Sampling error and Calculation of project emissions.*
Calculation method	*Direct measurements.*
Comments	*N/A*

5.3 Monitoring Plan

Miro Forestry has already a procedure that addresses the management of the timber growing stock (volumes) on the plantations and ensures that timber is harvested on a sustainable basis within current market dictates. The forest inventories are called “enumerations” by the Company and are managed by the following organisational structure:

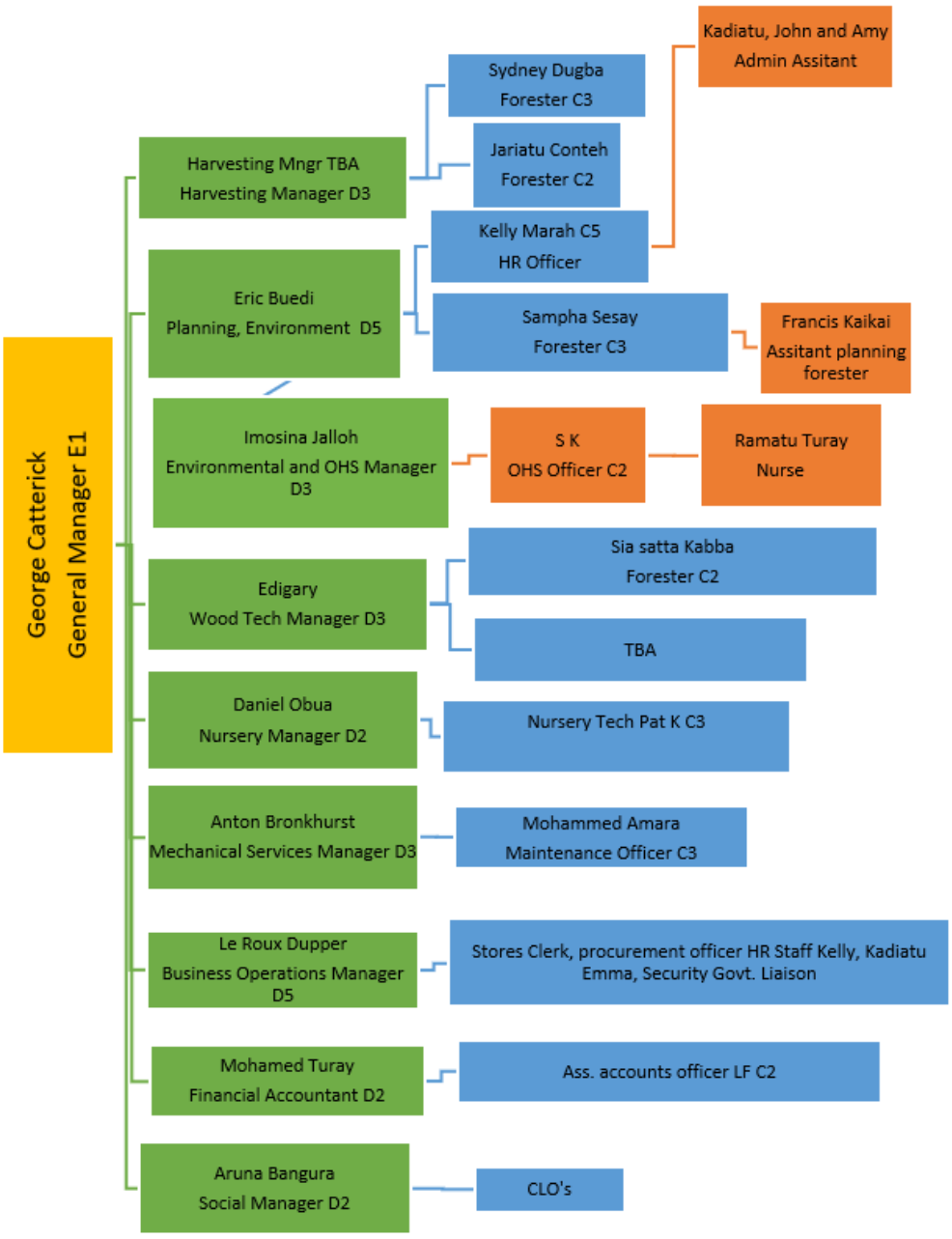


Figure 37. MIRO Sierra Leone Organigram

The following positions in the organisation are responsible for ensuring compliance with the enumeration (inventory) procedure, and perform the corresponding audits to the measurements:

