VILLAGE CLIMATE SOLUTIONS

Project title	Village Climate Solutions
Project ID	1325
Crediting period	21-April-2012 – 20-April-2064
Monitoring period	21-April-2022 – 30-June-2024
(CCB) GHG accounting period	21-April-2022 – 30-June-2024; 2.2 years
Original date of issue	29-Jun-2026
Most recent date of issue	29-Jun-2026
Version	1.4
VCS Standard version	4.7
CCB Standards version	3.1
Project location	Tanzania - Morogoro and Lindi Regions
Project proponent(s)	Village Climate Solutions, Charles Meshack, meshack@villageclimatesolutions.co.tz, +255 754 380 607
Validation/verification body	AENOR, José Luis FUENTES PÉREZ, jfuentes@aenor.com, (+34) 914 326 000
History of CCB Status	First validation/verification completed 21-December-2015
Gold Level criteria	**Climate change adaptation** – The project spans a 52-year crediting period, providing communities with REDD income previously

	unattainable and unavailable through any other forest enterprise. According to the opportunity cost survey, the project will offer more reliable income than farming, which is increasingly affected by changing climate conditions. Providing agricultural extension services aimed at enhancing the productivity of arable land by at least 1% annually will significantly strengthen climate resilience among local farmers. Additionally, having more forest cover in the landscape is associated with reduced temperatures and increased rainfall, which will reduce the impact of climate change on the project communities and biodiversity. **Exceptional community benefits** – The project will significantly boost community income and fund village development projects, enhancing social services, counting health, water, education and formal land titling. Investment in education will deliver long-term benefits to the younger generation, motivating them to pursue livelihoods that avoid forest clearing. **Exceptional biodiversity benefits** – The project will reduce deforestation and forest degradation in the biodiversity hotspot of the coastal forests of Rondo, Noto and the Chitoa Plateau in Lindi, home to at least 11 species listed as vulnerable or endangered on the IUCN Red List. It also protects sub-montane forests in the Eastern Arc Mountains in Morogoro home to at least 6 endangered and vulnerable species, while buffering protected areas of national and global significance, including Mikumi, Udzungwa, and Nyerere National Parks, as well as the Selous-Msanjesi-Niassa Wildlife Corridors where is provides habitat and mobility to at least 5 endangered and vulnerable species.
Prepared by	Prepared by Theron Morgan-Brown from Reterra Limited and Aklei Albert from Village Climate Solutions Limited.

CONTENTS

1 SUMMARY OF PROJECT BENEFITS 5
1.1 Unique Project Benefits 5
1.2 Standardized Benefit Metrics 7
2 PROJECT DETAILS 11
2.1 Summary Description of the Implementation Status of the Project 11
2.2 Project Implementation Status 44
2.3 Stakeholder Engagement & Safeguards 73
2.4 Management Capacity 92
2.5 Legal Status and Property Rights 98
3 CLIMATE 109
3.1 Monitoring GHG Emission Reductions and Removals 109
3.2 Quantification of GHG Emission Reductions and Removals 147
3.3 Optional Criterion: Climate Change Adaptation Benefits 182
4 COMMUNITY 183
4.1 Net Positive Community Impacts 183
4.2 Other Stakeholder Impacts 190
4.3 Community Impact Monitoring 191
4.4 Optional Criterion: Exceptional Community Benefits 198
5 BIODIVERSITY 205
5.1 Net Positive Biodiversity Impacts 205
5.2 Offsite Biodiversity Impacts 210
5.3 Biodiversity Impact Monitoring 210
5.4 Optional Criterion: Exceptional Biodiversity Benefits 214
APPENDIX 1: PROJECT RISKS TABLE 219
APPENDIX 2: STAKEHOLDER ENGAGEMENT MEETINGS 228
APPENDIX 3: METHODOLOGICAL ANNEX 241
1 PROJECT BOUNDARY 241
1.1 Spatial Boundaries 241
1.2 Temporal Boundaries 248
1.3 Carbon Pools 249
1.4 Sources of GHG Emissions 251
2 BASELINE SCENARIO 251
2.1 Determination of the most plausible baseline scenario 251
2.2 Description of Baseline Scenario (Step 2): Analysis of Agents, Drivers and Underlying Causes of Deforestation and Their Likely Future Development 259
3 ANALYSIS OF HISTORICAL LAND USE AND LAND COVER CHANGE 272
3.1 Collection of Suitable Data 273

3.2 Definition of Classes of Land Use and Land Cover 276
3.3 Definition of Land Use and Land Cover Change Categories 277
3.4 Analysis of Historical Land-Use and Land-Cover Change 277
3.5 Map Accuracy Assessment 291
3.6 Estimation of Land Cover and Land Cover Change Areas 294
4 PROJECTION OF FUTURE DEFORESTATION 294
4.1 Projection of the Quantity of Future Deforestation 294
4.2 Projection of the Location of Future Deforestation 298
5 DEFINITION OF LAND USE AND LAND COVER CHANGE COMPONENT OF THE BASELINE 316
5.1 Calculation of Baseline Activity Data Per Forest Class 316
5.2 Calculation of Baseline Activity Data Per Post-Deforestation Forest Class 318
6 ESTIMATION OF BASELINE CARBON STOCK CHANGES AND NON-CO2 EMISSIONS 320
6.1 Estimation of Baseline Carbon Stock Changes 320
6.2 Baseline Non-CO2 Emissions from Forest Fires 350
7 PROJECT EMISSIONS 353
7.1 Ex Ante Estimation of Actual Carbon Stock Changes and Non-CO2 Emissions in the Project Area 353
7.2 Ex Post Monitoring of Carbon Stock Changes and GHG Emissions Within the Project Area 363
8 LEAKAGE EMISSIONS 366
8.1 Ex Ante Estimation of Leakage (Step 8) 366
8.2 Monitoring Leakage 371
9 ESTIMATED GHG EMISSIONS REDUCTIONS 372
9.1 Ex Ante Total Net GHG Emission Reductions (Step 9) 372
9.2 Ex Post Net GHG Emission Reductions 375

1 SUMMARY OF PROJECT BENEFITS

1.1 Unique Project Benefits

Outcome or Impact	Achievements during the Monitoring Period	Section Reference	Achievements during the Project Lifetime
1) Improved village governance is expected to come as a biproduct of the benefit sharing system promoted by the project which treats REDD revenue as potential dividends to community members. Communities will meet annually to decide how much to cut from their dividends to spend on village development projects. This creates increased accountability over the delivery of development projects because the funding comes directly from community members rather than donors or rent.	In the absence of carbon credit revenue, no new progress during this monitoring period as the project hasn't implemented any benefit sharing during this monitoring period. Benefit sharing will resume after the sale of the credits from this monitoring period.		The project established and executed the benefit sharing system in 10 villages in project instance 1 in 2012 paying out a total of 472 million TSH (approximately 286,000 USD at the time of payments) by 2015, of which 346 million TSH was paid as dividends to 3306 men and 4574 women. Women collected dividends on behalf of 8171 dependents. 126 million TSH was spent on village health, education, and water projects, all of which were executed successfully.
2) Near universal stakeholder awareness and engagement. This is another impact of the project's benefit-sharing	In the absence of carbon credit revenue, the project could not implement the benefit sharing system during this monitoring period. However, another	2.2.1	95% of the cash payments were made in person in village assembly meetings where the basis for the

system. On dividend distribution days, as much as 95% of community members will appear in person to collect their dividends. This provides the project with the opportunity to directly engage with nearly all community members to increase their understanding of REDD and project activities, including the project's agricultural extension services.	unique way the project has been using to raise awareness of the project is by having the forest patrol teams provide leaflets to people they encounter in the project forests to educate them about the forest reserve they are in and REDD. This has the advantage of reaching people who aren't residents of the project villages as well. During this monitoring period 3741 patrol records were marked as complete, indicating that the forest patrol team had identified and talked to the person responsible for the forest disturbance they patrolled.		payments was explained meaning that there was near universal awareness about the project in the original 10 project villages in 2014.

