REFORESTATION OF DEGRADED LANDS IN SIERRA LEONE

Document Prepared by

South Pole Carbon Asset Management S.A.S.

Project Title	Reforestation of Degraded Lands in Sierra Leone
Version	4
Report ID	MR_2401_v4.4_3968ha_clean
Date of Issue	27-08-2024
Project ID	2401
Monitoring Period	11-01-2020- 20-09-2022
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CONTENTS

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Miro Forestry development limited 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. Miro Forestry Developments Limited (Miro Forestry) has established approximately5,600.99 hectares in Sierra Leone.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 [2]is arranged, payable into a community development fund. Before the establishment of the plantations, the area had a scarce amount of tree cover, mostly 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 20,809 tCO_2e annually and 624,267tCO_2e during the entire project lifetime[3].

The total area under monitoring for first verification was 2812.42 ha (from a total of 4005.86 hectares eligible from the total of 5,600.99 planted in the first verification[4][5]) and 155,923 tCO2e were achieved during the first monitoring (16-05-2016 to 10-01-2020).

The objective of this document is to describe the project activities that have been carried out during the second monitoring period, (11-01-2020-20-09-2022). For the second verification, together with the eligible selected area belonging to the first (2812.42), most

[1] Supporting documents/EHSS and Reports//FSC/FSC MFSL Certificate

[2] Supporting Documents/Additional information/Benefit sharing agreements

[3] Supporting Documents/ SL_ex-ante_2ndverification Aug2024 -3968.xlsx

[4] Referring to the PDD Reforestation of Degraded Lands in Sierra Leone, in section 1.3.

[5] Not all the eligible areas were included (2812.42 from 4005.86 ha) because some of the stands planted less than 2 years ago were not mature enough to be measured. For that reason, strata planted in 2019 were not included on the first verification, and were included in the second verification

of the remaining eligible areas were included (1,155.64 ha), to sum a total of 3968.07[6] hectares for the second monitoring.

The species considered are *Acacia mangium, Eucalyptus pellita, Gmelina arborea* and other species (which includes Corymbia, *Eucalyptus urophylla and Neolamarkia cadamba).* To clarify the different areas and the project evolution the following chart was created:

Areas (ha)	Validation & 1st verification (16/05/2016 – 10/01/2020)		2nd verification (11/01/2020 – 20/09/2022)	
Planted area	5,600.99			
Eligibility	Eligible area	Non-eligible area	Eligible area	Non-eligible area
	4,005.86	1,595.13	3,968.07	1,632.92
Verified/ monitored forest area	2,812.42 Only 2812.42 ha were measured/ monitored, the 1193.46 ha was not considered in the eligible areas since the plantation strata is still younger than 2 years old and couldn´t be measured) Note that the remaining 1193.46 ha remaining to reach all the eligible areas was carried forward to the 2nd verification	This area was determined as non-eligible and discounted from consideration since it was found that it was cartographically intersected with forest land and wetland. Thus, this area was removed from consideration.	3,968.07 The total area is the sum of the area from the 1st validation and verification (2812.42 ha) plus most of the remaining eligible areas (1,155.64* ha) *Note that out of 1193.44 ha that were not counted from the 1st verification, only 1155.65 ha are considered. The remaining 37.79 ha are discounted and added under the non-eligible area.	Not included in the verification following the methodology criteria. This accounts for the 1,595.13 from the non-eligible areas from the first verification, plus 37.79 ha discounted in the second.

Additionally[3], 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. Between 2018 and 2022, within Miro's budget each year, there has been funding channeled to programs within agriculture, education, water, and social services. These include, but are not limited to, 5 tertiary education scholarships in 2018 and 2019, expanding to 8 scholarships in 2022, rice cultivation initiatives in 12 communities, funding for development of new roads and support for people with disabilities within communities annually.[7] At the environmental level, the project included the improvement of the protective functioning 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.

[6] 37.79 ha were discounted due to a crop change in a stand of Teak during the previous years to the verification that made the compartment non-eleigible following the methodology criteria, so therefore the final eligible area is 3968.07 ha

[7] Supporting documents/EHSS and Reports/CSR Report 2018 to 2022

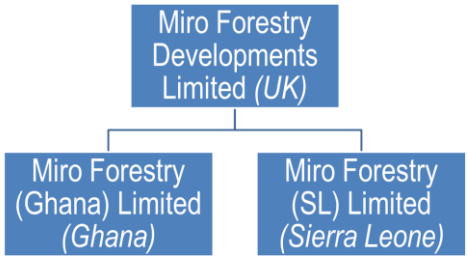
Audit Type	Period	Program	VVB Name	Number of years
Validation and Verification	16/05/2016 - 10/01/2020	VCS	Spanish Association for Standardisation and Certification (AENOR)	Four years and four months
Second Verification	11/01/2020- 20/09/2022	VCS	KBS Certification Services	One year, eleven months.
Total	16/05/2016 – 20/09/2022	VCS	AENOR and KBS	Six years and three months

1.2 Sectoral Scope and Project Type

The sectoral scope of this project is 14, Agriculture, Forestry, and Other Land Uses (AFOLU). Within this category, the project is of the Afforestation, Reforestation, Revegetation (ARR) type. This is not a grouped project.

1.3 Project Proponent

Miro Forestry Developments Limited (Miro Forestry) is a UK incorporated forestry and timber products investment company and is the holding company of the wholly (100%) owned subsidiaries, Miro Forestry (Ghana) Limited and Miro Forestry (Sierra Leone) Limited. MFD is the parent company and therefore wholly owns MFG and MFSL.



Organization name	Miro Forestry Developments Ltd.
Contact person	Mr. Andrew Collins
Title	Co-Founder, CEO
Address	5 Merchant Sq, London, W2 1AY, the United Kingdom
Telephone	Tel: +44(0)7899074158
Email	ac@miroforestry.com

1.4 Other Entities Involved in the Project

Organization name	Miro Forestry (Sierra Leone) Ltd. (Formerly NICOL Miro Forestry)
Role in the Project	Wholly owned subsidiary of Miro Forestry Developments Limited / Ghana operating subsidiary.
Contact person	Mr. Andrew Collins
Title	Co-Founder, CEO
Address	Office 4.01, 1-2 Paris Gardens, London, SE1 8ND, the United Kingdom
Telephone	Tel: +44(0)7899074158
Email	info@miroforestry.com

Organization name	South Pole Carbon Asset Management S.A.S.
Role in the Project	South Pole creates and oversees the development of appropriate project design and monitoring techniques in line with the guidelines of the VCS.
Contact person	Maria Fernanda Buitrago Acevedo

Title	ARR/ IFM Project Lead
Address	Technopark Str. 1, 8005 Zurich, Switzerland
Telephone	Tel: + 41 43 501 35 50
Email	m.buitrago@southpole.com

1.5 Project Start Date

Start date: 16-05-2016

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

1.6 Project Crediting Period

Start: 16-05-2016

End: 15-05-2046

Total number of years: 30 years.

According to Section 3.8.3 of the VCS Standard, the crediting period of AFOLU projects will have a minimum of 20 years and a maximum of 100 years. Therefore, the project activity is in line with the length of the crediting period, and it has the option to renew four more times. PP hasn't decided yet whether they will renew the crediting period or not. It can be decided later.

1.7 Project Location

The project plantations are located in the right (Figure 1). 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.

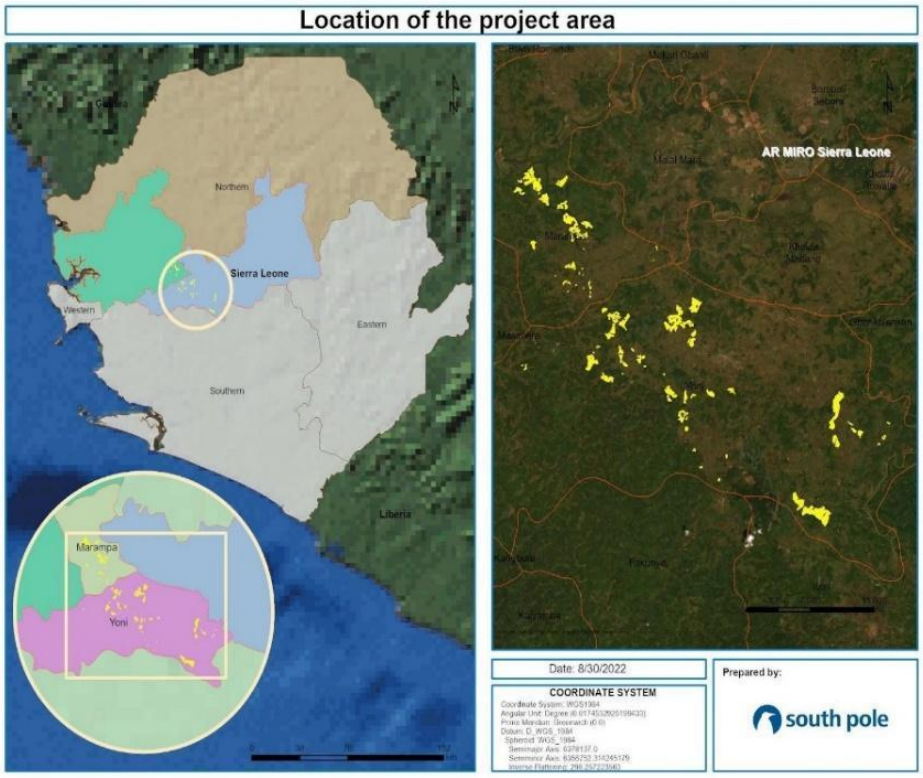


Figure 1: Project Location in Sierra Leone, and the location of the plantations (yellow polygons).

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) redistricting 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 2), 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.

1.8 Title and Reference of Methodology

The CDM consolidated methodology AR-ACM0003 V2.0: Afforestation and reforestation of lands except for wetlands – Version 02.0 was applied. The following tools were applied to the project for this monitoring period:

- Estimation of carbon stocks and change in the carbon stocks of trees and shrubs in A/R CDM project activities (Version 04.2).
- Tool for estimation of the change in soil organic carbon stocks due to the implementation of A/R CDM project activities (Version 01.1.0).
- VCS AFOLU Non-Permanence Risk Tool (Version 4.0); and
- AR-TOOL 15 A/R Methodological tool: Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity Version 02.0.

1.9 Participation under other GHG Programs

The project has not been registered and is not seeking registration under any other GHG program[8].

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

- **Emissions Trading Programs and Other Binding Limits**: there are no other emissions trading programs or binding limits.

- **Other Forms of Environmental Credit:** the project involves reforestation and no other credits than the VCU are aspired for by the project proponent. The project's FSC certification will not generate environmental credits.

- **Supply Chain (Scope 3) Emissions:** There are no scope 3/ supply chain emissions related to this project activity.

1.11 Sustainable Development Contributions

This project has five SDGs that are of a particular focus: No poverty; Gender Equality; Decent Work and Economic Growth; Climate Action; and Life on Land. Given the project's outcomes, the project will continue to ensure that they contribute to the United Nations Sustainable Development Goals. The projects quantifiable contributions to the specific targets and indicators of the SDGs for this monitoring period are provided in Table 1.

[8] Supporting documents/EHSS and Reports/ Miro Carbon Undertaking Letter

Table 1: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	1.3	1.3.1 Proportion of population covered by social protection floors/systems, by sex, distinguishing children, unemployed persons, older persons, persons with disabilities, pregnant women, newborns, work-injury victims and the poor and the vulnerable 	Implemented project activities has increased employment opportunities and reduced poverty.	Between 2018 and 2022, within Miro's budget each year, there has been funding channeled to programs within agriculture, education, water, and social services. These include, but are not limited to, 5 tertiary education scholarships in 2018 and 2019, expanding to 8 scholarships in 2022, rice cultivation initiatives in 12 communities, funding for development of new roads and support for people with disabilities within communities annually.[9]	MFSL has a Policy of Corporate Social Responsibility[10] (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 that assigns costs to promoting positive social and environmental impacts for local communities.[11]

[9] Supporting documents/EHSS and Reports/CSR Report 2018 to 2022

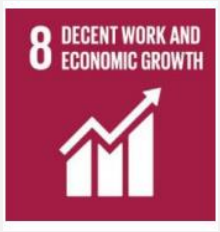
[10] Supporting documents/EHSS and Reports/MFD CSR Overview and Principles (2016.08.24)

[11] NPRT/External risks/MFSL FMP V12 2022.

2)	5.5	Increase women's participation in the workforce 	Implemented activities to increase involvement by women and minority groups in capacity-raising initiatives including climate preparedness, disaster relief and planning.	There has been a 3% increase in female employment to 297 women employed (and 1220 men) over the last three years. As a result of this increase, in 2021, 20% of the workforce was female. There has also been a steady rise in women being promoted and recruited at a more senior level, supporting empowerment at all levels of the organisation[12]. As a direct result of the nature of their work, MFSL ensures involvement by women and minority groups in capacity-raising initiatives including climate preparedness, disaster relief and planning.	Miro has a goal of increasing the number of female employees to an average of 40% across operations[13].

12 Supporting documents/EHSS and Report/Miro Annual Reports/Annual-Report-2020

13 Supporting documents/EHSS and Report/Miro Annual Reports/Annual-Report-2020

3)	8.2	Diversify revenue stream for communities and support existing labour-intensive industries 	Implemented project activities has increased employment opportunities and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	By implementing an emissions reduction project, Miro is providing a second revenue stream to the communities already involved in the plantations. MFSL also spends an annual $2.65m USD in local employment in addition to $331k USD towards land rent. MFSL supports sustainable economic growth through building roads and delivering telecommunications poles for rural electrification.[14]	The 230 students under scholarships funded by Miro should contribute positively to the local economy in the long term.[15] Many people (permanent, fixed-term contracts, and contract labourers) are currently engaged and take active roles in achieving the company's planting objectives)[16].
4)	13	13.2 Integrate climate change measures into national policies, strategies and planning 	The project is concerned with the sustainable development of its activities and its contribution to the mitigation of climate change by decreasing greenhouse gas emissions every year.	The project is estimated to remove. On average, the project gross estimates to remove 57,570 tCO_2e annually and 624,248 tCO_2e[17] during the entire project lifetime.	As a direct result of the nature of their work, MFSL ensures involvement by these groups in capacity-raising initiatives including climate preparedness, disaster relief and planning.

[14] Supporting documents/EHSS and Reports/Miro-Annual-Report-2021_V5_LR._

[15] NPRT/External risks/ MFSL FMP V12 2022.