Table 45. Positions in the organisation responsible for enumerations

Overall:	Country General Manager
Data management and quality control	Planning Forester/Manager
Enumerations	Planning Forester/Manager
Marking for thinning:	Enumerators
Audits:	Planning Forester/Manager

The outcomes from the enumerations are saved directly into these sites:

Table 46. Monitoring data record

Record	Responsibility	Where kept	Retention
Microforest Database	Planning Forester/Manager	Microforest	Ongoing
Enumeration Sheets	Planning Forester/Manager	Microforest	Permanent
Audits	Planning Forester/Manager	Planning Office	5 Years

Data quality:

The following steps are required to make sure the data collected are real, logical, and representative:

Table 47. General steps for monitoring

Step	Description
1	The overall accountability for the thinning and thinning control processes being carried out correctly and efficiently remains with the Planning Forester/Manager.
2	The General Manager will approve the analyses and give the final decisions regarding thinning (or remarking) by authorising the inventory analysis record in Microforest.
3	This shall become a permanent record in the database.
4	The concerned Forester is responsible for the effective and timeous execution of the marking and thinning operations.
5	The Planning Forester/Manager is responsible for the inventory process, comprising of the planning and execution, and reporting of the inventory by their team. The data analysis and presentation of the results, with recommendations, to the Plantation Manager for final approval and the incorporation of the inventory data into the plantation database.

Step	Description
6	With the inventory and analysis of the data, the Planning Forester/Manager will give special attention to the following: a) The correct execution of the inventory and data collection by the team b) The statistical validation of the inventory, i.e.: i. sample size (3%-10% by area depending on compartment size and variability) ii. keeping the standard error of the individual components (DBH, Height, and SPH) as far as possible to 5% or lower and the combined standard error (DBH, Height, SPH, and Volume regression) to 10% or lower iii. Acceptable DBH/height regression c) The analysis of the marking process. The following must be checked in detail on the analysis sheets d) Increase in mean DBH of the remaining stand (thinning from below) e) Improvement (narrowing) of DBH distribution after thinning f) More uniform SPHA distribution in the stand after thinning g) SPHA after thinning must be as prescribed in the thinning policy h) Volume from analysis must be made available to the General Manager i. Adjust thinning regime prescriptions where applicable, using the results of the inventories i) Capture the additional information (comments on weeds and pests) that has been gathered by the inventories in the compartment register (MF).
7	The Planning Forester/Manager is responsible for an annual audit of inventory teams.

Type and Frequency of Inventory:

Two basic types of plantation inventories are common practice in managing a company's growing stock (Table 482). Both inventory types should be used extensively and form the backbone of growth and yield prediction and projection in the plantation database.

Table 48. Type of inventory

Type	Description

Type	Description
1	Management Inventories, with the main purpose of determining current volume and quality of stands, and a secondary aim of using this information for predicting their future growth and yield with growth models. An additional advantage is standing information gathering (weeds, pests, etc.).
2	Thinning Control Inventories, which can be used for the same purposes as the management inventories as mentioned above but have the additional advantage of quality control of the marking operation.

The frequency of the enumerations is based on the management objective of the plantation. Currently there are two types of plantations: for sawtimber and fibre:

Table 49. Frequency of inventories

Management Objective	Type of Inventory/Enumeration	
	Thinning Control	Mature stand
Sawtimber	Before thinning	One to two years before harvesting
	Before thinning	One to two years before harvesting
Fibre	N/A	One to two years before harvesting

Field Monitoring

To estimate the total CO_2e content captured by the plantations, with a sampling error of 10% or less, circular plots of 300 m² and square plots of 400 m² were established, using stratified sampling (systematic or random). This sampling was selected because it can control the effect on the variance of the estimates generated by the differences between species and farms.

The following steps are crucial to capture the field data properly:

Table 50. Plot measurements

PLOT MEASUREMENTS	
Step	Description
1	Determine the correct plot boundaries and boundary trees for a 300m² plot (radius 9.8 m) and 400 m² plots (20m of side).