1.2 Standardized Benefit Metrics

Category	Metric	Achievements during Monitoring Period	Section Reference	Achievements during the Project Lifetime
GHG emission reductions & removals	Net estimated emission removals in the project area, measured against the without-project scenario	N/A		
	Net estimated emission reductions in the project area, measured against the without-project scenario	718,068	3.2.4	817,776
Forest[1] cover	For REDD[2] projects: Number of hectares of reduced forest loss in the project area measured against the without-project scenario	5,107	3.2.2	6038
	For ARR[3] projects: Number of hectares of forest cover increased in the project area measured against the without-project scenario	N/A		
Improved land management	Number of hectares of existing production forest land in which IFM[4] practices have occurred as a result of the project's activities, measured against the without-project scenario	N/A		
	Number of hectares of non-forest land in which improved land management has occurred as a result of the	N/A		

[1] Land with woody vegetation that meets an internationally accepted definition (e.g., UNFCCC, FAO, or IPCC) of what constitutes a forest, which includes threshold parameters, such as minimum forest area, tree height and level of crown cover, and may include mature, secondary, degraded and wetland forests (*VCS Program Definitions*)
[2] Reduced emissions from deforestation and forest degradation (REDD) – Activities that reduce GHG emissions by slowing or stopping conversion of forests to non-forest land and/or reduce the degradation of forest land where forest biomass is lost (*VCS Program Definitions*)
[3] Afforestation, reforestation and revegetation (ARR) – Activities that increase carbon stocks in woody biomass (and in some cases soils) by establishing, increasing and/or restoring vegetative cover through the planting, sowing and/or human-assisted natural regeneration of woody vegetation (*VCS Program Definitions*)
[4] Improved forest management (IFM) – Activities that change forest management practices and increase carbon stock on forest lands managed for wood products such as saw timber, pulpwood, and fuelwood (*VCS Program Definitions*)

	project's activities, measured against the without-project scenario			
Training	Total number of community members who have improved skills and/or knowledge resulting from training provided as part of project activities	1,732	4.3.1, 2.3.4, 4.1.1	1,732
	Number of female community members who have improved skills and/or knowledge resulting from training provided as part of project activities of project activities	550	4.3.1 2.3.4, 4.1.1	550
Employment	Total number of people employed in of project activities,[5] expressed as number of full-time employees[6]	41.2	2.4.2, 2.4.3, 4.1.1, 4.4.1	41.2
	Number of women employed in project activities, expressed as number of full-time employees	9.5	2.4.2, 2.4.3, 4.1.1, 4.4.1	9.5
Livelihoods	Total number of people with improved livelihoods[7] or income generated as a result of project activities	2,298	2.1.12, 4.1.1, 4.3.1, 4.4.1	18,349
	Number of women with improved livelihoods or income generated as a result of project activities	589	2.1.12, 4.1.1, 4.3.1, 4.4.1	9,330
Health	Total number of people for whom health services were improved as a result of project activities, measured against the without-project scenario	0	4.3.1	5,418
	Number of women for whom health services were improved as a result of	0	4.3.1	2,959

[5] Employed in project activities means people directly working on project activities in return for compensation (financial or otherwise), including employees, contracted workers, sub-contracted workers, and community members that are paid to carry out project-related work.
[6] Full time equivalency is calculated as the total number of hours worked (by full-time, part-time, temporary and/or seasonal staff) divided by the average number of hours worked in full-time jobs within the country, region, or economic territory (adapted from UN System of National Accounts (1993) paragraphs 17.14[15.102]; [17.28])
[7] Livelihoods are the capabilities, assets (including material and social resources) and activities required for a means of living (Krantz, Lasse, 2001. *The Sustainable Livelihood Approach to Poverty Reduction*. SIDA). Livelihood benefits may include benefits reported in the Employment metrics of this table.

	project activities, measured against the without-project scenario			
Education	Total number of people for whom access to, or quality of, education was improved as a result of project activities, measured against the without-project scenario	0	4.3.1	3,581
	Number of women and girls for whom access to, or quality of, education was improved as a result of project activities, measured against the without-project scenario	0	4.3.1	1,826
Water	Total number of people who experienced increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	0	4.3.1	5,826
	Number of women who experienced increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	0	4.3.1	3,282
Well-being	Total number of community members whose well-being[8] was improved as a result of project activities	2,298	2.1.12, 4.1.1, 4.3.1, 4.4.1	18,349
	Number of women whose well-being was improved as a result of project activities	589	2.1.12, 4.1.1, 4.3.1, 4.4.1	9,330
Biodiversity conservation	Change in the number of hectares significantly better managed by the project for biodiversity conservation,[9]	920	5.3.1	920

[8] Well-being is people's experience of the quality of their lives. Well-being benefits may include benefits reported in other metrics of this table (e.g. Training, Employment, Health, Education, Water, etc.), but could also include other benefits such as empowerment of community groups, strengthened legal rights to resources, conservation of access to areas of cultural significance, etc.
[9] Biodiversity conservation in this context means areas where specific management measures are being implemented as a part of project activities with an objective of enhancing biodiversity conservation.

measured against the without-project scenario			
Number of globally Critically Endangered or Endangered species[10] benefiting from reduced threats as a result of project activities,[11] measured against the without-project scenario	8	5.4.1	8

[10] Per IUCN's Red List of Threatened Species
[11] In the absence of direct population or occupancy measures, measurement of reduced threats may be used as evidence of benefit

2 PROJECT DETAILS

2.1 Summary Description of the Implementation Status of the Project

2.1.1 Summary Description of the Project (VCS, 2.1, 3.6; CCB, G1.2)

During this monitoring period, the project reduced emissions from deforestation by 718,068 tCO_2e. The project was revitalized and greatly expanded by Village Climate Solutions Limited, a 100% Tanzanian owned company which took over control of the project during this monitoring period. The project also took the necessary steps during this monitoring period to comply with the new Tanzania Carbon Trading Regulations first introduced in October 2022.

Activities contributing the emissions reductions during this during this monitoring period:

- Meeting with village councils, general assemblies and district councils to educate them about REDD and obtain 60 community consent letters (Nov 2022 – Sep 2023)
- Reviving /establishing, training, equipping and funding 60 forest patrol teams to cover all project area forests (Dec 2022 – Jun 2024)
- Establishing a Mergin Maps server, providing forest patrol teams with regular updates about the location of forest disturbances and tracking forest patrol work (Feb 2023 – Jun 2024)
- Updating forest management plans / establishing new plans to revise existing village forest reserve boundaries to create 97,919 ha of new village forest reserves and improving the management in 214,417 ha of existing forest reserves to bring the total forested project area to 327,234 ha (Feb 2024 – June 2024)
- Restructuring managing authorities through establishment of community-based organizations and agreements with local authorities to continue to protect village forest reserves in villages that had been dissolved into municipal or township land.
- Developing and funding boundary cutline clearing for 19 village forest reserves

The climate, community, and biodiversity objectives include:

- Help communities adapt to climate change by promoting climate-smart agriculture, maintaining forest cover to protect water sources, and mitigating impacts on local rainfall and temperature.
- Ensure communities receive REDD compensation exceeding opportunity costs and support democratic benefit-sharing systems that leverage earnings for greater economic impacts.
- Protect critical habitats for endangered mammal species including African Savanna Elephant, Rondo Dwarf Galago, African Wild Dog, and Abbot's Duiker, as well as 14 other plant and animal species listed as endangered or vulnerable in the IUCN Red List.