[16] Supporting documents/PO Information/ EHSS and reports/ Payroll Data_SL

[17] Supporting Documents/Estimations/Updated MR and estimations

5)	15	15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species 	Implemented activities to decrease degradation of natural habitat and prevent loss of biodiversity.	MFSL manages over 8000ha of conservation area including 150ha of rehabilitation planting. Here, MFSL plants indigenous species to encourage the restoration of biodiversity within once degraded forest regions. These conservation areas are managed in a way that joins up riparian areas and connects wildlife corridors. On top of this, MFSL works on 18,500ha of sustainable forest land. Their sustainable timber harvesting and high employment rates within the local communities, aim to prevent unsustainable harvesting of indigenous forests.[18]	The reduction of greenhouse gas emissions through carbon sequestration over the lifetime of the project will not only contribute to local climate action, but also raise awareness within participating communities about the importance of conservation and sustainability,

[18] Supporting documents/EHSS and Reports/Miro-Annual-Report-2021_V5_LR.

2 SAFEGUARDS

2.2 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 ensure a responsible and sustainable forest management standard, the Company obtained an FSC certification 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[19] in 2014 and a new study for areas annexed after 2014[20]. In addition, MFSL performed a Need Assessment Survey[21] in 2016, 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[22]. Below is a summary of the main impacts and the steps taken to mitigate them:

Socio-economic Impacts

The project is expected to provide incomes to more than six hundred People (600) there by contributing to their improved standard of living within the Tonkolili District, especially the Yoni chiefdom in Sierra Leone. On a wider scale, the Project is expected to bring economic benefits to the economy of Sierra Leone in the form of foreign currency, thereby encouraging the Miro Forestry company to plant more tree crops for sale in the European market.

The fringe communities in the project area has also benefited from diverse local employment opportunities that have been opened up by the Company's ongoing development, the benefits of which have a direct positive impact on the communities. Employment is due to increasing over the lifetime of the project, employment enhances the living conditions and wellbeing of the workforce and their families. Small and medium-scale support businesses have also been created due to the company's entry into the community and has boosted local economic activity in villages surrounding the project area[23].

Environmental Impacts

The project has adopted best practices to ensure sustainable management and contribute to the establishment of a vegetative cover to improve soil and water conservation as well as reduce the loss of soil nutrients through erosion.

[19] Supporting documents/ 1_PDD/PO_Information/ESIA/MFSL ESIA FINAL Report (2014)

[20] Support documents/ 1_PDD/PO_Information/ESIA/MFSL ESIA for Miro New Leases – Geodata020082018

[21] Support documents/1_PDD/PO_Information/Procedures/Social/CSR Needs Assessment 2016

[22] Support documents/1_PDD/PO_Information/ESIA/MFSL ESIA FINAL Report (2014)

[23] NPRT/External risks/MFSL FMP V12 2022

The project's plan to respect considerations for environmental conservation by identifying and protecting conservation areas will contribute greatly to environmental conservation of flora and fauna. The environmental benefits expected from the project will include the improvement of the protective function of the remaining extant forest cover within the project area. The project will adopt best practices to ensure sustainable management and contribute to the establishment of a vegetative cover to minimize the intensity of desiccating winds, improvement in soil and water conservation as well as the reduction in the loss of soil nutrients through erosion. The project's plan to respect considerations for environmental conservation by identifying and protecting conservation areas will contribute greatly to environmental conservation on the land areas[24].

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.[25] 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.

The planted areas not included in the eligibility (1,632.92 hectares) do not negatively harm the environment nor the stakeholders. As stated in the PDD[26], 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 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.

Related to this and concerning the environment, MIRO SL is not causing any harm to the it, as explained in the PDD[27] the area there are very limited tree cover. The rest of the areas are degraded woodlands and wetlands. Environmentally sensitive conservation areas are identified during the planning phase of operations and designated as conservation zones which are protected. All conservation zones are captured into the GIS system and into the Microforest conservation database. Management comprise alien plant control, maintenance

[24] NPRT/External risks/MFSL FMP V12 2022

[25] NPRT/External risks/FIRE MANAGEMENT PLAN 2022

[26] Referring to the PDD Reforestation of Degraded Lands in Sierra Leone, Section 2.1.

[27] Referring to the PDD Reforestation of Degraded Lands in Sierra Leone, Section 3.2.

of a buffer between plantations and these natural areas and providing protection against further disturbances.

Regarding the wetlands Miro conducted a detailed survey 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. This has been confirmed by SGS in a Forest Management Report[28] where they reported that they were very impressed in the way Miro have conducted the reforestation and have ensured that no commercial plantings have occurred within at least 20 m of all wetlands.

2.3 Local Stakeholder Consultation

During the second verification period, there were no relevant changes to the project activities implemented that could alter the benefits for the stakeholders. There were also no changes to the risks, costs, financial resources or benefits able to local stakeholders or which is needed to implement the project that could affect the stakeholder groups. All the activities associated with this project is still underway.

MFSL has a Stakeholder Engagement policy and timeline for agreeing in advance land for plantation establishment as well as providing a forum for open discussion with local communities. There is a group of representatives for all landowners named the Amalgamated Area Development Committee. MFSL engages with this committee and with the communities directly, including the Chiefdom Councils. In addition, MFSL has employed Community Liaison Officers who have a constant presence in the communities ensuring all communication channels are open. In 2015 the Company installed a grievance mechanism, whereby any grievance can be communicated to the Company confidentially and without fear of reprisal[29]. The grievances have been addressed in Sierra Leone and a document outlining the nature of the grievances are also provided as a support from Miro.[30]

[28] Supporting information/123151-SL - Miro Forestry SA2019-11 - AD 36-A-19 NM (4).pdf

[29] NPRT/External risks/MFSL FMP V12 2022.

[30] Supporting Documents/Additional Information/Grievance

Figure 2: Image of the grievance box that is stationed within the site for Sierra Leone

Figure 3: Image showing Local stakeholder Consultation in one of the villages in Sierra Leone

There have also been no changes to the relevant laws and regulations[31] covering workers right in Sierra Leone from what was mentioned in section 1.14 in the PDD.

Whilst no new stakeholders have been affected for this monitoring period, Miro Forestry has held and will continue to hold ongoing communication with the local stakeholder groups. The comments from the consultations that took place during this monitoring period did not result in any changes to the project design. More information on the Local Stakeholder Consultation Process that took place during project validation and the information relevant to understanding carbon credits discussed with the stakeholders and the role of the project can be found in section 2.2 of the PDD. Relevant stakeholder engagements that occurred during the monitoring period are described briefly below:

During September and October 2020, Miro undertook extensive stakeholder engagement in the form of multi-stakeholder forums with the local villages. 12 meetings were held in the following communities: Bonkababay, Petifu, Mafala 2, Manjehun, Mapoli, Marainday, Mabankra, Mayolla, Petifu Makoserry, Rosarr, Rosiut Thonkla y Yanbay.[32] 323 participants attended across the two months. Through verbal discussions and visual education materials (figure 3), all participants were made aware of the project design and implementation, risks, costs and benefits, relevant local and national law, and the process of VCS certification (See the stakeholder engagement plan[33] for further details).The topics relevant to the project activities included environment and climate change, water (water cycle, water use, soil (importance, soil cycle), and conservation (ecosystems and conservation and carbon credits). Responses from the community meetings included positive reception to the idea of environmental conservation and the links with positive economic and health benefits. They understood the idea of carbon credits and certification, comparing it to FSC certification with the plantations. The procedures or methods used for documenting the outcomes of the local stakeholder communication.

[31] Supporting documents/EHSS and Reports/MFD policies_2019

[32] Supporting Documents/1_PDD/ Stakeholder_Consultation/ Attendance lists

[33] Supporting Documents/1_PDD/PO_Information/Procedures/Social/Stakeholder Engagement/MFC Stakeholder Engagement Plan 2015

Figure 4: Instructional material presented during the meetings.

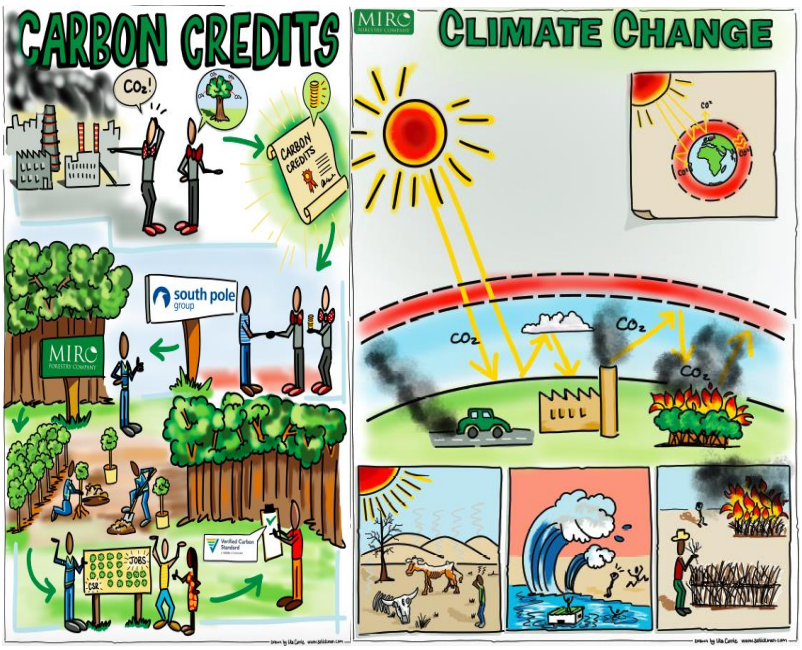


Figure 5: Participants at meetings in Rosiut Thonkla and Mayolla[34]

Overall, the local stakeholders have been made aware of the direct positive impacts of the reforestation project which includes[35]:

- Access to water
- Increased employment opportunities
- Improved road network
- Ongoing educational support

[34] Supporting documents/1_PDD/ Stakeholder_Consultation/ Photos

[35] NPRT/External risks/MFSL FMP V12 2022

- Improved agriculture practices
- Access to healthcare

At each stakeholder engagement that occurs within the project zone, Miro Forestry showcases the slides on the carbon project as seen in Figure 6.

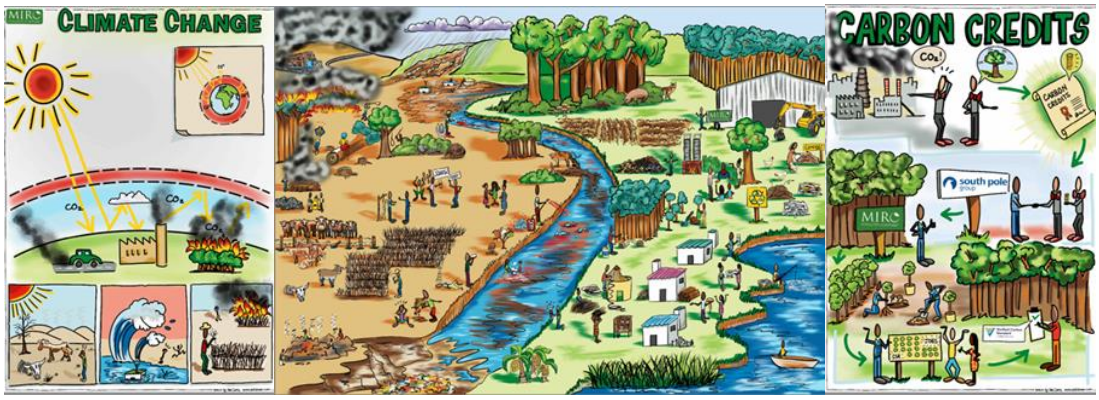


Figure 6 : Slides that are showcased to the stakeholders describing the carbon project at each stakeholder engagement meeting held.

The second verification audit site visit has been communicated to the stakeholder (Miro Forestry). In addition, the Monitoring report has been made available one month before the audit site visit to Miro Forestry.[36]

2.4 AFOLU-Specific Safeguards

Miro Forestry is committed to engaging with local communities who are considered as stakeholders that have impacts on their operational activities and to ensure that they are listened to, and that their views are considered as the company conducts their business. There is an ongoing communication process between Miro Forestry and the stakeholders of the project. In some cases, activities are developed and need to be implemented to mitigate risks posed by project implementation or from the risk posed from local stakeholders on the project activities and these are regularly communicated. Activities implemented to mitigate risks from local stakeholders due to project implementation as identified from section 2.1, include the following environmental and socio-economic impacts. Project has increased employment opportunities for the communities living in fringe areas. There are not many negative impacts that have been identified due to project activities. With regards to fires, fire breaks are managed, the project liaises with traditional authorities to tackle nomadic herdsmen menaces and encourages illegal loggers to

[36] Supporting Documents/EHSS and Reports/Email MR SS

participate in the reforestation activities. The project implementation impacts, and mitigation measures can be referred to in greater detail in section 2.1 of this report.

Stakeholder engagement: Stakeholder engagement: MFSL is committed to engaging with the stakeholder in the communities that its operation impacts, to ensure they are listened to, and their view is considered as the Company conducts their business. To achieve that commitment, MFSL developed a Stakeholder Engagement Plan[37] (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:

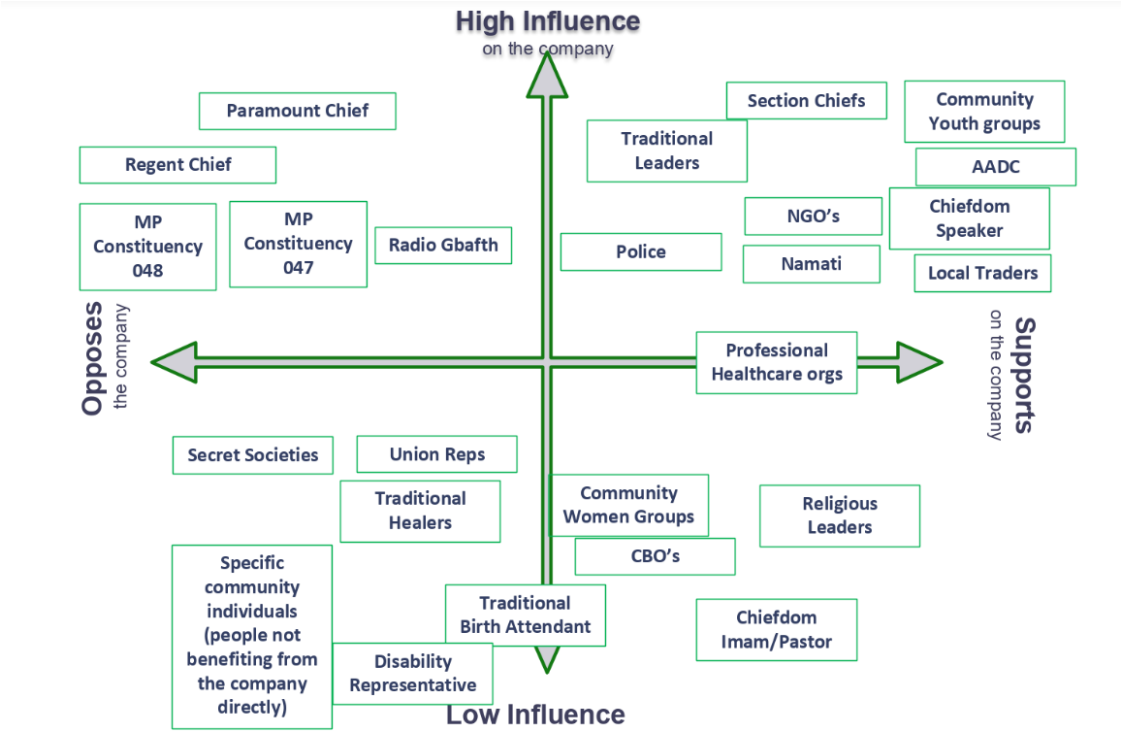


Figure 7: Stakeholder mapping results. MFSL 2018

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

Acronyms:

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

The current results of the stakeholder identification process are provided[38] in the supporting documents folder. A summary of the stakeholders identified (until April 2018) is presented in the following table:

Table 2: 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 3).