PLOT MEASUREMENTS	
Step	**Description**
2	Diameter at breast height (DBH) of 1.37 m of all trees in the plot shall be measured and recorded to the nearest cm.
3	A minimum of 3 plot measurements is required per compartment inventory.
4	DBH/Height pairs of at least 36 trees spread across the entire DBH range shall be measured per compartment.
5	DBH shall be measured to the nearest mm while height shall be recorded to the nearest 10 cm.
6	Ensure that the sampling intensity regarding stem count (sph) is high enough, especially in small and patchy compartments.
7	Record details on pruned height, tree species, defects, weeds, insects, fungi and climatic damages
8	Evaluation of open spaces and gaps and recommendations for the adjustment of the compartment area (effective area) at the end of the cruise shall be done as specified.
9	If none of the above is seen in the compartment, a record of “clean” shall be recorded.
10	All unusual observations of insects and pest damage shall be reported to the Manager of Research and Development.

Is important to verify the compartment shape before being in the field, to cover all the area and prepare a route plan to improve the measurements yield:

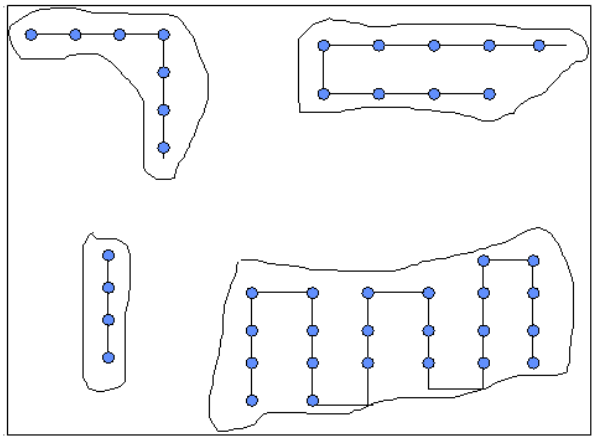


Figure 38. Compartment shape layout

Data collection:

DBH and Location:

The equipment used to collect the DBH´s and the plot coordinates is a digital calliper from the brand Masser® Excalliper II. This machine guarantees +/-0.1 cm error capturing diameter, and 1 m of error capturing the plot coordinate (Figure 39).

Figure 39. Digital calliper

Heights and plot size:

The equipment used to measure the heights is a digital hypsometer from the brand Haglof, Vertex IV® series. This machine guarantees +/-10 cm error capturing heights. With the same machine, the plot diameter is measured with a +/-10 cm error.

Figure 40. Digital Hipsometer

Monitoring of the carbon stock in trees $\Delta C_{TREE\_PROJ,t}$

The estimation of the carbon stock was carried out under Section 8.2 of the Tool "Estimation of carbon stocks and change in carbon stocks in trees and shrubs in A/R CDM project activities", of the AR-ACM0003 Methodology. Under this first verification is presented monitored data for the years 2016, 2017 and 2018 plantations.

Stratum Definition

The management units (stratum) used to manage the information database was defined by plantation age and specie, finding the following:

Table 51. Monitoring stratum

Plantation Year	Species	Stratum	Eligible area (ha)
2016	*Acacia mangium*	1,1	205,3
2016	*Corymba citriodora*	1,2	63,8
2016	*Eucalyptus pellita*	1,3	275,6
2016	*Gmelina arborea*	1,4	21,9
2016	*Other*	1,6	13,0
2017	*Acacia mangium*	2,1	134,4
2017	*Corymba citriodora*	2,2	51,5
2017	*Eucalyptus pellita*	2,3	529,4
2017	*Gmelina arborea*	2,4	127,5
2017	*Tectona grandis*	2,5	19,4
2017	*Other*	2,6	15,5
2018	*Acacia mangium*	3,1	88,7
2018	*Corymba citriodora*	3,2	113,1
2018	*Eucalyptus pellita*	3,3	1032,9
2018	*Gmelina arborea*	3,4	60,4
2018	*Tectona grandis*	3,5	3,8
2018	*Other*	3,6	56,1
	TOTAL		**2812,4**

The total area monitored for the first verification is 2,812,4 hectares.