2.1.2 Audit History (VCS, 4.1)

Audit Type	Period	Program	VVB Name	Number of years
Validation/ Verification	(21-April-2012-- 20-April-2013)	VCS, CCB	SCS Global Services	1
Verification	(21-April-2013-- 20-April-2022)	VCS	TÜV Rheinland Energy & Environment GmbH	9
Revalidation / verification	(21-April-2022-- 30-June-2024)	VCS, CCB	AENOR	2.2

2.1.3 Sectoral Scope and Project Type (VCS, 3.2)

Sectoral Scope	14: Agriculture, forestry, and other land use
AFOLU Project Category	Reduced Emissions from Deforestation and Degradation (REDD)
Project Activity Type	Avoiding Unplanned Deforestation and/or Degradation (AUDD)

2.1.4 Project Proponent (VCS, 3.7; CCB, G1.1)

Organization name	Village Climate Solutions Limited
Contact person	Charles Meshack
Title	Managing Director
Address	Plot # 245, Bock B, Morocco Ali Hassan Mwinyi Rd, Dar es Salaam-Tanzania
Telephone	+255 754 380 607
Email	meshack@villageclimatesolutions.co.tz

2.1.5 Other Entities Involved in the Project

Organization name	Lindi Municipal Council

Role in the project	Managing Authority, and Technical Advisor to Village Councils
Contact person	Juma Mnwele
Title	Executive Director
Address	P.O. Box 1070 LINDI
Telephone	+255 717 469 888
Email	md@lindimc.go.tz

Organization name	University of Dar es Salaam
Role in the project	Managing Authority
Contact person	Prof. Saudin J. Mwakaje
Title	Chief Corporate Counsel and Secretary to Council
Address	Mwalimu Julius Nyerere Mlimani Campus, P.O. Box 35091, Dar es Salaam
Telephone	+2552410110
Email	ira@udsm.ac.tz

Organization name	Mtama District Council
Role in the project	Technical Advisor to Village Councils participating in the project
Contact person	Anderson David Msumba
Title	Executive Director
Address	P.O.Box 328, MTAMA
Telephone	+255 714 272 727
Email	ded@mtamadc.go.tz

Organization name	Nachingwea District Council
Role in the project	Technical Advisor to Village Councils participating in the project
Contact person	Chionda Mfaume Kawawa

Title	Executive Director
Address	P.O.Box 291, NACHINGWEA
Telephone	+255 754 549 193
Email	ded@nachingweadc.go.tz

Organization name	Morogoro District Council
Role in the project	Technical Advisor to Village Councils participating in the project
Contact person	Jeshi G. Lupembe
Title	Executive Director
Address	P.O.Box 1880 MOROGORO
Telephone	+255 754 277 558
Email	ded@morogorodc.go.tz

Organization name	Mvomero District Council
Role in the project	Technical Advisor to Village Councils participating in the project
Contact person	Linno Pius
Title	Executive Director
Address	P.O.Box 663, MVOMERO
Telephone	+255 739 348 024
Email	ded@mvomerodc.go.tz

Organization name	Kilosa District Council
Role in the project	Technical Advisor to Village Councils participating in the project
Contact person	Michael J.Gwimile
Title	Executive Director
Address	P.O.Box 65, KILOSA
Telephone	+255 739 348 024

Email	ded@kilosadc.go.tz

Organization name	Mikumi Township Council
Role in the project	Managing Authority
Contact person	Edith F. Mlay
Title	Township Executive Officer
Address	P.O.Box 77, MIKUMI
Telephone	+255 756 957 080
Email	ded@kilosadc.go.tz

Organization name	Tanzania Forest Conservation Group
Role in the project	Majority shareholder of VCSL, technical advice
Contact person	Charles Meshack
Title	Executive Director
Address	Plot 323, Msasani Village, Old Bagamoyo Road, PO Box 23410, Dar es Salaam, Tanzania
Telephone	+255 22 2669007
Email	tfcg@tfcg.or.tz

Organization name	Reterra Ltd
Role in the project	Technical Advice, GIS works and Marketing
Contact person	Theron-Morgan Brown
Title	Managing Director
Address	Top Floor, 145 Uxbridge Road, London, United Kingdom, W12 9RB
Telephone	+255 765 980 601
Email	theron@reterra.ltd

Organization name	Chimbendenga Village Council
Role in the project	Managing Authority
Contact person	Swedi M. Mkupile
Title	Village Executive Officer
Address	P. O. Box 291 Nachingwea
Telephone	+255 612 022 681
Email	

Organization name	Kiegei A Village Council
Role in the project	Managing Authority
Contact person	Kainda C. Mtanga
Title	Village Executive Officer
Address	P. O. Box 291 Nachingwea
Telephone	+255 733 551 760
Email	

Organization name	Kiegei B Village Council
Role in the project	Managing Authority
Contact person	Abdalah Makalila
Title	Village Executive Officer
Address	P. O. Box 291 Nachingwea
Telephone	+255 733259590/787143803
Email	

Organization name	Kilimarondo Village Council
Role in the project	Managing Authority

Contact person	Zainabu Omary Salumu
Title	Village Executive Officer
Address	P. O. Box 291 Nachingwea
Telephone	+255 733 050 402
Email	

Organization name	Lionja B Village Council
Role in the project	Managing Authority
Contact person	Zabron E . Mkane
Title	Village Executive Officer
Address	P. O. Box 291 Nachingwea
Telephone	+255 692 755 347
Email	

Organization name	Lipuyu Village Council
Role in the project	Managing Authority
Contact person	Japhari M Maliki
Title	Village Executive Officer
Address	P. O. Box 291 Nachingwea
Telephone	+255 734176617
Email	

Organization name	Majonanga Village Council
Role in the project	Managing Authority
Contact person	Anna Ludwick Yohakimu
Title	Village Executive Officer

Address	P. O. Box 291 Nachingwea
Telephone	+255 625 725 604
Email	

Organization name	Matekwe Village Council
Role in the project	Managing Authority
Contact person	Majid Hamisi Ngajupa
Title	Village Executive Officer
Address	P. O. Box 291 Nachingwea
Telephone	+255 620368002/743882909
Email	

Organization name	Mbondo Village Council
Role in the project	Managing Authority
Contact person	Josephine Chesco Mgata
Title	Village Executive Officer
Address	P. O. Box 291 Nachingwea
Telephone	+255 738 629 096
Email	

Organization name	Mtua Village Council
Role in the project	Managing Authority
Contact person	Alfred Petro Ndimbo
Title	Village Executive Officer
Address	P. O. Box 291 Nachingwea
Telephone	+255 756443271

Email	

Organization name	Nahimba Village Council
Role in the project	Managing Authority
Contact person	Babu Rashidi Magoja
Title	Village Executive Officer
Address	P. O. Box 291 Nachingwea
Telephone	+255 738301073
Email	

Organization name	Nakalonji Village Council
Role in the project	Managing Authority
Contact person	Razack Samson Liviga
Title	Village Executive Officer
Address	P. O. Box 291 Nachingwea
Telephone	+255 738 550 603
Email	

Organization name	Namatunu Village Council
Role in the project	Managing Authority
Contact person	Agatha Y Milanzi
Title	Village Executive Officer
Address	P. O. Box 291 Nachingwea
Telephone	+255 738697621
Email	

Organization name	Nanjihi Village Council
Role in the project	Managing Authority
Contact person	Leonard Anthony Emmanuel
Title	Village Executive Officer
Address	P. O. Box 291 Nachingwea
Telephone	+255 733664143
Email	