Table 3: Stakeholders engagement procedures

ENGAGEMENT PROCEDURE	TOOLS	MFSL COMMITMENT
Information Dissemination: • Written and verbal information about the	• Distribution/displaying of documents (information	Information dissemination strategies must be tailored to benefit specific target groups:

[38] Supporting Documents/1_PDD/PO_Information/Procedures/Social/Stakeholder Engagement/MFSL Stakeholders list April 2018

ENGAGEMENT PROCEDURE	TOOLS	MFSL COMMITMENT
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	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	• 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 information between the Company and stakeholders • Accessible to all groups	• Focus Groups • One-to-one discussions 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	• Relevant information will be provided to stakeholders in advance of consultation • 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

ENGAGEMENT PROCEDURE	TOOLS	MFSL COMMITMENT
		• 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 employed 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[39].

In June 2014, a Livelihood Study[40] 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:

[39] Supporting Documents/1_PDD/PO_Information/Procedures/Social/ MFC Land Development – Policy, Implementation Framework

[40] Supporting Documents/1_PDD/PO_Information/Procedures/Social/ MFSL Livelihood Study and Development Plan

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[41] 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:

[41] Supporting Documents/1_PDD/PO_Information/Procedures/Social/ MFSL Livelihood Study and Development Plan

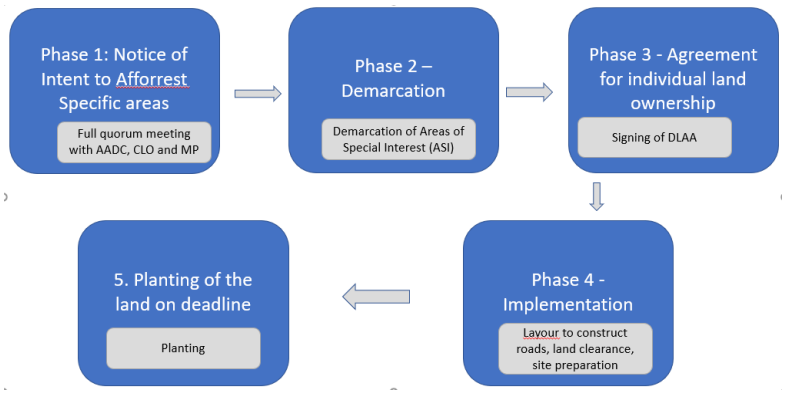


Figure 8: Summary of the procedure to commence land afforestation and stakeholder engagement

3 Implementation Status

3.2 Implementation Status 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 reserve.[42] All activities are described in full detail in the PDD, section 1.11.2. and include such information as Land mapping and planning; management of natural areas; planning, conservation areas; management of commercial areas and species used. Therefore, during this monitoring period, all project activities described in the PDD and first verification are still currently underway.

The second monitoring period for this project was carried out from 11-01-2020- 20-09-2022 with Eucalyptus spp, Acacia mangium and Gmelina arborea 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 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.

[42] NPRT/External risks/MFSL FMP V12 2022.

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 company aim to develop 20,000+ ha of plantation land out of which 12,000hectares will be of standing timber using largely the key selected species and rest of the area (6,000 - 8,000) will cover the land-take for roads, Special Management Zones (protection areas) and unproductive areas that will not be planted[43] with timber. Nevertheless, the eligible project area for the AR project will not cover more than 4005.86 hectares as stated in the PDD[44]ha. With E. pellita (39%) and A. mangium (29%) are the most widely grown species. Significant areas are planted to Gmelina arborea (14%) and C. citriodora ssp. citriodora (5.4%) and smaller areas are planted to C. torelliana (2%), Eucalyptus clonal hybrids (4.1%) E. urophylla (1.2%) and Tectona grandis (1.1%)[45]. The entire project area will be constituted into groups ("blocks") of compartments for planting of commercial fast growing exotic timber species and for conservation areas. During land preparation,80% of land clearing process was done in a mechanized way using equipment like Bulldozer, tractors, slashing machine, plough and rigger and the 20% is done manually. Land preparation also involves appropriate soil preparation with minimum tillage techniques and site specie matching based on the soil mapping. This will ensure optimisation of the site using good land prep and best specie selection[46] .

In terms of utilisable standing volume majority is made up of Eucalyptus species[47] (65%), *Acacia mangium* (17%), *Gmelina arborea* (5%), *Corymba citriodora* (6%), *Tectona grandis* (1%), and other species (3%). .

Planting: Planting is targeted for between May and October annually (funding timing and other constraints permitting) depending on the weather during that period. In 2021, MFSL established an additional 1095 hectares of plantation. Another 1000 hectares is expected in 2022 and beyond.[48] 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 2.5 m x 3.6 m for all species (stocking: 1111 stems Eucalyptus spp per hectare). When areas require planting of indigenous species, a spacing of 4m x 4m will be used. The planting 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 (approx. 5cm). Soil is then placed around the

[43] NPRT/internal risks/MFSL Mgt 2019

[44] Then reduced to 3,968.07 ha as explained in the project description section of this document

[45] Supporting information/PO Information/EHSS and Reports/Technical review of plantation assets: forest inventory and woodflows. Miro Forestry Developments

[46] NPRT/External risks/MFSL FMP V12 2022

[47] *Eucalyptus pellita, Eucalyptus urophyla, Eucalyptus hibrid cross urophilla x grandis*

[48] NPRT/External risks/MFSL FMP V12 2022.

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.

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.[49]

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.[50]

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.

Weeding within the plantations occurs in March/April, June/July and September/October for the first year after planting. From there, weeding occurs on a flexible, as-needed basis using post-planting line weeding, slashing or hoeing, ring hoeing, line hoeing and full cover hoeing.[51]

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. Currently, Leptocybe invasa and halopensis pose a threat to Eucalyptus species. The Company uses seed selection measures to improve resistance to L invasa. To reduce the likelihood of termite invasion, the Company applies 5g of Imidacloprid (5% granular) per seedling at planting into the base of the planting pit.

The Company also 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.

[49] NPRT/External risks/MFSL FMP V12 2022.

[50] NPRT/External risks/MFSL FMP V12 2022.

[51] NPRT/External risks/MFSL FMP V12 2022.

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.

Thinning will be carried out in each annual coupe to ensure that the final crop develops under conditions that will maximize volume increment. Thinned biomass can be seen in Table 4.

Table 4 Thinned Biomass per hectare

Period	MU	Species	Strata Area (ha)	Biomass AGB per strata per year after thinning (ton/strata)	Total biomass before thinning (AGB+Thinned)	Thinned Biomass	Thinned biomass per hectare (ton/ha)	Thinning from the entire strata (%)
2020	2.5	Teak	19.44	6	8.76	2.76	0.14	46%
2020	3.1	Aman	88.75	70	93.80	23.80	0.27	34%
2020	3.2	Corym	113.13	45	60.30	15.30	0.14	34%
2020	3.3	Epel	1032.86	56	75.04	19.04	0.02	34%
2021	3.5	Teak	3.84	7	10.22	3.22	0.84	46%
2021	4.1	Aman	242.5	60	80.40	20.40	0.08	34%
2021	4.2	Epel	752.5	21	28.14	7.14	0.01	34%

Monitoring of leakage

As described in full detail in the PD, including sections 1.17. Leakage, 9. Baseline and 10. Monitoring Plan, the monitoring of leakage can be neglected because leakage only occurs with the displacement of agriculture activities (according to the methodology AR-ACM0003 V2.0 and AR-TOOL 15 "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activities"). No displacement of agricultural activities occurs in the project; therefore, leakage can be counted as zero.

Risk factor

The risk factor was assessed using the VCS Tool for AFOLU Non-Permanence Risk Analysis and Buffer Determination. Project risks and activities described to uphold the project permanence are described in the PDD in section 4.4. Identification of risks that may substantially affect the project's GHG emission reductions or removal enhancements. For this verification, the buffer risk was set at 17 %[52] (Accounting 0.2% for Internal risks, 0% for external risks and 16 % for natural risks)[53] according to the potential risk and mitigation measurements of the project. Detailed information is presented in the supporting information, Non-Permanence Risk Tool assessment.[54]

3.3 Deviations

3.2.1 Methodology Deviations

No methodology deviations were noted for this monitoring period.

3.2.2 Project Description Deviations

The following project deviations were noted for the project:

1. **Reduction in number of sample plots**

A deviation was made about the establishment of Permanent sample plots (PSPs). As noted in section 5.3 Monitoring Plan in the joint PDD and MR: "To estimate the total CO2e content captured by the project plantations with a sampling error of 10% or less, 1588 circular plots of 300 m^2 and square plots of 400 m^2 were established and distributed across all the defined strata". For the second verification, the number of sample plots that were surveyed was calculated according to the CDM_A/R Methodological Tool" Calculation of the number of sample plots for measurements within A/R CDM project activities Version 2.1"[55]

- This tool can be used for the calculation of the number of sample plots required for the estimation of biomass stocks from sampling-based measurements in the baseline and project scenarios of an A/R CDM project activity.
- The tool calculates the number of required sample plots based on the specified targeted precision for biomass stocks to be estimated.
- For the purpose of this tool all parameters used in the calculation of plot-level biomass stock (e.g., biomass expansion factors, root-shoot ratios) are considered fixed constants. Similarly, all models used for the calculation of plot-level biomass stock (e.g., volume tables or equations, allometric equations) are exact.

This deviation does not impact the applicability of the methodology, additionality, or appropriateness of the baseline scenario and therefore the project remains in compliance

[52] Supporting information/ NPRT_Miro_SL track change_3968.docx

[53] Supporting information/ NPRT_v4_MIROSL_Aug2024_3968

[54] Supporting information/ NPRT_Miro_SL track change_3968.docx

[55] This methodology tool is available online: https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-03-v2.1.0.pdf

with the applied methodology. The deviation does not relate to any other part of the methodology and does not affect the conservativeness of the quantification of the GHG emission reductions or removals as described below.

During the first verification, the CDM methodological tool for calculating sample plots was not used, and all the available enumeration data was used for the ex-post calculations for estimating the biomass. Under normal conditions, the CDM_A/R Methodological Tool" Calculation of the number of sample plots for measurements within A/R CDM project activities Version 02.1 should be used to determine the correct sample size for the project area of interest. During this verification, the previous enumeration data has been used as a "pre-sampling" to define the tentative number of plots that satisfy the error. Should the tool have been run during the project design and at the previous monitoring period the PSPs would be statistically determined and found to be n= 147 for existing strata and n=34[56]for new eligible areas added during the second verification period instead of 1588 as originally put forth. This sums a total of 181 PSP. As MFSL previously utilizes the sampling recommendations of FSC for the permanent sample plots and for their enumeration processes and therefore this high sample size was utilized previously. However, conducting the monitoring of PSPs at such a high sampling size (1588 plots) in the field takes a lot of time and is also not ideal with the circumstances related to the monitoring of the carbon project. As such the reduction in the sample size is preferred as it leads to the monitoring being conducted at a faster pace in the field.

Given that the project has multiple strata, the allocation of the total number of sample plots for each stratum was then stratified based on the proportion of the PSPs that were monitored at the past verification. The calculation for the sample plots, therefore, takes into consideration the conservativeness for each stratum by ensuring the correct proportion of plots is monitored in relation to the previous monitoring period. The decrease in the number of PSPs from the previous monitoring period does not affect the estimation of biomass of the strata as the margin of error is maintained at 5% and at a 95% confidence level, guaranteeing the best accuracy for the relevant stratums' biomass estimation. All plots will also be measured at 500m^2.

In addition, any new PSPs that will be developed for new strata affiliated with a new planting year and species for all additional areas that are added to the total project area in the future will also be recalculated using the tool as applicable.

This deviation becomes effective for this monitoring period and the tool will be used when eligible areas are added as new strata for the carbon project. Therefore, the deviation taken affects all monitoring periods henceforth. Having determined that the correct sample size of the PSPs was 147 for existing strata and 34 for new strata, a random selection of 147 plots was undertaken using Microsoft Excel and ArcGIS from within 1588 currently established

[56] Supporting Documents/ Sierra Leone plots/Gis plots final/SL sample plot calculation

PSPs. Therefore these 147 PSPs are a subset of the previously established 1588 PSPs and therefore no biomass was lost and ensuring that result is not being compromised.

2. Change in area of sample plots

MFSL has opted to increase the area of sample plots from 300m2 to 500m2 to standardize their forestry inventory operations across the organization with the aim of improving their enumeration data collection procedures to match the forestry industry standard. Various studies have also shown that the area of plots for forest inventories should be at least 500m2 in order to ensure that an accurate forestry inventory database is developed (Neldner and Butler, 2008; Lombardy et al., 2015). Each circular sample plot should consist of 30 - 40 trees thus meaning that at a plot size of 300m2 will be most accurate at large stand densities above 800 trees per hectare and therefore considering the decrease in plantation density over time the plot size should increase to maintain the statistically reasonable number of trees per plot i.e. 30 - 40 as outlined by Howard (2012). The 500m2 plot maintains the high number of trees per plot even at smaller plantation densities which helps to maintain the accuracy required in the sampling procedure. This increase in area improves the accuracy of measuring and monitoring the trees in the forests, as there is a strong relationship between the size of the sample plots and the accuracy of the growing stick volume (Stereńczak et al., 2018).The increase in plot area provides better estimates of the stem density which is vital for deriving accurate stand statistics related to growing stocks and will result in more accurate biomass estimations within the compartments in Sierra Leone. Therefore, the area of circular plots has changed from 300m2 to 500m2 for the second verification, and the 500m2 plot area will be used for all further forest inventory measurements on site and for the monitoring of permanent sample plots henceforth. This deviation does not impact the applicability of the methodology, additionality, or appropriateness of the baseline scenario and therefore the project remains in compliance with the applied methodology. This deviation becomes effective for this monitoring period. This deviation has met all of the requirements set out in section 3.20.2 of VCS standard 4.4.