Volume and Biomass models used

To estimate the biomass and volumes, literature models were used for all the species:

Table 52. Volume and biomass models

Specie	Volume	Biomass
Acacia mangium		X

Specie	Volume	Biomass
Tectona grandis		X
Gmelina arborea	X	
Eucalyptus pellita	X	
Corymbia citriodora		X
Other species		X

These models were selected according to Chapter 1.13 (Conditions Prior to Project Initiation) aiming for the most credible and accurate models. The complete description for each model is explained below.

Acacia mangium

Above ground biomass equation developed by S. Traoré *et al*. (2018)[113] was selected for monitoring estimations from the study for *Acacia mangium* trees located in Ivory Coast, southern west Africa, where precipitation reaches 1766 mm per year and temperatures in a range from 24˚C to 34˚C. In this same study it is state that expansion factor (BEF) decreased with stand age and was 1.66 in 3-year stand, 1.37 in 7-year stand and 1.21 in 11-year stand. These values were incorporated in the estimations.

$$AGBt = \exp(-1.073 + 2.081\ x\ ln(DBH))$$

Where;

AGBt Above ground biomass (kg)
DBH Diameter (cm)

Eucalyptus pellita

Volume equation developed by Nieto V *et al.* (2016).[114] for *Eucalyptus pellita* trees grown under precipitations between 1800 mm to 2000 mm and mean daily temperatures range between 23°C and 30°C was selected for this species.

$$Vt = 0.000051265 \times DBH^{1.8753} \times Ht^{0.9888}$$

Vt Individual tree volume (m^3)

[113] Soulemane, Traore & Djomo, Adrien & Guessan, Anatole & Coulibaly, Brahima & Ahoba, Assandé & Gnahoua, Guy & Guessan, Édouard & Adou, Yao & Kassi, N'Dja & Noël, Zontsika. (2018). Stand Structure, Allometric Equations, Biomass and Carbon Sequestration Capacity of Acacia mangium Wild. (Mimosaceae) in Côte d'Ivoire. Open Journal of Forestry.

[114] Nieto, Victor & Giraldo Charria, Diana & Oviedo, Monica & Borralho, Nuno. (2016). Effects of provenance and genetic variation on the growth and stem formation of eucalyptus pellita in Colombia. Journal of Tropical Forest Science.

DBH Diameter at breast height (cm)

Ht Tree height (m)

Tectona grandis

Stem biomass and volume models[115] were selected for *Tectona Grandis* developed for trees grown in Benin, West Africa; with a mean annual precipitation of 1100 mm and temperatures: 25°C and 29°C

$$AGBt = EXP(-2.1209 + (2.4871\ xLN(DBH))$$

$AGBt$ Above ground biomass per tree(kg)

DBH Diameter at breast height (cm)

Corymbia citriodora

Biomass model[116] selected for *Corymbia citriodora* developed for trees grown under mean annual precipitation of 1037 mm and temperatures between 13.3°C and 26°C in New South Wales, Australia.

$$Ln\ (Stem\ Biomass) = -\ 2.41135 + 2.519862\ x\ ln\ (DBH)$$

DBH: Tree diameter at breast height (cm)

This equation is also used to calculate the biomass for the category "other species" which groups mainly species of eucalypts such as *Eucalyptus urophylla* and stands of mixed species of eucalypts that were used as stands to test the growth of several species. According to the field managers these "other species" have a growth like *Corymbia citriodora* which is a synonym of *Eucalyptus citriodora*.

Gmelina arborea

Volume equation[117] selected for *Gmelina arborea* was developed for trees grown under precipitation from 2500 mm to 3000 mm and temperatures between 26.7°C and 30°C in Moyamba District, Sierra Leone.

$$V = 0.0206 + 0.00004(DBH^2 * Ht)$$

DBH: Diameter at breast height (cm)

Ht: Tree height (m)

[115] GHS Guendehou , A Lehtonen , M Moudachirou , R Mäkipää & B Sinsin (2012) Stem biomass and volume models of selected tropical tree species in West Africa, Southern Forests: a Journal of Forest Science, 74:2,77-88.

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[117] Mattia, Stephen & A., and. (2015). Allometric equations for volume estimation of Gmelina arborea Roxb wood at Singamba forest reserve in Njama, Sierra Leone. Journal of Sustainable Environmental Management. 7. 1 - 10.

Establishment of temporary sample plots

To estimate the total CO_2e content captured by the project plantations, they were established 1,588 circular plots of 300 m^2, distributed in all the defined strata (Table 53).