Organization name	Ngunichile Village Council
Role in the project	Managing Authority
Contact person	Sadati Ally Mahundu
Title	Village Executive Officer
Address	P. O. Box 291 Nachingwea
Telephone	+255 658 462 187
Email	

Organization name	Chiwerere Village Council
Role in the project	Managing Authority
Contact person	Hamisi Mtioli
Title	Village Executive Officer
Address	P O Box 328 Mtama
Telephone	+255 0776733545
Email	

Organization name	Liganga Village Council
Role in the project	Managing Authority

Contact person	Bakari Ally Rashidi
Title	Village Executive Officer
Address	P O Box 328 Mtama
Telephone	+255 712245934
Email	

Organization name	Mihima Village Council
Role in the project	Managing Authority
Contact person	Ismail Chipondelo
Title	Village Executive Officer
Address	P O Box 328 Mtama
Telephone	+255 657585325
Email	

Organization name	Muungano II Village Council
Role in the project	Managing Authority
Contact person	Ashura Athumani
Title	Village Executive Officer
Address	P O Box 328 Mtama
Telephone	+255 716234376
Email	

Organization name	Nndawa Village Council
Role in the project	Managing Authority
Contact person	Noel Joseph Mpetula
Title	Village Executive Officer

Address	P O Box 328 Mtama
Telephone	+255 622968103
Email	

Organization name	Ntene Village Council
Role in the project	Managing Authority
Contact person	Esha Mchopa
Title	Village Executive Officer
Address	P O Box 328 Mtama
Telephone	+255 657185005
Email	

Organization name	Kinyope Village Council
Role in the project	Managing Authority
Contact person	Maunde Yusufu
Title	Village Executive Officer
Address	P O Box 1070 Lindi
Telephone	+255 627662531
Email	

Organization name	Kiwawa Village Council
Role in the project	Managing Authority
Contact person	Twalibu B Magulu
Title	Village Executive Officer
Address	P O Box 1070 Lindi
Telephone	+255 672474026

Email	

Organization name	Likwaya Village Council
Role in the project	Managing Authority
Contact person	Raymond Mlaponi
Title	Village Executive Officer
Address	P O Box 1070 Lindi
Telephone	+255 788057969
Email	

Organization name	Makumba Village Council
Role in the project	Managing Authority
Contact person	Rashidi Mpwili
Title	Village Executive Officer
Address	P O Box 1070 Lindi
Telephone	+255 786062079
Email	

Organization name	Milola Magharibi Village Council
Role in the project	Managing Authority
Contact person	Mohamedi Katuli
Title	Village Executive Officer
Address	P O Box 1070 Lindi
Telephone	+255 784794341
Email	

Organization name	Mkombamosi Village Council
Role in the project	Managing Authority
Contact person	Issa Mbaruku
Title	Village Executive Officer
Address	P O Box 1070 Lindi
Telephone	+255 783706901
Email	

Organization name	Muungano Village Council
Role in the project	Managing Authority
Contact person	Rashidi Rashidi
Title	Village Executive Officer
Address	P O Box 1070 Lindi
Telephone	+255 682593698
Email	

Organization name	Namkongo Village Council
Role in the project	Managing Authority
Contact person	Hamisi Mkopa
Title	Village Executive Officer
Address	P O Box 1070 Lindi
Telephone	+255 620435874
Email	

Organization name	Ruhoma Village Council
Role in the project	Managing Authority

Contact person	Rajabu Mohamedi Mangongo
Title	Village Executive Officer
Address	P O Box 1070 Lindi
Telephone	+255 621507227
Email	

Organization name	Mputwa Village Council
Role in the project	Managing Authority
Contact person	Saada Othmani Mbottoni
Title	Village Executive Officer
Address	P O Box 1070 Lindi
Telephone	+255 783649478
Email	

Organization name	NONA – Community Based Organization (Nandambi & Mkanga 1)
Role in the project	Forest Manager
Contact person	Hassani Saidi Patandi
Title	Secretary
Address	P O Box 1070 Lindi
Telephone	+255 715785923
Email	

Organization name	MTENA – Community Based Organization (Narunyu)
Role in the project	Forest Manager
Contact person	Issa Hamisi Namteje
Title	Secretary

Address	P O Box 1070 Lindi
Telephone	+255 789607698
Email	

Organization name	KUMIRU – Community Based Organization (Rutamba)
Role in the project	Forest Manager
Contact person	Bakari Fadhili Mponda
Title	Secretary
Address	P O Box 1070 Lindi
Telephone	+255 621127248
Email	

Organization name	Diguzi Village Council
Role in the project	Managing Authority
Contact person	Redemta Matola
Title	Village Executive Officer
Address	P. O Box 1880 Morogoro
Telephone	+255 711244921/789413656
Email	

Organization name	Lulongwe Village Council
Role in the project	Managing Authority
Contact person	Ramadhani Sekamba Mnyani
Title	Village Executive Officer
Address	P. O Box 1880 Morogoro
Telephone	+255 683001388

Email	

Organization name	Matuli Village Council
Role in the project	Managing Authority
Contact person	Kelvin Alex Mgomapayo
Title	Village Executive Officer
Address	P. O Box 1880 Morogoro
Telephone	+255 692122911
Email	

Organization name	Mlilingwa Village Council
Role in the project	Managing Authority
Contact person	Valence Franko Lukas
Title	Village Executive Officer
Address	P. O Box 1880 Morogoro
Telephone	+255 613040261
Email	

Organization name	Tununguo Village Council
Role in the project	Managing Authority
Contact person	Octavia Gereniah Kobero
Title	Village Executive Officer
Address	P. O Box 1880 Morogoro
Telephone	+255 774804675
Email	

Organization name	Kihondo Village Council
Role in the project	Managing Authority
Contact person	Wilned Yustine
Title	Village Executive Officer
Address	P. O. Box 663 Mvomero
Telephone	+255 716380662
Email	

Organization name	Maharaka Village Council
Role in the project	Managing Authority
Contact person	Eliza Mchilo
Title	Village Executive Officer
Address	P. O. Box 663 Mvomero
Telephone	+255 674122540
Email	

Organization name	Misengele Village Council
Role in the project	Managing Authority
Contact person	Choleta J Ngavumba
Title	Village Executive Officer
Address	P. O. Box 663 Mvomero
Telephone	+255 713090605
Email	

Organization name	Msongozi Village Council
Role in the project	Managing Authority

Contact person	Zainabu L John
Title	Village Executive Officer
Address	P. O. Box 663 Mvomero
Telephone	+255 676989043
Email	

Organization name	Sewe Kipera Village Council
Role in the project	Managing Authority
Contact person	Choleta J Ngavumba
Title	Village Executive Officer
Address	P. O. Box 663 Mvomero
Telephone	+255 713090605
Email	

Organization name	Chabima Village Council
Role in the project	Managing Authority
Contact person	Merrygoleth Mlengeni
Title	Village Executive Officer
Address	P O Box 65 Kilosa
Telephone	+255 786928515
Email	

Organization name	Dodoma Isanga Village Council
Role in the project	Managing Authority
Contact person	Fatuma I. Tengeza
Title	Village Executive Officer

Address	P O Box 65 Kilosa
Telephone	+255 719617020
Email	

Organization name	Gongwe Village Council
Role in the project	Managing Authority
Contact person	Mwanaharusi S. Matola
Title	Village Executive Officer
Address	P O Box 65 Kilosa
Telephone	+255 677615670
Email	

Organization name	Kisanga Village Council
Role in the project	Managing Authority
Contact person	Nyawebwa Wambura
Title	Village Executive Officer
Address	P O Box 65 Kilosa
Telephone	+255 699862410
Email	