3. Change in volume equation for *Eucalyptus pellita*

According to the observations made during the technical review of the raw data for E.pellita, it was observed that the ex-ante volume equation used for the estimation of biomass was underestimating volume and hence biomass for the tree. It was also assessed that the equation was not suitable for the environmental conditions of Sierra Leone as it was developed for a much higher productivity region (Victor et al. 2006) as compared to that of Sierra Leone. The initial equation that was used to calculate volume of E.pellita in the article referenced, was modelled using E. pellita clonal stands in a genetic trial conducted in a high rainfall area. The species in the trial are in the age range of <5 years, and a DBH range of 0.2 - 11.83 cm, with a height range of 0.4 - 15.80 m (Victor et al. 2006), which was found to underestimate the volume of older trees in Sierra Leone as it was initially modelled for young clonal stands at rapid growth, therefore underestimating volume for the older E.pellita trees.

Upon further investigation, a literature review was conducted, in which a suitable E.pellita volume equation was identified which would be more suitable for environmental conditions

associated with Sierra Leone and the study which was conducted more recently in 2018. A comparison of the old volume equation Vs the new volume equation was conducted using ex-post data and it was found that the literature from 2018 was found to be more suitable for the volume estimation as compared to the prior and can be reviewed here[57].

In addition, this new volume equation adopted as provided below more suitably estimated the growth of E.pellita trees at various age groups and at a wider range of heights and diameters as compared to the old equation. It will also be ensured that this new volume equation will be used in future verifications also. As per requirement no. 2 of section 3.20.2 of VCS standard V4.4, the change in volume equation is not impacting the applicability of the methodology, additionality or the appropriateness of the baseline scenario, and the project remains in conformance with the applied methodology.

New Volume equation, v = (DBH^2*H) / (23163.87+149.03*DBH)

Reference- (Isnaini, H. N. (2018). Growth and yield modelling for unthinned acacia mangium, acacia crassicarpa and eucalyptus pellita plantations in Indonesia)

4. <u>Addition of a new volume equation for *Gmelina arborea*</u>

During the technical review of the enumeration data collected from the field it was observed that there is big variation in DBH values associated with the Gmelina trees growing within a plot within Sierra Leone's plantations. Due to this variation in the DBH of the Gmelina trees, the current equation that was being used for the estimation of volume was overestimating the volume of trees with a DBH value lower than 12 cm. The current equation for Gmelina was developed and suited to tree's with a DBH greater than 12 cm and therefore overestimated the volume of smaller trees by assuming the trees with a DBH smaller than 12 cm had a 1/4 of a cubic meter of wood, leading to an overestimation of the wood volume of smaller trees.

Mattia and Dugba (2015) the developers of the current Gmelina equation also provide an alternative equation that was developed, and which is conservative and suitable for Gmelina trees with DBH values that are smaller than 12 cm. It is therefore more accurate to utilize two equations for volume estimation of Gmelina in Sierra Leone based on the variation in DBH ranges seen within the plots[58]. The current equation will continue to be utilized for Gmelina trees with DBH greater than 12 cm and an alternative equation from the same literature source will be adopted for trees that are smaller than 12 cm. By separating the volume equations for Gmelina based on DBH ranges, the overestimation of volume for DBH values smaller than 12 cm should not occur, leading to more accuracy in the biomass estimation within the plot as the alternative equation accounts for that scenario.

Volume Equations	Species Name	Reference
V=0,000537511*(DBH^0,943497899) *(H^1,229083295)	Gmel with dbh<12cm	Mattia, Stephen & A., and. (2015). Allometric

[57] Supporting Documents/Additional Information/Epel and Gmel equations comparison

[58] Supporting Documents/Additional Information/Epel and Gmel equations comparison

V=0,24950005 + 0,000018027 ((DBH ^2) * Height)	Gmel with dbh>12cm	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.

3.4 Grouped Projects

It is not a grouped project.

4 Data and Parameters

4.2 Data and Parameters Available at Validation

Data / Parameter	Root to shoot ratio for mixed tropical broadleaf species ($Rmix$)
Data unit	Dimensionless
Description	Converts the above-ground biomass to the above and belowground biomass
Source of data	*2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (TABLE 4.4 (UPDATED) RATIO OF BELOW-GROUND BIOMASS TO ABOVE-GROUND BIOMASS (R) [TONNE ROOT D.M. (TONNE SHOOT D.M.)-1])*
Value applied	0.232
Justification of choice of data or description of measurement methods and procedures applied	Conservatively chosen for tropical moist forest to calculate the belowground biomass.
Purpose of Data	Calculation of project emissions
Comments	NA

Data / Parameter	Biomass expansion factor (BEF)
Data unit	Dimensionless
Description	Converts trunk biomass to total above and belowground tree biomass
Source of data	*2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*
Value applied	1.5
Justification of choice of data or description of measurement methods and procedures applied	Tropical, broadleaf, over bark
Purpose of Data	Estimation of belowground biomass
Comments	N/A

Data / Parameter	Carbon fraction
Data unit	Dimensionless
Description	Tons of carbon per ton of biomass dry matter
Source of data	*2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* .
Value applied	All species: 0.47
Justification of choice of data or description of measurement methods and procedures applied	It is used for the 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[59]". Version 01.1.0. Table 3. Page 3.
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

4.3 Data and Parameters Monitored

Data / Parameter	DBH (Diameter breast height)
Data unit	Centimetres (cm)
Description	Diameter of the tree at 1.37 m of height
Source of data	Measured by the project proponent
Description of measurement methods and procedures to be applied	Is measured in temporal sample plots, see chapter 5.3 of the PDD for elaboration
Frequency of monitoring/recording	According to the management objectives shown on the monitoring plan (chapter 5.3) of the PDD
Value monitored	Variable ranges from 0.4 cm to 30.60 cm
Monitoring equipment	Masser Excalliper II

[59] This methodology tool is available online: https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-16-v1.1.0.pdf

QA/QC procedures to be applied	Microforest platform database check, outliers' revision and measurement approval, according to the enumeration procedure
Purpose of the data	Calculation of project emissions
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 to be applied	Measured in temporal sample plots, see chapter 5.3 of the PDD for elaboration
Frequency of monitoring/recording	According to the management objectives shown on the monitoring plan (chapter 5.3) of the PDD
Value monitored	Depending on age between 0.5 and 31.11 m
Monitoring equipment	Vertex IV Hypsometer: accuracy +/-10 cm Measuring tape: accuracy +/- 1 cm
QA/QC procedures to be applied	Microforest platform database check, outliers' revision and measurement approval, according to the enumeration procedure
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	Plot location
Data unit	Latitude, longitude
Description	Plot's location coordinates
Source of data	Project proponent measurements
Description of measurement methods and procedures to be 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) of the PDD
Value monitored	Variable
Monitoring equipment	GPS of the calliper with an accuracy of 0.5 m GPS navigato
QA/QC procedures to be applied	Internal audit, according to the data quality steps, described in chapter 5.3 of the PDD
Purpose of the 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	Plot area is measured to guarantee quality and accuracy in the estimations.

procedures to be applied	
Frequency of monitoring/recording	According to the management, objectives showed on the monitoring plan (chapter 5.3)
Value monitored	Circular plots: 500 m^2 (Radius: 12.62 m)
Monitoring equipment	Vertex IV Hypsometer: accuracy +/-10 cm
QA/QC procedures to be applied	Internal audit, according to the data quality steps, described in chapter 5.3 of the PDD
Purpose of the data	Sampling error and calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	Subsistence farming activity displaced $A_{\text{disp.subistence farming}}$
Data unit	Hectares (ha)
Description	Total area of subsistence farming displaced before the plantation starts
Source of data	PP field monitoring
Description of measurement methods and procedures to be applied	It will be measured by field identification by the PP, stakeholder consultations. After aerial maps would be used to complement this information
Frequency of monitoring/recording	Every time that new areas included in the verification are planted
Value monitored	Variable (always in hectares)
Monitoring equipment	-

QA/QC procedures to be applied	Cross-checking the information collected on the field with aerial maps
Purpose of the data	This parameter is measured for the leakage calculation.
Calculation method	N/A
Comments	N/A

4.4 Monitoring Plan

This monitoring plan provides guidance on monitoring and standard operational procedures for the ARR project activity. It fulfils the requirement that the project activity should have credible and accurate monitoring procedures in place to enable the evaluation of project performance and verification of the net anthropogenic GHG emission removals.

The detailed monitoring plan is described in the PDD under Section 5.3 Monitoring Plan.

Only the above-ground biomass of trees established will be measured (DBH and Ht). Therefore, only the individual growth of trees will be monitored in temporal sample plots.

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 04.1” was used. According to section 8.2 of this tool, this method is used. The carbon content below-ground (in dead wood and litter) and soil carbon organic content to project activities will not be monitored. The SOC will be estimated by using default values and suggested methods using the tools CDM_AR_tool_16."Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities".

Miro Forestry already has 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 organizational structure:

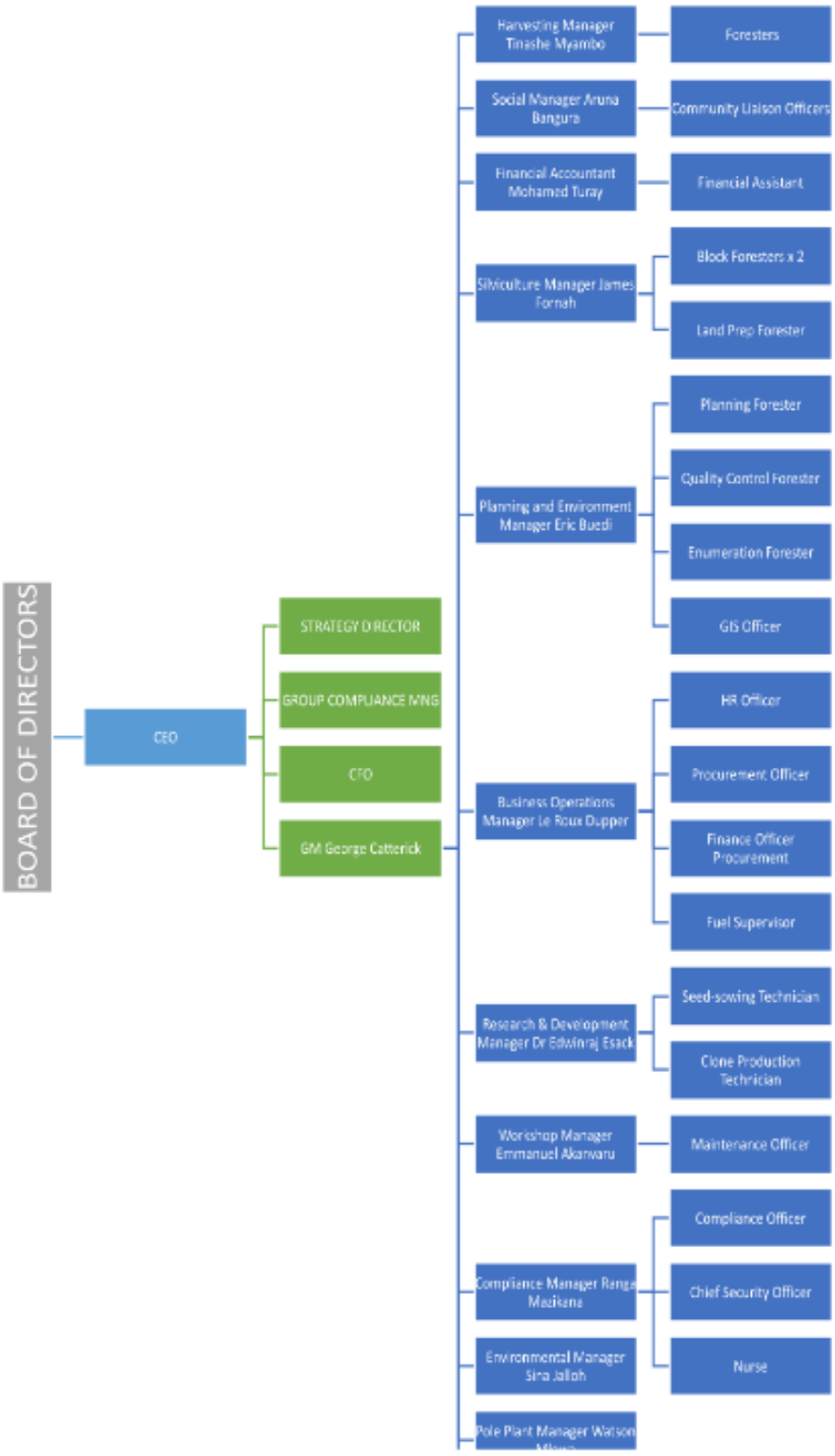


Figure 9: organization structure managing enumerations

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

Table 4: Positions in the organization 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 5 : 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

Considering the methodology AR ACM0003 V2.0 are required elements to verify:

- **The Precision requirements**: For this methodology, the precision requirements were estimated using equation 15 of the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities.
- **Verification of changes in carbon stocks in the pools selected**

The following is a brief overview of the monitoring plan. The detailed monitoring plan is described in the PDD under Section 5.3 Monitoring Plan.

Monitoring periods and frequency

The project monitoring is expected to cover the crediting period of 30 years, starting from 2016. The crediting period started from 16-05-2016 to 15-05-2046 and the first monitoring period from 16-May-2016 to 10-January-2020. Moreover, the second monitoring period is from 11-01-2020- 20-09-2022. The project participants use the VCS buffer approach to address any loss of permanence.

Monitoring and operational procedure

The project participants use Standard Operation Procedures (SOPs)[60] for data collection. All measured and experimental data are documented and archived. Operational procedures under this monitoring plan are defined as those that enable measuring and estimating net carbon stock changes associated with the plantations under the project activity, as well as general monitoring of forestry operations. The project participants keep records of all activities, like changes in the actual planted areas, site preparation and forest management. All the support information for the SOP templates and the register of the monitored activities is presented in Supporting information\NPRT\Internal risk\Project management\SOPs and Supporting information\NPRT\Internal risk\Project management.

Stratification and sampling

According to the "AR-ACM0003 V2.0 A/R Large-scale Consolidated Methodology: Afforestation and reforestation of lands except wetlands Version 02.0", if biomass distribution over the project area is not homogeneous, stratification should be carried out to improve the precision of biomass estimation. Different stratifications may be appropriate for the baseline and project scenarios to achieve optimal precision of the estimation of net GHG removals by sinks.

In particular:
For actual net GHG removals by sinks, the stratification for ex-ante estimations is based on the project planting schedule plan (see Table 7).