Table 53. Monitoring plots intensity

Stratum	N° Plots 2020	Sum of sampled area (ha)	Total Stratum Area (Ha)
1,1	56	2,24	205,3
1,2	19	0,57	63,8
1,3	101	3,23	275,6
1,4	48	1,92	21,9
1,6	26	0,78	13,0
2,1	40	1,20	134,4
2,2	13	0,39	51,5
2,3	389	11,67	529,4
2,4	32	1,28	127,5
2,5	18	0,54	19,4
2,6	19	0,57	15,5
3,1	32	0,96	88,7
3,2	79	2,37	113,1
3,3	573	17,46	1032,9
3,4	49	1,79	60,4
3,5	35	1,05	3,8
3,6	59	1,77	56,1
	1588	**49,78**	**2,812.4**

On average the monitoring inventory was performed at 1,76% intensity.

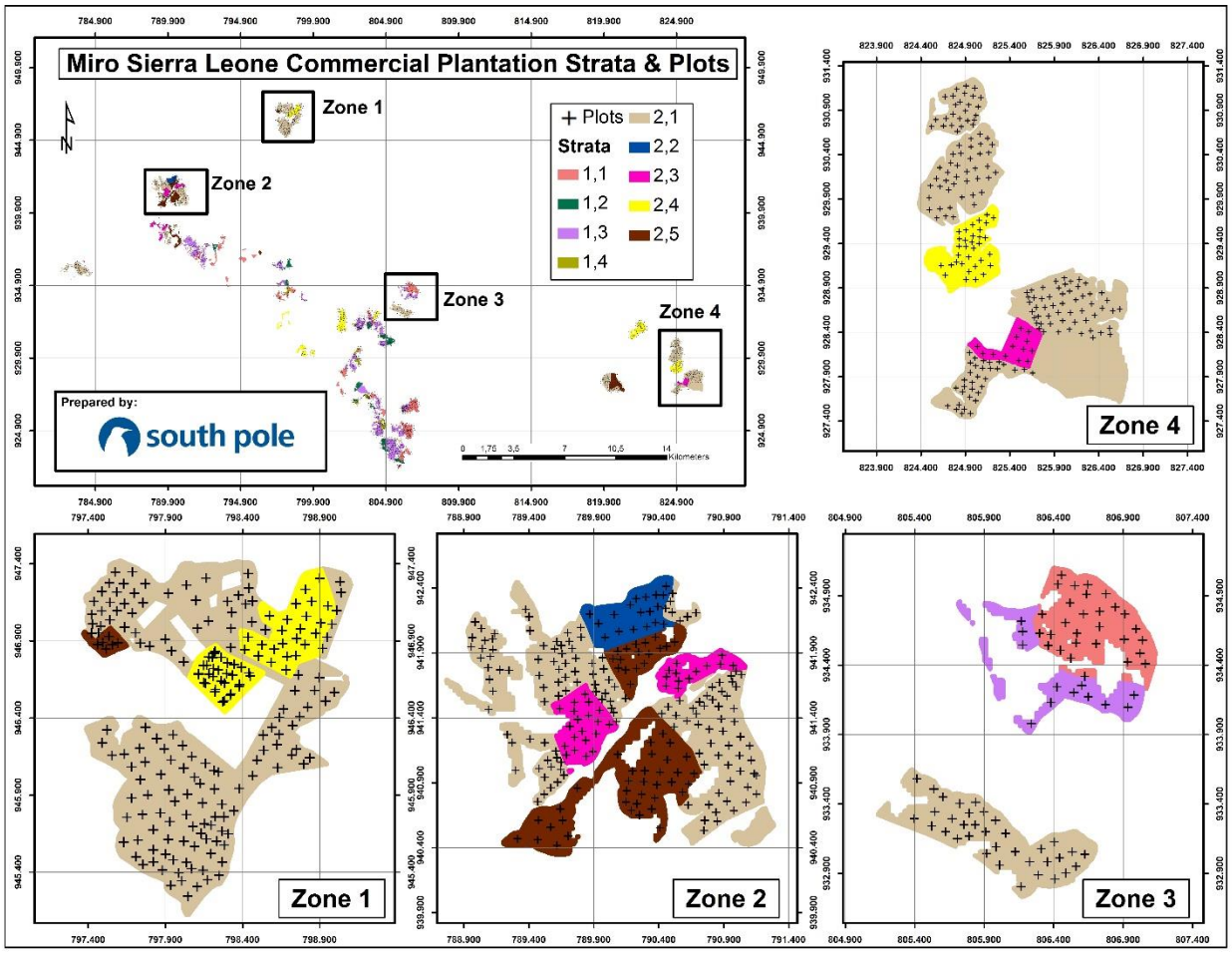

Figure 41. Monitoring plots

The map shows the monitoring plots was zoomed-in in a few areas, into an explicative way due to the scale of the polygons, in the support's shapefile is the complete plots information.

Height Models

It is important to highlight that due to the methodology used by the Company through the software Microforest, it only requires a low sample of heights depending on the diameter frequency, but uses 100% of the diameters to fit with the volume model used by the Company, it means that not all of the height is being measured in the Company enumerations, only the required frequency, and the sample of diameters are higher than the DHB-Ht pairs captured along the compartments measured.

The expression used to estimate the heights were:

DBH-Ht Regression: ln(Ht) = b0+b1/DBH

The coefficients and the expression were extracted from the regressions made by Microforest and can be consulted on the report Annexe 11, with the ex-post estimations spreadsheet[118].

-Sampling error and uncertainly

The sampling error was determined using the following expressions suggested by Cochran, 1977 and Gatz & Smith, 1994:

$$\boldsymbol{E(\%) = \frac{Sye * Z(\infty)}{\bar{X}} * 100}$$

$$\boldsymbol{(SEMw^2) = \frac{1}{n}\left(\frac{1}{\sum pj}\right)\sum Pj(Xi - Xw)2}$$