Organization name	Kisongwe Village Council
Role in the project	Managing Authority
Contact person	Kassimu S. Danguche
Title	Village Executive Officer
Address	P O Box 65 Kilosa
Telephone	+255 757563460

Email	

Organization name	Kitunduweta Village Council
Role in the project	Managing Authority
Contact person	Lucian J. Matimbo
Title	Village Executive Officer
Address	P O Box 65 Kilosa
Telephone	+255 712469927
Email	

Organization name	Malolo A Village Council
Role in the project	Managing Authority
Contact person	Hawa H. Kamwana
Title	Village Executive Officer
Address	P O Box 65 Kilosa
Telephone	+255 786563652
Email	

Organization name	Mbamba Village Council
Role in the project	Managing Authority
Contact person	Rajabu Omary
Title	Village Executive Officer
Address	P O Box 65 Kilosa
Telephone	+255 656258700
Email	

Organization name	Mhenda Village Council
Role in the project	Managing Authority
Contact person	Sylvester M. Benedict
Title	Village Executive Officer
Address	P O Box 65 Kilosa
Telephone	+255 677225035
Email	

Organization name	Nyali Village Council
Role in the project	Managing Authority
Contact person	Mohamed L. Kenya
Title	Village Executive Officer
Address	P O Box 65 Kilosa
Telephone	+255 712941418
Email	

Organization name	Rudewa Gongoni Village Council
Role in the project	Managing Authority
Contact person	Haleluya M. Nehemia
Title	Village Executive Officer
Address	P O Box 65 Kilosa
Telephone	+255 656864777
Email	

Organization name	Ulaya Mbuyuni Village Council
Role in the project	Managing Authority

Contact person	Pearon L. Peter
Title	Village Executive Officer
Address	P O Box 65 Kilosa
Telephone	+255 713708494
Email	

Organization name	Unone Village Council
Role in the project	Managing Authority
Contact person	Gasper D. Sija
Title	Village Executive Officer
Address	P O Box 65 Kilosa
Telephone	+255 685810559
Email	

Organization name	JUHIMM – Msimba – Community Based Organization (Msimba)
Role in the project	Forest Manager
Contact person	Samson Menasy Kahemela
Title	Secretary of Community Based Organization
Address	P.O.Box 77 Mikumi
Telephone	+255 717871833
Email	

Organization name	JUHIMI – Community Based Organization (Ihombwe)
Role in the project	Forest Manager
Contact person	Rashid Mohamed
Title	Secretary of Community Based Organization

Address	P.O.Box 01 Mikumi
Telephone	+255 715909575
Email	

2.1.6 Project Start Date (VCS, 3.8)

Project start date	28-May-2011 – project instance 1 09-February-2023 – project instance 2
Justification	The project start date is May 28, 2011, which is the date that the first project village (Mkanga 1) passed its forest management plan and supporting by-laws in a village assembly meeting. This represents the start of the implementation of new forest management practices aimed at reducing greenhouse gas emissions in the project area. The start date for the second instance is Feb 9th, 2023, which is the date of the first on the ground patrols supported by the project in the new instance.

2.1.7 Benefits Assessment and Project Crediting Period (VCS, 3.9; CCB, G1.9)

Crediting Period	The project crediting period will be for 52 years from April 21st, 2012, to April 20th, 2062. The start of the project crediting period corresponds to the last Landsat imagery used in the baseline deforestation analysis because there was no suitable imagery from 2011. This imagery was selected because it was the cloud free, wet season Landsat imagery that was temporally closest to the project start date. The start of the crediting period is after the project start date and as such is conservative since it leads so a slight underestimate of project GHG reductions. The methodology used by this project allows for using satellite imagery that was captured within two years of the project start date to establish the forest cover benchmark map for the project area at the start date. The initial crediting period was to be 30 years, but this has been extended by an additional 22 years in new contracts with the participating forest owners. This project description was prepared for a revalidation of the project thus meeting all the requirements for renewal of a project crediting period. Version

	4.7 of the VCS standard requires a minimum of 20-year crediting periods for AFOLU projects which can be renewed for a maximum of 100 years. The standard also sets a minimum of 40 years for AFOLU project longevity. The 52-year crediting period is sufficiently long to meet the requirements of the standard without exceeding the 100-year limit.
Start Date of First or Fixed Crediting Period	21-April-2012 to 20-April-2064
Total Number of Years of Crediting Period	52 years
CCB Benefits Assessment Period	Changes in climate change adaptive capacity and resilience, biodiversity, and community well-being resulting from project activities will be monitored for the remainder of fixed crediting period (21-April-2022 to 20-April-2064).

2.1.8 Project Location (VCS, 3.11; CCB, G1.3)

The project location is the forested areas within the project instance boundaries shown in Figure 1. For simplicity of planning monitoring of the project area per the requirements of the applied methodology, this excludes areas of forest in the first project instance which were deforested during the previous baseline validity period. These areas are part of the project area and have been monitored since the beginning of the project as per the requirements of VM0015 with the emissions from the deforestation being fully captured in previous monitoring reports. VM0015 is a gross deforestation methodology, so once an area has been deforested and the emissions reported, there is no need for future monitoring of that area.

While the project lost control over some project area in Nandambi and Mkanga 1 villages in instance 1 after they were municipalized in 2018, these areas have been returned to the project through an agreement signed between VCSL and Lindi Municipality. The project continued to monitor those areas during the period of loss of control and all emissions from deforestation in those areas were captured in either previous monitoring reports or this monitoring report.