Table 7. Monitoring stratum

Year	Species	Stratum	Eligible Area (ha)
2016	Aman	1.1	205.3
2016	Cctr	1.2	63.8
2016	Epel	1.3	275.6
2016	Gmel	1.4	21.9
2016	Other	1.6	13
2017	Aman	2.1	134.4
2017	Cctr	2.2	51.5
2017	Epel	2.3	529.4
2017	Gmel	2.4	127.5

[60] Supporting Information/Additional Information/MFSF SOP

2017	Tgra	2.5	19.4
2017	Other	2.6	15.5
2018	Aman	3.1	88.7
2018	Cctr	3.2	113.1
2018	Epel	3.3	1032.9
2018	Gmel	3.4	60.4
2018	Tgra	3.5	3.8
2018	Other	3.6	56.1
2019	Aman	4.1	242.5
2019	Epel	4.2	752.5
2019	Gmel	4.3	136.0
2019	Other	4.4	24.7
			3968.07

For this monitoring period there are 350 compartments[61] that are being considered with a total area of 3968.07 ha.

Permanent sample plots

During the first verification 1588 plots were established and distributed across all the defined strata to estimate the total CO2e content captured by the project plantations with a sampling error of 10% or less.

During the second verification the amount of sample plots needed to meet the 10% sample error or less was calculated using the CDM_A/R Methodological Tool" Calculation of the number of sample plots for measurements within A/R CDM project activities Version 2.1and 181[62] plots were measured in the field.

Establishment of the plot in field

The sample plots are used to take measurements such as tree height, DBH and species type, with the objective of registering the sampling over time and to measure and monitor changes of the relevant carbon stocks.

Location of monitoring plots

The plots were systematically located randomly in each stratum to avoid subjective choice of plot locations. The plot location has been identified with the help of a GPS device in the field. For each plot the geographic position (GPS coordinate) and compartment series number is recorded and archived.[63]

[61] Supporting documents/Additional Information/Compartments SL

[62] Supporting Documents/ Sierra Leone plots/Gis plots final/SL sample plot calculation

[63] 20220824_Selected_Plots_AR_Miro_SierraLeone.kmz

The plots were randomly selected in each stratum using GIS techniques to avoid subjective choice of plot locations.[64]

Organizational structure, responsibilities and competencies

Information about the project monitoring team of Miro Forestry (Sierra Leone)

The project monitoring team consists of the Planning Manager, Eric Buedi, GIS Officer, Stephen A.K. Kassigbie, Quality Control Forester, Effort Madzime, Enumeration Forester, Sahr Samuel George and Francis Kaikai as Enumeration Forester for Auditing. Moreover, six enumerators and thirteen Marking for Thinning members were supported throughout the monitoring process.

The personnel involved in the measurement of carbon pools were fully trained in field data collection and analysis by the technical manager. Table 8 presented the technical team involved in the remeasurement of the plot for this second verification.

Table 8. Miro Forestry (Sierra Leone) staff for the monitoring process

Technical Team	Job Description
Planning Manager	Eric Buedi
GIS Officer	Stephen A.K. Kassigbie
Assistant GIS Officer	Papieu Kewullay Conteh
Quality Control Forester	Effort Madzime
Enumeration Forester	Sahr Samuel George
Enumerator	Abdulai B Kanu
Enumerator	John F Fornah
Enumerator	James Kosia
Enumerator	Foday Tholley
Enumerator	Frances Kamara
Enumerator	Momoh Kargbo
Enumeration Forester (Auditing)	Francis Kaikai

The average monitoring inventory was performed at 0.61% intensity, according to Table 9.

Table 9. Monitoring plots intensity

Year	Stratum	Species	Area (ha)	N° Plots	Monitored area (Ha)	Intensity (%)
2016	1.1	Aman	10.5	5	0.25	0.12%

[64] 20220824_Selected_Plots_AR_Miro_SierraLeone.kmz

2016	1.2	Cctr	63.8	5	0.25	0.39%
2016	1.3	Epel	275.6	7	0.35	0.13%
2016	1.4	Gmel	21.9	3	0.15	0.68%
2016	1.6	Other	13.0	2	0.1	0.77%
2017	2.1	Aman	134.4	5	0.25	0.19%
2017	2.2	Cctr	51.5	5	0.25	0.49%
2017	2.3	Epel	529.4	30	1.5	0.28%
2017	2.4	Gmel	127.5	5	0.25	0.20%
2017	2.5	Tgra	19.4	5	0.25	1.29%
2017	2.6	Other	15.5	5	0.25	1.62%
2018	3.1	Aman	88.7	5	0.25	0.28%
2018	3.2	Cctr	113.1	7	0.35	0.31%
2018	3.3	Epel	1032.9	49	2.45	0.24%
2018	3.4	Gmel	60.4	3	0.15	0.25%
2018	3.5	Tgra	3.8	3	0.05	3.91%
2018	3.6	Other	56.1	3	0.15	0.27%
2019	4.1	Aman	242.5	8	0.4	0.16%
2019	4.2	Epel	752.5	14	0.7	0.09%
2019	4.3	Gmel	136.0	8	0.4	0.29%
2019	4.4	other	24.7	4	0.2	0.81%
			3968.07	**181**	**9.1**	0.59%

The map of the monitoring plots is zoomed into a few areas due to the scale of the polygons – the support's shapefile has the complete plot information. Figure 14 shows the monitoring plots that were sampled during the second verification and Figure 15 shows the strata and monitoring plots sampled during the first verification period.

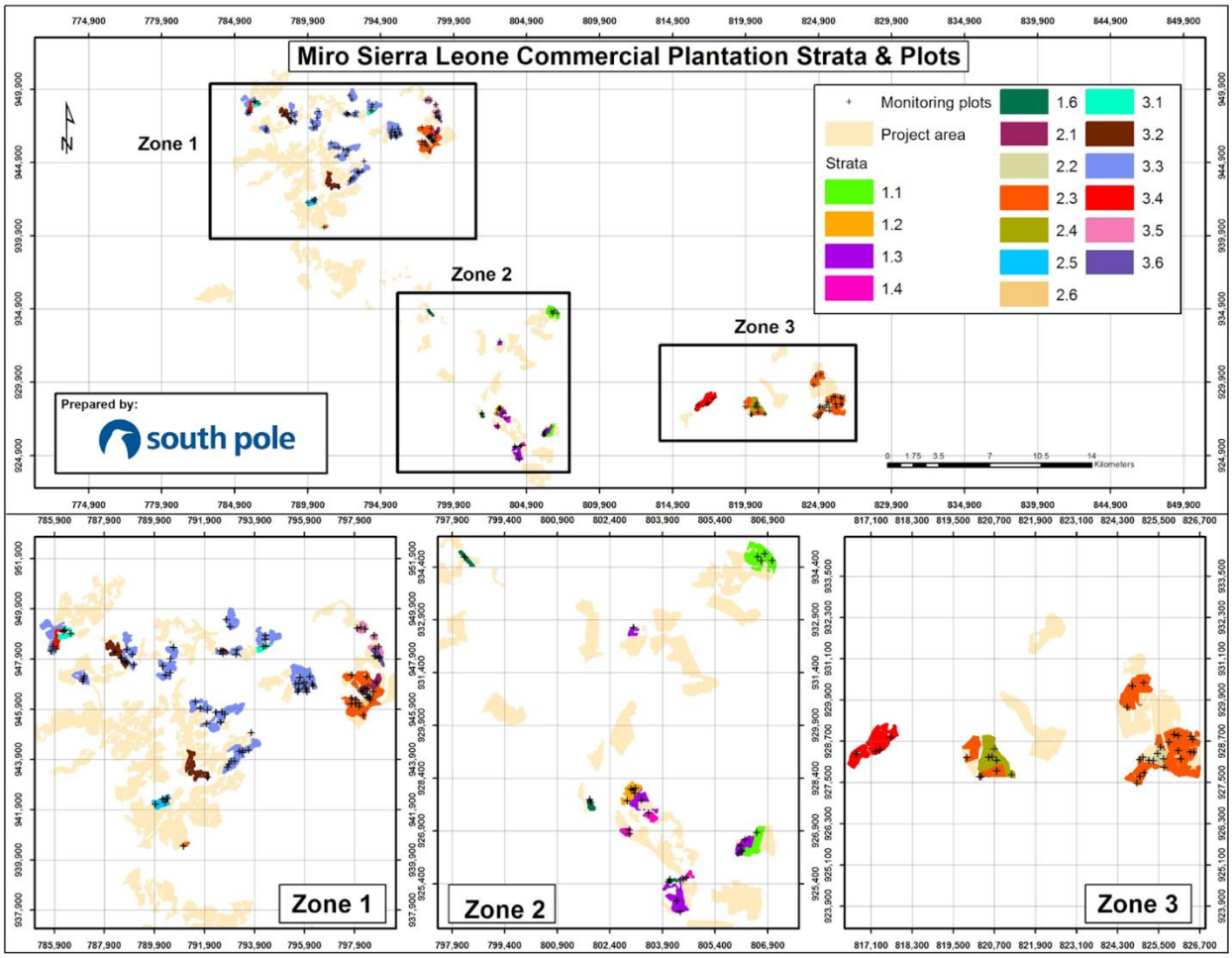


Figure 9 Monitoring plots sampled during the second verification period

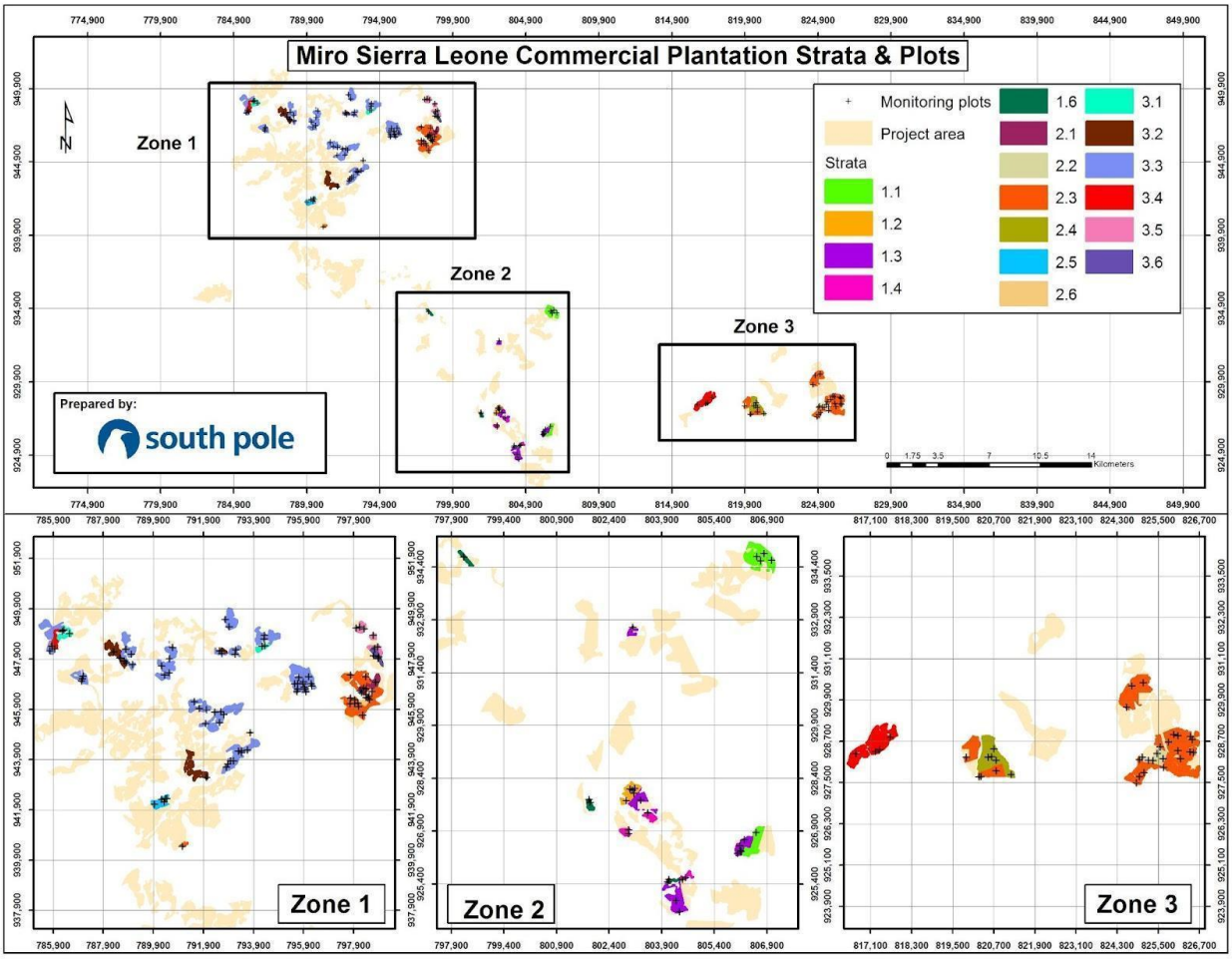


Figure 10. Monitoring plots sampled during the first verification period.

Verification of project emission leakage emissions

This project is not responsible for any leakage emissions and therefore no leakage monitoring activities are needed. As described in section 4.3 of the PDD, this project is not considering any emissions associated with leakage. No displacement of agricultural activities occurs in the project; therefore, leakage can be counted as zero. Therefore, the monitoring of leakage can be neglected because leakage only occurs with the displacement of agriculture activities according to the CDM consolidated methodology AR-ACM0003 V2.0: Afforestation and reforestation of lands except for wetlands – Version 02.0[65] and AR-TOOL 15 A/R Methodological tool: Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity Version 02.0.[66]

This project is also not considering any leakage due to the agreements made between the landowners in the forest reserves and Sierra Leone's Forestry Commission, as well as the

[65] This methodology is available online at: https://cdm.unfccc.int/filestorage/T/H/N/THNRJC15IW4K89UBE6DFZYX23OVP0Q/EB75_repan30_AR-ACM0003_ver02.0.pdf?t=OVp8cmpxY3pxfDB3dq3lBDG7f-NJBOiMFJhl

[66] This methodology tool is available here: https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-15-v2.0.pdf

intercropping activities developed among the parties as the country's policies prohibit farming activities within the reserves. In addition, the company provides social mitigation measures, that include the offering of alternative livelihood solutions – predominantly employment and intercropping.

In the same way, Miro Forestry has policies that contribute to leakage management, mainly through stakeholder engagement. Some of the farmers employed by the company have legal access to land and can benefit the local communities with the land leasing and benefits agreement. Also, the probability of leakage occurring due to people moving inside of the project area is limited due to the land management policies created by the forestry commission and because most of the land outside of the project area is already at a very low baseline for agriculture.

Therefore, it can be concluded that these agriculture activities will not be displaced to another area but instead will be improved with the support of Miro Forestry.