The result after the process of the database was:

Table 54. Monitoring sampling error

Sampling Error	
Plot area (m²)	300
Total area (ha)	2,812.42
No. Plots established	1,580
Mean standard error (Sy)	0,19
t value(0,05; n-1)	1,961
E(%) Sampling error	0.1

By completing all inputs in the required expression we can conclude that the database of the monitoring inventory is within the quality parameters required <10%.

The uncertainty regarding the change in tree biomass was estimated using the following equation from Tool 14 of the CDM:

$$U\Delta C = \frac{\sqrt{(u1\ x\ Bimass, t1^2) + (u2x\ Biomass, t2^2)}}{\Delta CBiomass}$$

Results of uncertainty calculations are presented in the following tables:

[118] Supports/2. Estimations/Ex-post

Table 55. Uncertainty figures

Year	MU	N° Plots	Sp	Total area (ha)	Sampled area (ha)	Percentage of area sampled (%)	AGB+BGB Biomass (tonnes / ha)	wi	si	wi*bTREE,i	wi2*si2/ni
2016	1,1	56	Acacia	205	2,2	1,1	83,7	0,1	12,5	6,1	0,0
2016	1,2	19	Corymbia	64	0,6	0,9	14,1	0,0	8,2	0,3	0,0
2016	1,3	101	Eucalypt	276	3,2	1,2	29,7	0,1	12,8	2,9	0,0
2016	1,4	45	Gmelina	22	1,9	8,8	49,6	0,0	12,9	0,4	0,0
2016	1,6	26	Other sp.	13	0,8	6,0	24,1	0,0	15,9	0,1	0,0
2017	2,1	40	Acacia	134	1,2	0,9	24,8	0,0	5,7	1,2	0,0
2017	2,2	13	Corymbia	52	0,4	0,8	13,7	0,0	5,7	0,3	0,1
2017	2,3	389	Eucalypt	529	11,7	2,2	6,2	0,2	3,9	1,2	0,0
2017	2,4	32	Gmelina	127	1,3	1,0	45,3	0,0	8,5	2,1	0,0
2017	2,5	18	Teak	19	0,5	2,8	3,6	0,0	3,4	0,0	0,0
2017	2,6	19	Other sp.	15	0,6	3,7	11,5	0,0	5,2	0,1	0,0
2018	1,1	32	Acacia	89	1,0	1,1	27,5	0,0	6,4	0,9	0,0
2018	1,2	79	Corymbia	113	2,4	2,1	11,5	0,0	6,2	0,5	0,1
2018	1,3	568	Eucalypt	1033	17,5	1,7	10,9	0,4	5,4	4,0	0,0
2018	1,4	49	Gmelina	60	1,8	3,0	31,1	0,0	10,8	0,7	0,0
2018	1,5	35	Teak	4	1,0	27,3	1,7	0,0	1,0	0,0	0,0
2018	1,6	59	Other sp.	56	1,8	3,2	2,9	0,0	3,6	0,1	0,0