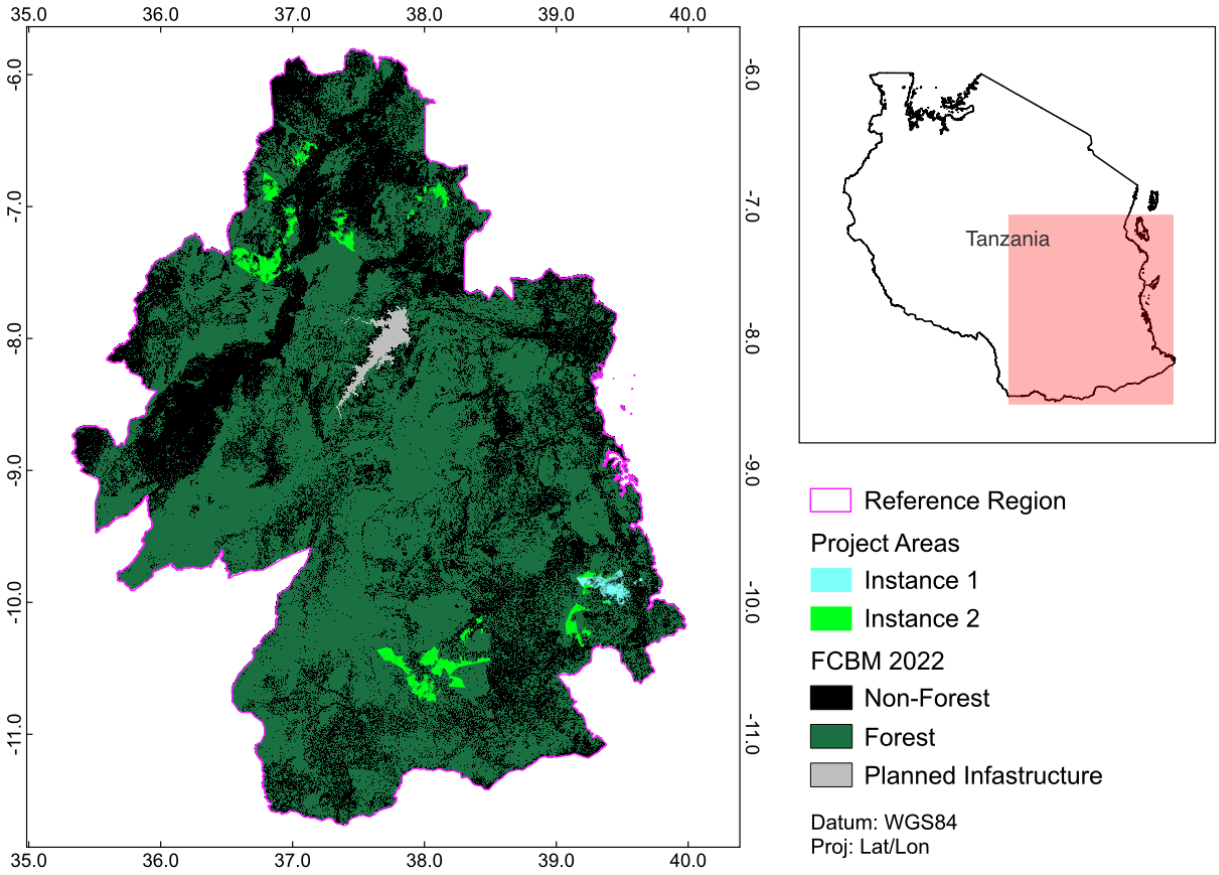


Figure 1 Location of Project Activity Instances as of 2023

☒ KML file has been provided

2.1.9 Title and Reference of Methodology (VCS, 3.1)

Type (methodology, tool, module)	Reference ID (if applicable)	Title	Version
Methodology	VM0015	AVOIDED UNPLANNED DEFORESTATION	1.2
Tool	VT0001	VCS VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities	3.0
Tool		VCS AFOLU Non-Permanence Risk Tool	4.2

2.1.10 Double Counting and Participation under Other GHG Programs (VCS, 3.23; CCB, G5.9)

2.1.10.1 No Double Issuance

Is the project receiving or seeking credit for reductions and removals from a project activity under another GHG program, or any other form of community, social, or biodiversity unit or credit?

☐ Yes ☒ No

2.1.10.2 Registration in Other GHG Programs

Was the project registered or seeking registration under any other GHG programs?

☐ Yes ☒ No

2.1.10.3 Projects Rejected by Other GHG Programs

Has the project been rejected by any other GHG programs?

☐ Yes ☒ No

2.1.11 Double Claiming, Other Forms of Credit, and Scope 3 Emissions (VCS, 3.24)

2.1.11.1 No Double Claiming with Emissions Trading Programs or Binding Emission Limits

Are project reductions and removals or project activities also included in an emissions trading program or binding emission limit? See the VCS Program Definitions for definitions of emissions trading program and binding emission limit.

☐ Yes ☒ No

2.1.11.2 No Double Claiming with Other Forms of Environmental Credit

Has the project activity sought, received, or is planning to receive credit from another GHG-related environmental credit system? See the VCS Program Definitions for definition of GHG-related environmental credit system.

☐ Yes ☒ No

2.1.11.3 Supply Chain (Scope 3) Emissions

Do the project activities affect the emissions footprint of any product(s) (goods or services) that are part of a supply chain?

☐ Yes ☒ No

2.1.12 Sustainable Development Contributions (VCS, 3.17)

Project activities during the monitoring period which contribute to the SDGs include expansion and creation of new Village Land Forest Reserves (VLFRs) by 97,919 and making cutlines in 14 VLFRs, provision of forest patrol technology to participating communities as well as educating Village Councils and Natural Resource Committees on REDD+ and the VCSL model. These activities contribute to the SDGs by boosting community income, enhancing forest and species protection, and improving water resource security.

The efforts focused on conserving the natural forests older than 10 years in the project area (SDG 15), protecting critical water catchment areas (SDG 6), and safeguarding High Conservation Value wildlife habitats in the Ilole, Noto, Chitoa, Rondo, and Wildlife Corridors and buffer zones of the National Protected Areas. (SDG 15). The boundary clearing activities provided additional income to communities. Besides, reduced deforestation has generated emission reductions which upon being verified will generate over $2.2 million for communities, contributing to poverty reduction (SDG 1).

The project introduced patrol technology and provided capacity building on its use, alongside training in community-based forestry and REDD+. These trainings targeted patrol teams, Village Councils, and Village Natural Resource Committees (VNRCs) across all participating villages, leading to improved village technical skills in community-based forestry. This outcome contributes to SDG 4 by enhancing the participation of youth and adults in formal and non-formal education and training.

Additionally, the project facilitated the establishment of three new VNRCs—one in each of the newly created Village Land Forest Reserves—comprising 40 members, of whom 33% are women. This inclusive approach supports SDG 5 by promoting women's participation in natural resource governance.

Estimates of project contributions for previous monitoring periods come a 2014 project report from a survey implemented by MJUMITA which was shared with VCSL.

Table 1: Sustainable Development Contributions

Row number	SDG target	SDG indicator	Net impact on SDG indicator	Current project contributions	Contributions over project lifetime
1)	1.2	1.2.2 Proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions	Implemented activities to decrease	Boundary clearing activities generated additional income of TZS 20.9 million (approximately USD $8700), benefiting 527 men and 39 women across 14 villages. The project provided an additional payment of $21,082 to the patrol team—income they would not have earned without the project. The project anticipates generating $2.2 million USD for participating communities from credits to be issued during this monitoring period.	Since commencement of the project in 2012, the benefit sharing system paid out a total of 472 million TSH (approximately 286,000 USD at the time of payments) by 2015, of which 346 million TSH was paid as dividends to 3306 men and 4574 women. Women collected dividends on behalf of 8171 children. 126 million TSH was spent on village health, education, and water projects, all of which were executed successfully. Boundary clearing activities generated additional income of TZS 20.9 million ($8700 USD), benefiting 527 men and 39 women across 14 villages. Patrol work provided additional $21,082 to communities. The project anticipates generating $2.2 million USD for participating communities from credits to be issued from this monitoring period.

2)	1.4	1.4.1 Proportion of population living in households with access to basic services	Implemented activities to increase	No changes this monitoring period	No changes this monitoring period
3)	1.4	1.4.2 Proportion of total adult population with secure tenure rights to land, with legally recognized documentation and who perceive their rights to land as secure, by sex and by type of tenure.	Implemented activities to increase	No changes this monitoring period	No changes this monitoring period
4)	2.4	2.4.1 Proportion of agricultural area under productive and sustainable agriculture.	Implemented activities to increase	No changes this monitoring period	A total of 515 farmers in project villages received conservation agriculture training and supplies from the project since its commencement in 2012
5)	4.1	4.1.2 Completion rate (primary education, lower secondary education, upper secondary education)	Implemented activities to increase	No changes this monitoring period	Since its start in 2012, the project has contributed to improving classrooms, toilets, and desks in Makumba, Kinyope, Mkanga 1, and Muungano villages. These efforts are estimated to have benefited 3,581 children, including 1,826 girls.