Number of plots

The number of plots required for measuring the variation within the project boundary and strata shall be estimated by using the CDM tool "A/R Methodological Tool" for "Calculation of the number of sample plots for measurements within A/R CDM project activities". The number[67] of plots to be established and measured will be estimated as follows:

The number of plots to be established and measured will be estimated as follows:

$$n = \frac{N * t^2 * \left(\sum_{i=1}^{I} wi * s_i\right)^2}{N * E^2 + t^2 * \sum_{i=1}^{I} wi * s_i^2}$$

Where:

n	Number of sample plots required for estimation of biomass stocks within the project boundary; dimensionless
I	Total number of strata within the project boundary
I	1, 2, 3, … biomass stock estimation strata within the project boundary
N	Total number of possible sample plots within the project boundary (i.e., the sampling space or the population); dimensionless
t	Two-sided Student's t-value, at infinite degrees of freedom, for the required confidence level; dimensionless
wi	Relative weight of the area of stratum
i	(i.e., the area of the stratum i divided by the project area); dimensionless
si	Estimated standard deviation of biomass stock in stratum i; (t ha-1)

[67] CDM "A/R Methodological Tool: Calculation of the number of sample plots for measurements within A/R CDM project activities" available at: https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-03-v2.1.0.pdf

E Acceptable margin of error in estimations of biomass stock within the project boundary; t d.m. (or t d.m. ha-1), i.e. in the units used for si

If the number of sample plots ***n*** calculated in the first iteration using the equation is above 30 or more, then no further iteration is carried out and the value of n obtained in the first iteration is the final value of n. The number of plots calculated in this verification was 181 plots[68].

Table 10. Monitoring sampling error

Sampling Error	
Plot area (m^2)	500
Total area (ha)	3968.07
No. Plots established	181
Mean standard error (Sy)	1.34
t value(0,05; n-1)	1.973
E(%) Sampling error	3.88

Verification of project emissions

The project will quantify and monitor the non-CO_2 GHG emissions resulting from any fire occurrences (forest fires) within the project boundary, whose accumulated area affected by such fires for the present verification is less than 5% of the project area69. These events will be monitored, and the affected area will be recorded.

Emissions of non-CO_2 GHGs resulting from the loss of above-ground tree biomass due to fire will be calculated in each verification period by using: the above-ground biomass in trees of relevant strata calculated in the previous verification, the default values for the combustion factor, the emission factors, and the global warming potential.

Analysis of the monitored data and parameter

Data recorded in the forest inventory (DBH and height) will be the input for the volume equation that will define the total biomass accumulated for the project at the time of monitoring. For ex-post estimates, the default parameters and equations (sections 3.1 and 3.2) will be the same ones

[68] Supporting Documents/ Sierra Leone plots/Gis plots final/SL sample plot calculation

[69] Supporting information/Risks/Fire Affected Compt.xlsx

used for ex-ante estimations, unless better values exist at the verification time. These will always be in compliance with the AR tool for carbon stock estimation. See section 4.1 for ex-ante net GHG emission reductions and removals[70].

Procedures of internal auditing and quality assurance and quality check

A QA/QC procedure was implemented and monitored to ensure that net anthropogenic GHG removals by sinks are measured and precisely, and are credible, verifiable, and transparent.

- Training for all relevant personnel on all data collection and analysis procedures.
- Steps are taken to control mistakes in sampling and data analysis to develop a credible plan for measuring and monitoring carbon stock change in the project. The same procedures are used throughout the project lifetime to ensure continuity.
- An internal QA/QC of the values registered in field is done by the technical manager of the project
- Another QA/QC is developed by South Pole, in order to analyse the variation of the data and the changes presented in the plantation in comparison with the past verification. This process involves a comparison of the tree growth, starting with the diameter register and verified possible out layers in the data, e.g., extreme high values or "reduction" in the diameter and high values. In this case, if they are not a justification for these changes in the field forms, like mechanical damage of the trees or mortality of them, it is necessary to make a verification in the field.

The main activities implemented in the QA/QC process are presented in Table 9. All the QC procedures were developed for this second verification.

Table 11. Verification and checklist considered to guarantee the quality of the information gathered and its management

QC activity	Procedures	Observation
Check for transcription errors in data input and reference	• Confirm that bibliographical data references are properly cited in the internal documentation • Cross-check a sample of input data (either measurements or parameters used in calculations) for transcription errors	**OK**

[70] Supporting Documents/Estimations/Updated MR and estimations

Check that removals are calculated correctly	• Reproduce a representative sample of removal calculations	**OK**
Check that parameter and units are correctly recorded and that appropriate conversion factors are used	• Check that units are properly labelled in calculation sheets • Check that units are correctly carried through from the beginning to the end of calculations • Check that conversion factors are correct • Check that temporal and spatial adjustment factors are used correctly	**OK**
Check the integrity of database files	• Confirm that the appropriate data processing steps are correctly represented in the database • Confirm that data relationships are correctly represented in the database • Ensure that data fields are properly labelled and have the correct design specifications • Ensure that adequate documentation of database and model structure and operation are archived	**OK**
Check that the movement of inventory data among processing steps is correct	• Check that removal data are correctly reported when preparing summaries • Check that removal data are correctly transcribed between different intermediate products	**OK**
Check that uncertainties in removals are estimated or calculated correctly	• Check that qualifications, assumptions, and expert judgments are recorded • Check that calculated uncertainties are complete and calculated correctly, following the methodology requirements	**OK**
Undertake review of internal documentation	• Check that there is detailed internal documentation to support the estimates and to enable the reproduction of the emission and removal estimates	**OK**

	• Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed reviews • Check the integrity of any data archiving arrangements of outside organizations involved in inventory preparation	
Undertake completeness checks	• Confirm that estimates are reported for all years • Check that known data gaps that may result in incomplete emissions estimates are documented and treated conservatively	**OK**
Compare estimates to previous estimates	• Current inventory estimates should be compared to previous estimates, if available. If there are significant changes or departures from expected trends, re-check estimates and explain the differences	**OK**

Uncertainty assessment

The project follows the modalities and procedures for A/R project activities to estimate baseline net GHG removal by sinks, actual net GHG removal by sinks, and net anthropogenic removal by sinks. Equation 15 of the AR-TOOL 14 was used to calculate the uncertainty in tree volume. The uncertainty value of 4.48% was estimated for the current monitoring period – according to the methodological tool, there is no discount necessary (< 10% uncertainty). These estimations can be consulted in the ex-post estimations spreadsheet[71].

Table 12 Uncertainty figures

Year	Management Unit (MU)	N° Plots	Sp	Eligible Area (Ha)	Monitored area (Ha)	Percentage of area sampled (%)	Biomass (tons/ha)	wi	si	wi*bTREE,i	wi2*si2/ni
2016	**1.1**	5	Aman	205.31	0.3	0.122	100.759	0.04	10.4	4.115	0.0

[71] Supporting information/ SL_Ex post_2ndver_Aug2024-3968.xlsx

2016	**1.2**	5	Cctr	63.79	0.3	0.392	100.573	0.01	15.0	1.276	0.0
2016	**1.3**	7	Epel	275.63	0.4	0.127	169.269	0.05	26.2	9.282	0.3
2016	**1.4**	3	Gmel	21.91	0.2	0.685	84.705	0.00	33.9	0.369	0.0
2016	**1.6**	2	Other	13.01	0.1	0.769	46.331	0.00	14.9	0.120	0.0
2017	**2.1**	5	Aman	134.39	0.3	0.186	63.463	0.03	5.1	1.697	0.0
2017	**2.2**	5	Cctr	51.53	0.3	0.485	83.777	0.01	24.7	0.859	0.0
2017	**2.3**	30	Epel	529.43	1.5	0.283	64.541	0.11	24.2	6.798	0.2
2017	**2.4**	5	Gmel	127.49	0.3	0.196	130.939	0.03	16.0	3.321	0.0
2017	**2.5**	5	Tgra	19.44	0.3	1.286	5.860	0.00	2.2	0.023	0.0
2017	**2.6**	5	Other	15.48	0.3	1.615	19.061	0.00	4.2	0.059	0.0
2018	**3.1**	5	Aman	88.75	0.3	0.282	70.142	0.02	7.2	1.238	0.0
2018	**3.2**	7	Cctr	113.13	0.4	0.309	44.807	0.02	11.4	1.008	0.0
2018	**3.3**	49	Epel	1032.86	2.5	0.237	55.566	0.21	16.6	11.418	0.2
2018	**3.4**	3	Gmel	60.38	0.2	0.248	94.138	0.01	17.4	1.131	0.0
2018	**3.5**	3	Tgra	3.84	0.2	3.906	6.925	0.001	3.1	0.005	0.0
2018	**3.6**	3	Other	56.06	0.2	0.268	30.926	0.01	7.1	0.345	0.0
2019	**4.1**	8	Aman	242.47	0.4	0.165	59.761	0.05	12.1	2.883	0.0
2019	**4.2**	14	Epel	752.46	0.7	0.093	25.702	0.15	14.6	3.847	0.3

2019	**4.3**	8	Gmel	135.97	0.4	0.294	47.860	0.03	31.5	1.295	0.1
2019	**4.4**	4	other	24.75	0.2	0.808	34.911	0.00	9.3	0.172	0.0
		181		**3968.07**	**9.1**	**12.757**		**1.00**		**64.93**	**2.17**

Table 13. Uncertainty

No. Plots:	181
t_val:	1.973
u_c:	4.48%

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.2 Baseline Emissions

The methodology "AR-ACM0003 V2.0 A/R Large scale Consolidated Methodology: Afforestation and reforestation of lands except for wetlands (Version 2.0)" was considered. As required by the methodology and given that biomass distribution over the project area is not homogeneous, project area was stratified by land cover type to calculate the GHG baseline.

Details on the GIS processing can be found in section 1.3 Eligibility of the PDD. From that section, it can be concluded that the main land cover present in the project area, after discounting forested areas and wetlands areas, is Grassland. However, in the districts where the project area is located, the most common vegetation type are grasslands, a result of agriculture and fire. Due to the dynamic of the agricultural practice in the area, the fallow periods are short, which is insufficient for forest regeneration or the establishment of the local flora, which leads to a non-significant carbon stock in the baseline scenario.

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. As a result of this, baseline stock was zero and no estimations are required.

5.3 Project Emissions

Removals by sinks

According to AR-ACM0003 V2.0 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 the project boundary, and transportation attributable to the project activity shall be considered insignificant and therefore accounted as zero. The quantification of project emissions and/or removals was calculated following the section 5.5 of the AR-ACM0003 V2.0 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 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

The 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, is estimated as presented in the tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity". This tool can be used for estimation of non-CO_2 GHG emissions resulting from burning of biomass and forest fires. The tool does not apply because fire is not used in site preparation or land clearing. Therefore, emissions resulting from burning of biomass and forest fires are accounted for as zero.

The change in the carbon stocks occurring in the project for its selected carbon pools in year t shall be calculated as follows:

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

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"; tCO2e.

$\Delta C_{DW\_PROJ,t}$ 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"; tCO2e.

$\Delta C_{LI\_PROJ,t}$ 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"; tCO2e.

$\Delta SOC_{AL,t}$ 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; tCO2e.

Estimating carbon stock in trees at given point in time

Tree carbon estimation

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 04.1" 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

Since the beginning of the plantation project, Miro Forestry has been recording and analysing crop data using the Microforest software and enumerations in the field. Table 12 summarises the annual average increase (MAI) per species:

Table 14 Average MAI data per species

Species	MAI (m^3/ha/yr)	Source
Eucalyptus pellita	20.0	Yepes et al. (2011). Protocol for national and subnational biomass-Carbon estimation in Colombia. Table 11.
Acacia mangium	26.0	Yepes et al. (2011). Protocol for national and subnational biomass-Carbon estimation in Colombia. Table 11.
Corymbia citriodora	16.0	FAO - Forest Resources of Tropical Africa (The MAI value employed is an average between 12 and 20 m3/ha/yr)
Gmelina arborea	13.7	UST, P. (1994). Growth and biomass production of Gmelina arborea in conventional plantations in Ghana. Ghana Journal of Forestry, 1, 5.
Tectona grandis	10.3	Mattia, S. B., & Sesay, S. (2020). Ground Forest Inventory and Assessment of Carbon Stocks in Sierra Leone, West Africa. In Natural Resources Management and Biological Sciences.

Other species	11.87	Project data

Ex-ante or projected estimations were made based on the MAI of each species planted in the project area, which is the average growth per species extracted from literature. The MAI per species is averaged from the project start date to obtain a more representative and realistic value.

Step 2. Biomass estimation

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

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

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 CO2e

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:

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

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 "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 V2.0 methodology, which accepts the use of a conservative default value that relates 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,

$\boldsymbol{C_{TREE}, i, t}$ 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 deadwood as a percentage of carbon stock in tree biomass (tCO2e).

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

Where,

$\boldsymbol{CLI, i, t}$ 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).

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 V2.0 methodology.

$$SOC_{Initial,i} = SOCRef,i \; x \; fLU,i \; x \; fMG,i \; x \; fIN,i$$

Eq. 1

Where,

$\boldsymbol{SOC_{Initial}}$, SOC stock at the start of the project activity in stratum i of the soil areas (tC/ha).

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

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

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

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

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

Eq. 2

Where:

$SOC_{LOSS,i}$, SOC loss caused by disturbances attributable to the AR project activity, in stratum i of the soil area; tC/ha

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 used in the project baseline.

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:

$SOC_{LOSS,i} = 0$

$d_{SOCt,I} = (SOC_{Ref,i} - (SOC_{INITIAL,i} - SOC_{LOSS,i}))/(20 \text{ years})$ Eq.6

Where:

$d_{SOCt,i,}$ Rate of change in the SOC stock in stratum i of the soil areas, in year t; tC/ha * year.

$\Delta SOC_{AL,t} = 44/12 \sum_t Ai \ dSOC_{t,i} \times 1 \text{ year}$ Eq.8

Where:

$\Delta SOC_{AL,t}$ 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

Calculation of tCERs and lCERs

According to the standard requirements, for those projects where harvesting practices are contemplated on project activities, the loss of carbon due to harvesting shall be included 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, CH4 and leakage.

BEt The total to-date GHG emission reductions and removals projected for the baseline scenario (tCO2e). Accounted

t Year.

n Total number of years in the established time-period

The long-term average for the project is 624,267 tCO_2e (Ex-ante[72]).

The project will quantify and monitor the non-CO2 GHG emissions resulting from any fire occurrences (forest fires) within the project boundary, whose accumulated area affected by such fires in a year is less than 5%[73] of the project area. These events will be monitored, and the affected area will be recorded. Emissions of non-CO_2 GHGs resulting from the loss of above-ground tree biomass due to fire will be calculated in each verification period by using: the above-ground biomass in trees of relevant strata calculated in the previous verification, the default values for the combustion factor, the emission factors, and the global warming potential.

For this monitoring period, the accumulated areas affected by fires was less than 5 percent[74] of the project area and therefore estimations using this tool does not need to be quantified.

The project follows the modalities and procedures for A/R project activities to estimate net GHG removal by sinks, actual net GHG removal by sinks, and net anthropogenic removal by sinks. Equation 15 of the AR-TOOL 14 was used to calculate the uncertainty in tree volume. The uncertainty value of 4.48% was estimated for the current monitoring period – according to the methodological tool, there is no discount necessary (< 10% uncertainty). These estimations can be consulted in the ex-post estimations spreadsheet[75].