Table 56. Uncertainty

No. Plots:	1,580
t_val:	1.96
u_c:	2.16%

A total of 2.16% uncertainty was estimated for the current monitoring period, according to the methodological tool there is no discount necessary (<10%). These estimations can be consulted on the ex-post estimations spreadsheet[119].

[119] Supports/2. Estimations/Ex-post

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored

The following parameters were monitored used to quantify GHG emissions and removals achieved for the monitoring period:

Data / Parameter	*DBH (Diameter breast height)*
Data unit	*Centimetres (cm)*
Description	*Diameter of the tree at 1.37 m of height*
Value applied:	*Variable*
Comments	*It is measured by project proponent II in temporal sample plots* using *Masser Excalliper, see Chapter 5.3 of this PDD for frequency and other considerations. Microforest platform database check, outlier revision, and measurement approval, according to the enumeration procedure.*

Data / Parameter	*Ht (Height)*
Data unit	*Metres (m)*
Description	*Total height of the trees.*
Value applied:	*Depending on age between 0.5 and 30 metres.*
Comments	*It is measured by project proponent in temporal sample plots* using *Vertex IV Hipsometer (accuracy +/-10 cm. Measuring tape: Accuracy +/- 1 cm), see Chapter 5.3 of this PDD for frequency and other considerations. Microforest platform database check, outlier's revision, and measurement approval, according to the enumeration procedure.*

Data / Parameter	*Plot location*
Data unit	*Latitude, Longitude*
Description	*Plots location coordinates.*
Value applied:	*Variable.*
Comments	Project proponent measurements. *The geographic coordinate of each monitoring plot (using GPS of the calliper with an accuracy of 0.5 metres, GPS navigator), according with the management objectives showed on the monitoring plan (Chapter 5.3). Internal audit, according to the data quality steps, described on Chapter 5.3.*

Data / Parameter	*Plot area A_{plot}*
Data unit	*Square metres (m^2)*
Description	*Total area of sample plots*
Value applied:	*300 m^2 (9.8 m) and 400 m^2 (20 m)*
Comments	*Data provided from PP field monitoring. The plot area is measured to guarantee quality and accuracy in the estimations, according to the management, objectives showed on the monitoring plan (Chapter 5.3), using a Vertex IV Hypsometer (accuracy +/-10 cm). Internal audit, according to the data quality steps, described in Chapter 5.3.*

6.2 Baseline Emissions

As mentioned in previous sections, considering that the project has no Baseline Emissions, there is no measurement nor discount of carbon to the project scenario.

6.3 Project Emissions

Project emissions shown in Table 57, for the monitoring period considers tree biomass, dead wood, and litter.

Estimating carbon stock of litter and dead wood pools

Carbon in dead wood and litter was calculated using equations 9 and 15 of the tool "A/R Tool 12 estimation of carbon stocks and change in carbon stocks in dead Wood and litter in A/R CDM projects activities" of the AR-ACM0003 methodology, which accepts the use of a conservative default value, which relates the carbon content (in dead wood and litter) as a percentage of the total carbon in the tree's biomass.

$$CDW,i,t = CTREE,i,t \; x \; DFDW$$

Where,

$\boldsymbol{CTREE, i, t}$: Carbon stock in the biomass of trees in stratum i at a time point in year t (tCO_2e). Conservative default value expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass (tCO_2e).

$$CLI,i,t := CTREE,i,t \; x \; DFLI$$

Where,

CLI, i, t: | Leaf litter carbon stock in stratum *i* at a time point in year *t* (tCO_2e). Conservative default value that expresses the carbon stock in the litter as a percentage of the carbon stock in the tree biomass (tCO_2e).