6)	4.3	4.3.1 Participation rate of youth and adults in formal and non-formal education and training in the previous 12 months, by sex	Implemented activities to increase	A total of 454 village patrol team members (136 women and 318 men) were trained in using VCSL's cloud-based platforms for forest patrols. Additionally, 1,732 members of Village Councils and Village Natural Resource Committees (550 women and 1,182 men) received trainings on the REDD initiative and the VCSL model during project establishment process	A total of 454 village patrol team members (136 women and 318 men) were trained in using VCSL's cloud-based platforms for forest patrols. Additionally, 1,732 members of Village Councils and Village Natural Resource Committees (550 women and 1,182 men) received 2 trainings on the REDD initiative and the VCSL model during project establishment process
7)	6.1	6.1.1 Proportion of population using safely managed drinking water services	Implemented activities to increase	No changes this monitoring period	Water delivery infrastructure improvements were implemented in Ruhoma, Likwaya, Muungano, and Mkombamosi villages. In Ruhoma, two boreholes were repaired, although the allocated funds were insufficient, requiring additional support from other sources. At Likwaya, water taps were installed throughout the village. In Muungano, two boreholes were repaired, with one located in Uleka sub-village and the other at the village center. Similarly, two boreholes were repaired in Mkombamosi. These enhancements have made water more

					accessible to 5,826 people, including 1,560 females and 889 males and 3,377 children, by bringing it closer to their homes.
8)	13.0	Tons of greenhouse gas emissions avoided or removed	Implemented activities to increase	By avoiding deforestation of 5,107 ha of natural forests and woodlands the project has prevented the release of 718,068 tCO2e- into the atmosphere.	By avoiding deforestation of 6,038 ha of natural forests and woodlands the project has prevented the release of 817,776 tCO2e- into the atmosphere.
9)	15.1	15.1.1 Forest area as a proportion of total land area	Implemented activities to increase	By implementing Community based forest management in 3 new villages and working with communities to expand the existing Village Land Forest Reserves, the project has added 97,919 hectares of natural forests under formal management.	Total reserved forest land under the Village Climate Solutions Project is 327,234 hectares.
10)	15.2	15.2.1 Progress towards sustainable forest management	Implemented activities to increase	The revision of 60 VLFR boundaries, aligning them with clear physical features and establishing cutlines in 16 VLFRs, has strengthened defensible forest boundaries for patrol teams. Additionally, the introduction of functional patrol technology has	The revision of 60 forest boundaries, aligning them with clear physical features and establishing cutlines in 16 VLFRs, has strengthened defensible forest boundaries for patrol teams. Additionally, the introduction of functional patrol technology has enhanced the capacity of 58 Forest

				enhanced the capacity of 58 Forest Managers to effectively protect forests in the Project Area.	Managers to effectively protect forests in the Project Area.
11)	15.5	15.5.1 Red List Index	Implemented activities to decrease	By conserving 327,234hectares of natural forests in the project area, the project has helped prevent deforestation of approximately 920 hectares of Mountain, Coastal, and Miombo forests in Noto Plateau and Ilole, as well as buffers for Lionja, Rondo, Litipo, and Ukwiva Forest Reserves, the Msanjesi Game Reserve buffer, and the Udzungwa and Mikumi buffers, while playing a key role in the protection of eight endangered and ten vulnerable species listed on the IUCN Red List documented within the project area.	By conserving 327,234 hectares of natural forests in the project area, the project has helped prevent deforestation of approximately 920 hectares of Mountain, Coastal, and Miombo forests in Noto Plateau and Ilole, as well as buffers for Lionja, Rondo, Litipo, and Ukwiva Forest Reserves, the Msanjesi Game Reserve buffer, and the Udzungwa and Mikumi buffers, while playing a key role in the protection of eight endangered and ten vulnerable species listed on the IUCN Red List documented within the project area.

2.2 Project Implementation Status

2.2.1 Implementation Schedule (VCS, 3.2; CCB, G1.9)

Overview and monitoring framework

The project was originally established in 2012 as the MJUMITA Community Forest Project (Lindi), registered under MJUMITA, a Tanzanian NGO. Following MJUMITA's inability to secure a buyer for the 2012–2013 vintage credits at an economically viable price, active project support went into hibernation after 2016, though the village forest reserves established for the project continued to exist under community management. Communities in Instance 1 villages continued to conduct forest patrols independently and without external support throughout this period. This was confirmed by baseline surveys conducted by VCSL in November 2022, in which all Instance 1 communities reported continuing forest patrol activities. The project continued to achieve modest emission reductions relative to the baseline through 2018 without active NGO or proponent support, demonstrating the durability of the community forest management structures established during the original project period.

From 2018 onwards, deforestation increased in two Instance 1 villages following the Lindi Municipality's decision to convert those village areas to municipal land and begin allocating plots for commercial farming from within portions of their former village forest reserves. This caused a significant spike in deforestation in those areas resulting in emissions that exceeded baseline from 2018–2022. However, because the emission reductions achieved between 2013–2018 had not yet been credited, the losses did not constitute a reversal — cumulative reductions across the full 2013–2022 period still exceeded cumulative losses. The verified 2013–2022 monitoring report confirmed that cumulative emission reductions across Instance 1 exceeded cumulative losses over the full period, resulting in 28,000 net VCUs verified for that monitoring period (Verra Registry, Project ID 1325, monitoring period 2013–2022 verification).

VCSL assumed responsibility for the project in late 2022, renaming it the Village Climate Solutions Project, and undertook a full program of re-establishment and expansion activities described below.

The current monitoring period runs from 21 April 2022 to 30 June 2024. The monitoring period commences on 21 April 2022 as required by the VCS Standard's prohibition on gaps between consecutive monitoring periods. Project Instance 2, which was added during this monitoring period and increased the project area approximately 7.8-fold, has a baseline allocation and ex-post monitoring commencing February 2023, as documented in section 5.1 of the methodological annex. No baseline allocation applies to Instance 2 prior to that date, and monitoring of that instance starts after the instance start date (see section 3.1.3).

VCUs are allocated to annual vintages in proportion to the relative baseline projection for each year of the monitoring period rather than by direct annual measurement — the 2022 vintage reflects the Instance 1 baseline allocation for the period from 21 April to 31 December 2022

only, with Instance 2 contributing no baseline allocation until February 2023 (as described in section 5.1 of the methodological annex). The 2022 vintages do not represent a specific claim that instance 1 reduced that many emissions during that period, but rather is just a proportional allocation of performance based on the portion of baseline allocated to instance 1 in 2022. Most reductions, including in instance 1, likely occurred as a result of activities started in 2023.

Foundational activities for project re-establishment and Instance 2 expansion

The following activities were implemented to establish the legal, institutional, and physical foundations for forest protection across both instances. These are prerequisites for sustained emission reductions — without community consent, formal long-term agreements, demarcated boundaries, and functioning management structures, patrol-based protection cannot be effectively implemented or enforced at scale.

Community consent and engagement

Starting in November 2022, VCSL worked with District Forest Officers to introduce the project to 60 communities. Initial introductory meetings were attended by 1,610 members (507 female, 1,103 male, including 259 youth), followed by general assemblies attended by 5,456 community members (2,270 female, 3,186 male). Specific meeting dates are provided in Appendix 2: Stakeholder engagement Meetings. Community engagement is a prerequisite for all subsequent forest protection activities. Community excitement about REDD in 2022-2023 reflected the prior experience of Instance 1 communities with the MJUMITA project, their expectation of performance-based payments based on the 2013–2014 payment round, and in other villages, the wider awareness of significant income generated by other REDD projects in Tanzania which was widely reported on in the press . This expectation of future benefit is itself a contributor to emissions reductions during this monitoring period: when presented with the opportunity to join the VCSL project, communities agreed to restrict farm expansion and contribute labor to boundary clearing and patrols specifically because the project framework creates the prospect of income from carbon credits.