5.4 Leakage

The leakage was assessed on the displacement of small-scale agriculture happening illegally inside of the project areas prior to the project start.The project area is located in Sierra Leone in Yoni and Masimera Chiefdoms belonging to the districts of Tonkolili

[72] Supporting information/SL_ex-ante_2ndverification Aug2024 -3698.xlsx

[73] Supporting information/Risks/Fire Affected Compt.xlsx

[74] Supporting Documents/Additional information/Fire Analysis SL

[75] Supporting information/ SL_Ex post_2ndver_Aug2024-3968.xlsx

and Port Loko (See map below). The economic activity in Sierra Leone is mainly natural resource extraction and subsistence agriculture[76]. The agricultural sector is crucial for the country contributing to 55% of Gross Domestic Product (GDP) in the period of 2010-2018 and employing 60% of the population[77].

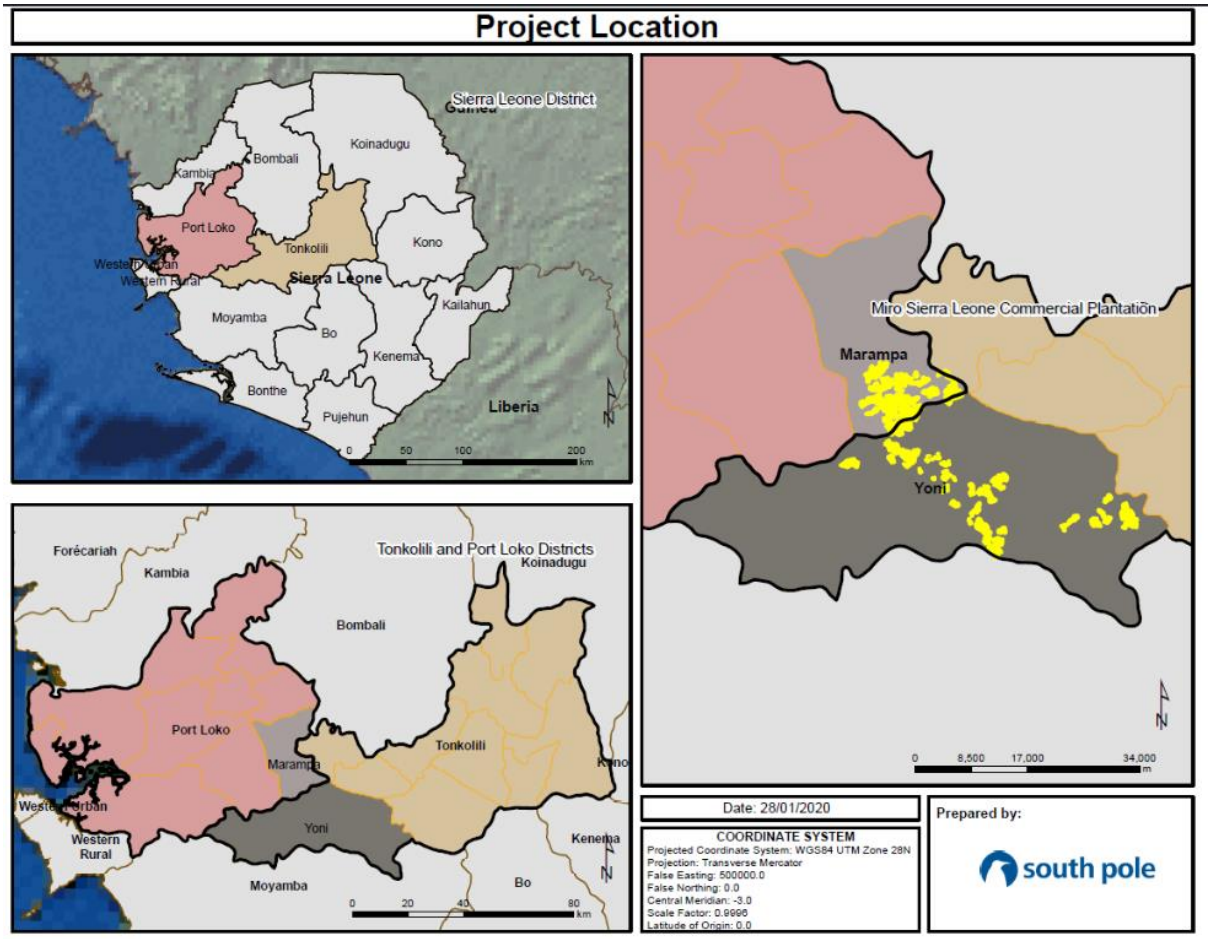


Figure 11. Map depicting the location of the project

The project area covers an extension of 5,600.99 ha[78] from which4,005.86[79] hectares are eligible for the project during the first verification, and finally 3,968.07 hectares were included as eligible area during the second verification.

The project was established in 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[80]. Furthermore, to ensure that no agricultural activity was displaced Miro Forestry Sierra Leone (thereafter MFSL) excluded all the land

[76] Supporting information/Additional/National_agriculture_development_plan_2010_2030.pdf

[77] Supporting information/Additional/4.2_World_Development_Indicators.pdf

[78] Supporting information/PO Information/EHSS and Reports/Technical review of plantation assets: forest inventory and woodflows. Miro Forestry Developments.

[79] Referring to the 20230818_Monitoring-Report_V4.1_MIRO Sierra Leone, section 1.1.

[80] Referring to the PDD Reforestation of Degraded Lands in Sierra Leone, in section 2.3.

classified as cropland before starting the project, only selecting the degraded grasslands[81] to implement the project (See image below).

Land cover	Cropland	Forest Land	Grassland	Total
Area (ha)	0	0	4,500.86	4,500.86

Figure 12.Land cover before starting the project

Nevertheless, illegal small-scale subsistence agriculture occurred in the project before its implementation (even though it is forbidden due to the country policies). 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)[82]. The main crop cultivated in the communities is rice, but this is very much on subsistence basis, mostly not sufficient for the annual feeding of the farming household. Almost all the farmers responded on cultivating more than one crop. Rice is cultivated in combination with cassava, cucumber, garden eggs, pepper, okra and other vegetables on the same farm. Groundnuts are grown immediately after the harvest of rice[83].

Despite the efforts of MFSL to not displace agriculture (small-scale subsistence), this has continuing happening at a very reduced scale as an illegal activity. Because of the difficulties to determine the extent of it MFSL undertook an environmental and social risk assessment to determine it. It consisted of a plot-by-plot basis, including but not limited to a survey of land uses and land users (both legal and illegal)[84]. The Community team spent a week in the field (forest reserve and surrounding communities) speaking to the people farming illegal on the reserve. According to the ESIA for new leases, 92% responded that they have other land areas for agriculture that excludes the portions they have leased to MFSL. Therefore, the remaining 8.0% of respondents did not have portions of land available for agriculture other than the ones found within the project area. This means that illegal farming activities happened in 317.45 hectares. However, for the sake of conservativeness, it was assumed that illegal farming occurred in 10% of the total project area (corresponding to 396.81 ha). Therefore the activity-shifting due to project implementation needs to be accounted for the calculation of leakage.

[81] Referring to the PDD Reforestation of Degraded Lands in Sierra Leone, in section 4.1.

[82] Supports/PDD/PO Information/ESIA

[83] Supporting information/Risk/MFSL ESIA Final Report (ECS 2014).pdf

[84] Supporting information/Risk/MFC Land Development - Policy, Implementation Framework and E_S Risk Assessment Guidelines.pdf

MFSL conscious of this situation has put measures to mitigate the activity displacement providing alternatively livelihood solutions like employment[85] at the company and space for intercropping activities within the reserves[86]. Approximately, 92% of the workers in the company come from the local population[87]. The intercropping activities typically only occurs in the first year after tree planting as thereafter the trees are too big to allow sufficient direct sunlight to the intercropped areas. Such intercropping can be attractive because Miro has prepared the land for tree planting and therefore the soil is effectively pre-harrowed thus meaning the farmers do not themselves have to make expenditure on land preparation. As across Miro's operational areas not all is for tree commercial planting, around the company's planted tree compartments there is both conservation areas (which the company protects to facilitate maximum biodiversity generation) and areas for farming (typically directly adjacent to the areas commercially planted with trees by the company). These areas are more than sufficient in scale to support the communities requirements and they offer ideal access given the company is maintaining the forestry roads amongst its commercial plantations. Typically areas intercropped and planted for food crops by communities, within Miro's land lease areas, amount to around 5% the total area under lease.

After deducting the intercropping areas from the activity displacement the remaining area susceptible of being displaced is 5% of the project area which means that 198.4 hectares of subsistence agriculture have been displaced.

To assess the leakage the A/R Methodological tool: Estimation of the increase in GHG emissions attributable to the displacement of pre-project agricultural activities in A/R CDM project activity, v2.0 (AR-TOOL15) [88]was applied. Following the steps provided by the AR-TOOL15:

9. Leakage emission attributable to the displacement of agricultural activities due to the implementation of an A/R CDM project activity is estimated as the decrease in carbon stocks in the affected carbon pools of the land receiving the displaced activity.

- In this case the leakage emission is attributed to the displacement of the small-scale subsistence farms that were illegally placed on the reserves before the project started is a consequence of the implementation of the project (It is not under the exceptions provided in Notes 1 and 2 depicted below).

[85] Supporting information/Additional/MFSL ESIA for Miro New Leases - GeoData 020082018.pdf

[86] Referring to the 20230818_Monitoring-Report_V4.1_MIRO Sierra Leone, section 4.4.

[87] Supporting information/Additional/123151-SL - Miro Forestry SA2019-11 - AD 36-A-19 NM.pdf

[88] AR-TOOL15 A/R Methodological tool: Estimation of the increase in GHG emissions attributable to displacement of preproject agricultural activities in A/R CDM project activity Version 02.0

Note 1. Displacement of an agricultural activity by itself does not result in leakage emission. Leakage emission occurs when the displacement leads to an increase in GHG emissions relative to the GHG emissions attributable to the activity as it exists within the project boundary.

Note 2. Increase in GHG emission occurring outside the project boundary attributable to the secondary effects of the A/R CDM project activity (e.g. changes in demand, supply or price of goods) is considered insignificant for the purpose of this tool and hence accounted as zero.

Figure 13. Notes 1 and 2 from the AR-TOOL 15

10. Leakage emission is attributable to the displacement of grazing activities under the following conditions is considered insignificant and hence accounted as zero:

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

(b) Animals are displaced to existing non-grazing grassland and the total number of animals displaced does not exceed the carrying capacity of the receiving grassland;

(c) Animals are displaced to cropland that has been abandoned within the last five years;

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

(e) Animals are displaced to a zero-grazing system.

- As previously explained the activity was not happening within the project area

11. In all other cases, the lands within the project boundary from which the pre-project agricultural activities are to be displaced outside the project boundary are delineated and their area is estimated. Leakage emission resulting from the displacement of the activities is estimated as follows:

$$LK_{AGRIC,t} = \frac{44}{12} \times \left(\Delta C_{BIOMASS,t} + \Delta SOC_{LUC,t}\right) \qquad \text{Equation (1)}$$

$$\Delta C_{BIOMASS,t} = [1.1 \times b_{TREE} \times (1 + R_{TREE}) + b_{SHRUB} \times (1 + R_S)] \times CF \times A_{DISP,t} \qquad \text{Equation (2)}$$

$$\Delta SOC_{LUC,t} = SOC_{REF} \times (f_{LUP} \times f_{MGP} \times f_{INP} - f_{LUD} \times f_{MGD} \times f_{IND}) \times \qquad \text{Equation (3)}$$

Where:

$LK_{AGRIC,t}$ = Leakage emission resulting from displacement of agricultural activities in year *t*; t CO_2e

$\Delta C_{BIOMASS,t}$ = Decrease in carbon stock in the carbon pools of the land receiving the activity displaced in year *t*; t d.m.

Note. The factor of 1.1 is used to account for the carbon stock in the dead wood and litter pools as a fixed percentage of the carbon stock in living trees.

CF = Carbon fraction of woody biomass; dimensionless.

A default value of 0.47 is used unless transparent and verifiable information can be provided to justify a different value.

$A_{DISP,t}$ = Area of land from which agricultural activity is being displaced in year *t*; ha

b_{TREE} = Mean above-ground tree biomass in land receiving the displaced activity; t d.m. ha^{-1}

The value of this parameter is obtained by applying one of the applicable methods from the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" to the land receiving the displaced activity.

Where the land receiving the displaced activity is unidentified, value of b_{TREE} is set equal to the applicable value of mean above-ground biomass in forest in the region or country where the A/R CDM project activity is located, as obtained from Table 3A.1.4 of the *IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry* (IPCC GPG-LULUCF 2003) unless transparent and verifiable information can be provided to justify a different value.

R_{TREE}	=	Root-shoot ratio for trees in the land receiving the displaced activity; dimensionless. A default value of 0.25 is used unless transparent and verifiable information can be provided to justify a different value.
b_{SHRUB}	=	Mean above-ground shrub biomass in land receiving the displaced activity; t d.m. ha^{-1}. The value of this parameter is obtained by applying one of the applicable methods from the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" to the land receiving the displaced activity.
R_S	=	Root-shoot ratio for shrubs in the land receiving the displaced activity; dimensionless. The default value of 0.40 is used unless transparent and verifiable information can be provided to justify a different value.
$\Delta SOC_{LUC,t}$	=	Change in soil organic carbon (SOC) stock due to land-use change in the land receiving the displaced activity in year *t*; tC ha^{-1}. The value of this parameter may be set to zero if: (a) The only displaced activity being received in the land is grazing activity; or (b) The value of the parameter as estimated from Equation (3) is less than zero (i.e. negative).
SOC_{REF}	=	SOC stock corresponding to the reference condition in native lands by climate region and soil type applicable to the land receiving the displaced activity; t C ha^{-1}. The value of this parameter is taken from Table 3 of the "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities".
f_{LUP}, f_{MGP}, f_{INP}	=	Relative SOC *stock change factors* for land-use, management practices, and inputs respectively, applicable to the receiving land before the displaced activity is received; dimensionless. The value of these parameters is taken from Tables 4, 5, and 6 of the "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities".
f_{LUD}, f_{MGD}, f_{IND}	=	Relative SOC *stock change factors* for land-use, management practices, and inputs respectively, applicable to the receiving land after the displaced activity has been received; dimensionless. The value of these parameters is taken from Tables 4, 5, and 6 of the "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities".
t	=	*1, 2, 3,* …years elapsed since the start of the A/R CDM project activity

Figure 14. Equations and explanations from the AR-TOOL 15

In the surroundings of the project area is mainly formed by a mosaic of degraded grasslands, shrubland, cropland and remaining fragments of forest. Despite the soils of this region being favourable for agricultural activities (ferrasols and cambisols), they have been degraded due to slash and burn agriculture which is a common practice in the region. This is why the activity is more likely to be displaced to grasslands or shrublands were by simple burning of the vegetation (grasses or small bushes) they can easily create a new farm.