Estimating carbon stock of soil

The tool "Tool for the estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activity Version 1.1.0" was applied to estimate the soil organic carbon (SOC) stocks, as suggested by the tool. The increase in SOC content in the project scenario takes place at a constant rate over a period of 20 years starting from the year of planting.

The initial SOC stock at the start of the project is estimated as follows:

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

Where,

$SOC_{INITIAL,i}$ SOC stock at the beginning of the A/R CDM project activity in stratum *i* of the areas of land; t C ha-1

$SOC_{REF,i}$ Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation normally forest) by climate region and soil type applicable to stratum *i* of the areas of land; t C ha-1

$f_{LU,i}$ Relative stock change factor for baseline land-use in stratum *i* of the areas of land; dimensionless

$f_{MG,i}$ Relative stock change factor for baseline management regime in stratum *i* of the areas of land; dimensionless

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

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

Table 57 Project Scenario - emissions reductions

Stratum	Plantation year	Eligible area (ha)	Dead wood (t/strata)	Litter (tCO2e)	C Tree (tCO2e)	SOC (tCO2e)	Cdw (tCO2e)	CLi (tCO2e)	Total Cabon (tCO2e)
1,1	2016	205	1492	249	42,863	190	2572	429	46,053
1,2	2016	64	74	12	2132	59	128	21	2,341
1,3	2016	276	703	117	20,196	255	1212	202	21,864
1,4	2016	22	93	16	2,675	20	161	27	2,883
1,6	2016	13	26	4	747	12	45	7	812
2,1	2017	134	287	48	8236	83	494	82	8,895
2,2	2017	52	62	10	1771	32	106	18	1,926

Stratum	Plantation year	Eligible area (ha)	Dead wood (t/strata)	Litter (tCO2e)	C Tree (tCO2e)	SOC (tCO2e)	Cdw (tCO2e)	CLi (tCO2e)	Total Cabon (tCO2e)
2,3	2017	529	286	48	8,226	326	494	82	9,128
2,4	2017	127	494	82	14,192	79	852	142	15,264
2,5	2017	19	6	1	162	12	10	2	185
2,6	2017	15	15	3	438	10	26	4	478
3,1	2018	89	211	35	6,071	27	364	61	6,524
3,2	2018	113	116	19	3,320	35	199	33	3,587
3,3	2018	1,033	981	164	28,182	318	1,691	282	30,472
3,4	2018	60	163	27	4,673	19	280	47	5,019
3,5	2018	4	1	0	17	1	1	0	20
3,6	2018	56	15	2	424	17	25	4	471
		2812	**5025**	**837**	**144,327**	**1494**	**8660**	**1443**	**155,923**

A gross total of 155,923tCO_2e was achieved during the current monitoring period, with no discounts from permanence. This period goes from the start date up to 10/01/2020.

6.4 Leakage

As indicated in Section 1.17, there will be no displacement of agricultural activities in the project area and leakage is not expected to occur, so it is deemed to be zero.

6.5 Net GHG Emission Reductions and Removals

Net GHG emission reductions and removals achieved for the monitoring period (16-May-2016 to 10-January-2020), including carbon stocks quantification and a buffer discount of 19% are calculated employing the following equation:

Anthropogenic net removal of GHG by the reservoirs:

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

Where:

$\Delta_{CAR\text{-}CDM,t}$: Net anthropogenic removal of GHG by reservoirs, in year *t*; tCO_2e

$\Delta_{CACTUAL,t}$: Net current GHG removal from reservoirs, in year *t*; tCO_2e

$\Delta_{CBSL,t}$: Net GHG removals by reservoirs at baseline, in year *t*; tCO_2e

L_{Kt} : GHG emissions due to leaks, in year *t*; tCO_2e

However, considering that baseline and leakage are deemed to be zero, as explained in sections 1.17, 4.3 and 4.4, the Net anthropogenic removals are equal to Project removals:

Table 58. VCUs eligible for Issuance

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)	Buffer pool allocation	VCUs eligible for Issuance
2016	0	0	0	0	0	0
2017	0	18,488	0	18,488	3,513	14,975
2018	0	30,447	0	30,447	5,785	24,662
2019	0	53,494	0	53,494	10,164	43,330
2020	0	53,494	0	53,494	10,164	43,330
Total	0	155,923	0	155,923	29,625	126,297

APPENDIX I: REFERENCES

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