The area of land from which agricultural activity is being displaced ($A_{disp,t}$) is 5% of the total project area (198.4 ha) as calculated before. The rest of the parameters values come from the following sources for the Tropical Wet Climatic region:

Table 15. Parameters of the leakage calculation, criteria and sources

Parameter	Value	Criteria	Source
$LK_{AGRIC,t}$ (t CO2)	Calculated	AR-TOOL15 equation	See *final result* section
$\Delta C_{Biomass,t}$ (t.d.m.)	Calculated	AR-TOOL15 equation	See *final result* section
$\Delta SOC_{LUC,t}$ (t C/ha)	Calculated	AR-TOOL15 equation	See *final result* section
CF (dimensionless)	0.47	Default value	2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC "Good Practice Guidance for LULUCF". 2006. Table 4.3.)
$A_{disp,t}$ (ha)	198.4	Calculated as the 5% of the project area	See *final result* section to see the amount per year and strata
b_{TREE} (t d.m. ha-1)	0	The biomass of trees was considered 0 because the trees in the land classes selected were scattered across the landscape (less than 5 per hectare).	See *Annex II* for more information: • Land Cover 20m Map of Africa 2016 • Google Earth images
R_{TREE} (dimensionless)	0	Not considered because the b_{TREE} is not used	-
b_{SHRUB} (t d.m. ha-1)	20.63	Value for bushland from the guinean savanna landscape in northern Sierra Leone.	Amara, E., Heiskanen, J., Aynekulu, E., & Pellikka, P. K. (2019). Relationship between carbon stocks and tree species diversity in a humid Guinean savanna landscape in northern Sierra Leone. *Southern Forests: a Journal of Forest Science*, 81(3), 235-245.

R_S (dimensionless)	0.40	Default value	AR-TOOL15 A/R Methodological tool: Estimation of the increase in GHG emissions attributable to displacement of preproject agricultural activities in A/R CDM project activity Version 02.1
SOC ref (tC/ha)	60	Calculated through GIS analysis using a buffer of 10 km to the project areas and information from Earth Map and calculating the average based on the distribution of soil types. All the soils types belong to Low-Activity Clay (LAC) soils under tropical wet conditions according to the IPCC Climate Zones	Table 3. of the CDM: "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities See Table 2 for more information on the calculations
f_{LUP} (dimensionless)	1	All permanent grassland is assigned a land-use factor of 1	Table 6. of the CDM: "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities See Table 2 for more information on the calculations
f_{MGP} (dimensionless)	0.97	Overgrazed or moderately degraded grassland, with somewhat reduced productivity (relative to the native or nominally managed grassland) and receiving no management inputs in Tropical regions	
f_{INP} (dimensionless)	1	All grassland without input of fertilizers is assigned an input factor of 1	
f_{LUD} (dimensionless)	0.82	Area has been managed for crops for less than 20 years and/or the area is cropland that has been in a fallow state for less than five years at any point during the last 20 years in Moist/Wet areas	Table 4: Relative stock change factors for different management activities on cropland (net effect over a period of 20 years) See Table 2 for more information on the calculations
f_{MGD} (dimensionless)	1.15	Primary and/or secondary tillage but with reduced soil disturbance (usually shallow and without full soil inversion). Normally leaves surface with	

		>30% coverage by residues at planting in tropical Moist/Wet regions	
f_{IND} (dimensionless)	0.92	Low inputs in Tropical Moist/Wet areas There is removal of residues (via collection or burning), or frequent bare-fallowing, or production of crops yielding low residues (e.g. vegetables, tobacco, cotton), or no mineral fertilization or N-fixing crops	Table 5: Relative stock change factors for different levels of nutrient input on cropland (net effect over a period of 20 years) See Table 2 for more information on the calculations

The following table (Table 16) explains why the different factors of stock change has been selected using referenced sources of information:

Table 16. Description of the selection of the relative stock change factors for land use change, management and inputs (All the values correspond to the Tropical Wet region according to the IPCC).

Parameter	Value	Description supporting the factor used	Reference
f_{LUP} (dimensionless)	1	The land use of the receiving land before the displaced activity has been received is permanent grassland. Using the Land Cover 20m Map of Africa 2016 it is clearly visible that the surface surrounding the project area in a 10 kilometer buffer is composed of grasslands with bushes ,shrubs, and scattered trees dispersed around	See Annex II for more information
f_{MGP} (dimensionless)	0.97	The management of the receiving land before the displaced activity has been received is moderately degraded grassland according to Table 6. Degradation of grasslands (and savannas). It is caused due to the effects of wildfires, and farming shifting. In the project are where rice is the main crop produced slash and burn practices are very common in the region (Kamara el al. 2016), these activities over the long-term caused the degradation of the grasslands.	Kamara, A., Vonu, O. S., Lansana, J., Lansana, J., & Sesay, F. S. (2016). Extent of reduction of the fallow period and its impact on upland rice production in the Nongowa chiefdom of Kenema district in eastern Sierra Leone. *Agricultural Sciences*, 7(11), 805.

f_{INP} (dimensionless)	1	The inputs to the receiving land before the displaced activity has been received are low. The grasslands are the result of the continued land use changes due to the establishment of multiple crops. The history of land degradation that results in this complex mosaic of forest remnants, agricultural areas, bushland and grasslands is mainly caused by deforestation, and multi-cropping. The main driver to transform grasslands to agricultural corps is fire because it is cheap labour and energy tool to remove the grasses and start cultivation. Therefore, the grasslands are not managed so any fertiliziers are added to these lands until they are converted to agricultural areas. In fact they are left without management for a period usually greater than 15 years to recover its fertility (Kamara et al. 2016).	Fayiah, M., Turay, A., Fayiah, M. S., Singh, S., & Verkhoturov, V. V. (2023). Multi-cropping: a land-use pattern that supports livelihood activities and prevents land degradation in Sierra Leone. *Glasnik Srpskog geografskog drustva*, 103(1), 433-446.
f_{LUD} (dimensionless)	0.82	The land use of the receiving land after the displaced activity has been received is short-term cultivated areas. These lands are usually cultivated in periods of 2-3 years without input of fertilizers. Then they are abandoned until they recover their fertility. Most of the land outside the project area are agricultural lands with very low potential because despite of the good soils the practices of slash and burn and continuous rotation of crops has degraded the soils, therefore the yield of the crops.	PDD Reforestation of Degraded Lands in Sierra Leone, in section 1.13. Kamara, A., Vonu, O. S., Lansana, J., Lansana, J., & Sesay, F. S. (2016). Extent of reduction of the fallow period and its impact on upland rice production in the Nongowa chiefdom of Kenema district in eastern Sierra Leone. *Agricultural Sciences*, 7(11), 805.
f_{MGD} (dimensionless)	1.15	The management of the receiving land after the displaced activity has been received is reduce tillage. In Sierra Leone the agriculture is mainly based in small-scale farmers, like in the surroundings of the project area were rice farms is mainly cultivated for subsistence, accounting for an average area of 1.06 ha per	Tholley, J. B. (2014). Integrated agricultural technology in food and energy production with small scale farmers at community level in the upland ecology of Sierra Leone.

		household (Conteh et al. 2012). Therefore the use of machinery is very limited mainly because of the lack of initial finance to purchase machinery. Most (if not all) of the operations are done manually by the farmers.	
f_{IND} (dimensionless)	0.92	The inputs to the receiving land after the displaced activity has been received are low. Practices like bare-fallowing are common in Sierra Leone, cultivating the land for 2-3 years and then moving to another land because of the lack of fertility (leaving it aside for 15 years). Furthermore, the use of crop residues in Sierra Leone is very low because they are significant products of the agroindustry sector (Amoo-Gottfried et al. 1999). Despite part of them are left in the soil, some others are burned. The state of the soils in Sierra Leone has presented deficiencies in macro and macronutrients (Denis et al. 2013).	Kamara, A., Vonu, O. S., Lansana, J., Lansana, J., & Sesay, F. S. (2016). Extent of reduction of the fallow period and its impact on upland rice production in the Nongowa chiefdom of Kenema district in eastern Sierra Leone. *Agricultural Sciences*, 7(11), 805.

FINAL LEAKAGE RESULTS:

The final leakage due to agricultural activities considering that only a 5% of the previous agricultural activity within the project area would have been displaced to the surrounding lands is:

Table 17. Final result (leakage)

Equation	Eq (2)	Eq (3)	Eq (1)
Parameter	$\Delta C_{Biomass,t}$	$\Delta SOC_{LUC,t}$	$LK_{AGRIC,t}$
Value	**2693.23**	**321.41**	**11055.00**

This broken down per strata and year is depicted in the following table:

Table 18. Final results of leakage per strata

Species code	Year	Area (Ha)	A disp (Ha)	Strata	ΔCBiomass,t (Eq. 2)	ΔSOCLUC,t (Eq. 3)	LKAGRIC,t (Eq. 1)
v	2016	205.31	10.27	1.1	139.35	16.63	571.97
Cctr	2016	63.79	3.19	1.2	43.29	5.17	177.70
Epel	2016	275.63	13.78	1.3	187.08	22.33	767.88
Gmel	2016	21.91	1.10	1.4	14.87	1.77	61.05
Other	2016	13.01	0.65	1.6	8.83	1.05	36.24
Aman	2017	134.39	6.72	2.1	91.22	10.89	374.41
Cctr	2017	51.53	2.58	2.2	34.97	4.17	143.55
Epel	2017	529.43	26.47	2.3	359.34	42.88	1474.96
Gmel	2017	127.49	6.37	2.4	86.53	10.33	355.18
Tgra	2017	19.44	0.97	2.5	13.19	1.57	54.15
Other	2017	15.48	0.77	2.6	10.51	1.25	43.12
Aman	2018	88.75	4.44	3.1	60.24	7.19	247.25
Cctr	2018	113.13	5.66	3.2	76.78	9.16	315.16
Epel	2018	1032.86	51.64	3.3	701.03	83.66	2877.47
Gmel	2018	60.38	3.02	3.4	40.98	4.89	168.20
Tgra	2018	3.84	0.19	3.5	2.61	0.31	10.70
Other	2018	56.06	2.80	3.6	38.05	4.54	156.18
Aman	2019	242.47	12.12	4.1	164.57	19.64	675.50
Epel	2019	752.46	37.62	4.2	510.71	60.95	2096.28
Gmel	2019	135.97	6.80	4.3	92.29	11.01	378.80
other	2019	24.75	1.24	4.4	16.80	2.00	68.95
		2968.07	**198.4**		**2693.23**	**321.41**	**11055**

And the broken down per year is depicted in the table below:

Year	Sum of LKAGRIC,t
2016	1614.84
2017	2445.37
2018	3774.97
2019	3219.53
Grand Total	**11054.71**

The final leakage due to agricultural activities was 11054.71, rounded up to 11055 of CO 2 equivalent[89,90].

[89] Supporting information/Leakage/Leakage Miro Ghana 2nd verification.pdf

[90] Supporting information/ SL_Ex post_2ndver_Aug2024-3968.xlsx (Leakage tab)

5.5 Net GHG Emission Reductions and Removals

The anthropogenic net removal of GHG by the reservoirs was estimated according to the equation of the AR-ACM0003 V2.0 presented below:

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

Eq.5

Where:

$\Delta C_{AR\text{-}CDM,t}$ Net anthropogenic removal of GHG by reservoirs in year t; tCO_2e

$\Delta C_{ACTUAL,t}$ Net current GHG removal from reservoirs in year t; tCO_2e

$\Delta C_{BSL,t}$ Net GHG removals by reservoirs at baseline in year t; tCO_2e

LK_t GHG emissions due to leaks in year t; tCO_2e

Since baseline removals as stated in the Baseline Emissions sections, considering the characteristics of the baseline vegetation, is equal to zero; and emissions due to leakage were 11055 of CO 2 equivalent[91,92]., as explained in section 1.17 and 4.3, net anthropogenic removals are expressed according to the formula:

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

The project proponents applied a buffer discount of a reserve of 17% to cover the aspects related to the risk of non-permanence. The complete non-permanence risk tool can be consulted in the supports folder.

Table 20: Net ex-ante removal of GHG emissions for the second monitoring period[93].

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 (17%)**	**VCUs eligible for issuance (tCO_2e)**
11-01-2020 to 31-11-2020	0	215407	11055	155105	26368	128737
01-01-2021-31	0	221475		159474	27111	132364

[91] Supporting information/Leakage/Leakage Miro Ghana 2nd verification.pdf

[92] Supporting information/ SL_Ex post_2ndver_Aug2024-3968.xlsx (Leakage tab)

[93] Supportinginformation/SL_ex-ante_2ndverification Aug2024 -3698.xlsx

to 12-12-2021						
01-01-2022 to 20-09-2022	0	159583		114909	19534	95374
Total		**596466**	**11055**	**429488**	**73014**	**356474**

Note that, the leakage has been updated and discounted to the 1st verification and 2nd verification (summing a total of 11055 t CO_2e)[94] before the buffer adjustments per strata.

Table 21. Estimated ex-ante GHG emission reductions and removals and the achieved emissions reductions and removals for this monitoring period.

Ex-ante emissions reductions/removals	**Achieved emissions reductions/removals**	**Percent difference**	**Justification for the difference**
Total 448,798[95] tCO2e	Total 356,474[96] tCO2e	-20.57%	The ex-ante emissions have been updated for this monitoring period and the achieved emissions reductions/ removals is fewer number of credits than initially reported.

APPENDIX

- Clean Development Mechanism. 2013. A/R Methodological tool: Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity. https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-15-v2.0.pdf
- UNFCCC. 2010. A/R Methodological Tool: tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities (ver 01.1.0). EB 60, Annex 12, page 1.

[94] Supporting information/ SL_Ex post_2ndver_Aug2024-3968.xlsx (Leakage tab)

[95] Supporting information/SL_ex-ante_2ndverification Aug2024 -3698.xlsx

[96] Supporting information/ SL_Ex post_2ndver_Aug2024-3968.xlsx

- UNFCCC. 2013. Methodological tool: estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities (Ver 04.2). Retrieved from https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-14-v4.2.pdf
- Verra. 2019. AFOLU Non-PermanenceRisk Tool. Retrieve from https://verra.org/wp-content/uploads/2019/09/AFOLU_Non-Permanence_Risk-Tool_v4.0.pdf
- Clean Development Mechanism. 2010. A/R Methodological Tool Calculation of the number of sample plots for measurements within A/R CDM project activities (Version 02.1.0). https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-03-v2.1.0.pdf
- IPCC. 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf
- Smith, C., & W., Brink. 2022. Technical review of plantation assets: forest inventory and woodflows. Miro Forestry Developments.