Lindi Municipality intervention

A significant contributing factor to emission reductions in two Instance 1 villages during the monitoring period was the Lindi Municipality's immediate response to VCSL's re-engagement in September 2022 (see Appendix 2: Stakeholder engagement Meetings) . Between 2018 and 2022, the Municipality had been converting two former village areas to municipal land and allocating plots for commercial farming within portions of their former village forest reserves, causing a marked uptick in deforestation in those areas. Following VCSL's, introductory meeting and training of the Municipal Council Management Team, on REDD and VCSL model conducted in September and October 2022, the Municipality immediately halted new land sales and actions which would lead to further deforestations. Then, most of the remaining forests in these areas were subsequently brought back into the project under a new institutional structure, comprising of the community-based organizations (CBOs) created under VCSL's support in 2023. The

Municipality as the Managing Authority, signed the carbon trade contract with the project on behalf of the communities. The contract allows communities through CBOs to protect the forests and benefit from the carbon trade in the same way they would under the village administration structures. This intervention demonstrates that project re-engagement can generate emission reductions through institutional and governance mechanisms as well as direct patrol-based enforcement.

Carbon trade contract development and execution

On 6–7 February 2024, a long-term carbon trade contract was drafted with contributions from 12 legal and forest officers (2 female, 10 male) from Nachingwea, Mtama, Lindi Municipality, Mvomero, Morogoro Rural, and Kilosa Local Authorities. The draft underwent detailed review from 22–24 May 2024 by 15 legal and forest officers (5 female, 10 male) from PO-RALG, VPO-DoE, Lindi and Morogoro Regional Secretariats, and the respective Local Authorities. Between February and June 2024, VCSL presented the draft contract at village council meetings attended by 1,815 members (549 female, 1,266 male, including 183 youth), followed by village and CBO general meetings attended by 4,991 members (1,761 female, 3,230 male, including 900 youth) (see Appendix 2: Stakeholder engagement Meetings). Between April and June 2024, VCSL participated in local authority meetings attended by 609 councilors and council management team members (170 female, 439 male) from Nachingwea, Lindi, Mvomero, Morogoro Rural, and Kilosa (see Appendix 2: Stakeholder engagement Meetings). The 40-year carbon trade contract was signed on 18 October 2024 with all managing authorities. The contract provides the legal basis for performance-based payments to communities, which are sequenced to commence once credits are issued following verification.

Boundary analysis, adjustment, and remarking

In 2022 and 2023, VCSL conducted detailed analysis of potential Instance 2 project areas across target districts to identify existing village land forest reserves (VLFRs), proposed wildlife management areas, areas with significant encroachment, and opportunities for VLFR expansion in previously unprotected forests. VCSL worked with districts and villages to adjust and remark boundaries, removing heavily deforested patches from VLFRs in Instance 2 villages and aligning boundaries with natural features where possible. In total, VCSL worked with project villages and districts to expand or create new village forest reserves covering 96,308 ha in Instance 2 villages. An additional 1,611 ha were added to VLFRs in Instance 1 villages, increasing the extent of protected forest within the existing project area. These boundary adjustments were incorporated into Village Forest Management Plans approved by the managing authorities alongside the carbon trade contracts.

The formal establishment and expansion of VLFRs through village assembly resolutions is itself a direct mechanism for reducing deforestation, and one that is qualitatively different from conventional community-based forest management (CBFM) interventions. Under conventional CBFM, communities can continue to benefit from sustainable timber harvesting within a forest reserve while encroachment and deforestation occur in other parts of the same reserve — the

financial returns from CBFM are not directly linked to preventing deforestation, so communities have limited incentive to actively police encroachment beyond what their own enforcement capacity and social norms sustain. This is precisely why widespread encroachment into formally designated village forest reserves is a documented feature of the Tanzanian landscape, and why the existence of a legal VLFR designation alone is insufficient to prevent the deforestation rates observed in the reference region.

REDD+ fundamentally changes this calculus. Every hectare of encroachment within the project area directly reduces community earnings — the financial return is tied not to what communities extract from the forest but to how much deforestation they prevent across the entire designated area. This means communities have a direct financial stake in actively enforcing protection across all parts of their forest reserves, not just those they use for sustainable harvesting. VCSL explained this explicitly to communities during the engagement process: higher earnings come not just from larger protected areas but specifically from including forest under higher threat of deforestation — areas at the edge of human settlements where encroachment pressure is greatest and where the gap between baseline deforestation and avoided deforestation is therefore largest. A significant portion of the 96,308 ha of new or expanded VLFRs in Instance 2 villages involved expanding boundaries outward toward the edges of human settlements precisely to bring the most threatened forest within the project area, where active community protection generates the greatest emission reductions and the greatest financial return to communities.

All but one of the communities that joined under Instance 2 had prior experience with CBFM and already had an existing village forest reserve — demonstrating that legal forest designation alone had not been sufficient to prevent the deforestation rates observed in the reference region. The one community (Nakalonji) without a village forest reserve or proposed wildlife management area had previously declined an approach by WWF to participate in a Wildlife Management Area, indicating that external conservation propositions without direct financial incentives linked to forest outcomes had limited traction. The decision by these communities to expand their forest reserves into higher-threat areas was made with a clear understanding that their financial returns depend specifically on protecting those areas against encroachment — the more threatened the forest included, the greater the potential earnings, but only if active protection is delivered. This represents a structural reduction in deforestation risk that operates independently of and in addition to the patrol-based enforcement program — communities are not merely subject to external monitoring but are active stakeholders in the outcome, with their financial interests explicitly and directly aligned with preventing deforestation across every hectare of the project area.

Boundary cutline development

VCSL developed boundary cutline maps for 19 villages, encompassing 859 clearing blocks covering 789 km of boundary, prioritizing areas adjacent to high deforestation threats and those lacking clear physical boundary markers such as rivers or roads. Prior to commencement, approval was obtained from village general assemblies in 14 villages, attended by 1,321

community members (446 female, 875 male, including 241 youth). Extension agents hired by the project supervised boundary clearing during the dry season from September to November 2023. The project employed 566 community members (527 male, 39 female) to clear 709 blocks covering 507 km, involving slashing all vegetation in a 3-metre-wide swath around the outside boundary of VLFRs while avoiding trees of 20 cm DBH or greater. Clear physical boundaries are a direct enabler of emission reductions: without demarcated boundaries, patrol teams cannot definitively identify encroachment events and violators can dispute whether clearing occurred inside the reserve. The cutline program was therefore a critical precondition for the targeted patrol program that followed.

Forest Management Plan development and updating

The project team facilitated Village Natural Resource Committees and village councils in developing new Forest Management Plans and bylaws in 3 villages based in Nachingwea district, namely Nakalonji, Chimbendenga and Mtua, where they did not previously exist and updating them as needed in the remaining villages. FMPs were approved by village councils and village general assemblies together with the carbon trade contracts, submitted to full district councils for final approval in new villages, and registered by district forest officers in the district registry as provided in the National CBFM Guideline 2007.

Managing authority restructuring

Between September and December 2023, VCSL facilitated the establishment of five CBOs in Nandambi and Narunyu streets and Rutamba village in Lindi Municipality, and in Msimba and Ihombwe hamlets in Mikumi Township, Kilosa District. A total of 24 meetings were held, attended by 943 people (295 female, 648 male, and 173 youth). As a result, a sum of 5 CBOs received formal certificates of registration and are responsible for protecting the community forests and benefit from the carbon trade in the same way they would under the village administration structures.

Imlementation of VCSL's Patrol technology

The project provided training on Mergin Maps' smartphone technology to 454 village patrol team members, comprising of 136 female, 318 male and 126 youth. Patrol teams sync their devices when network access is available, receiving monthly updates on the locations of encroachment events identified from satellite imagery analysis, enabling them to navigate directly to active deforestation sites rather than conducting generic area patrols. Patrol data and outcomes are uploaded via the Mergin Maps cloud platform. As of June 2024, the project had supported over 745 patrols covering more than 5,270 recent forest disturbance patches. At least 3,741 individuals were identified during patrols, educated about the project and the legal status of the forest reserves, and warned against further clearing. The combination of precise targeting from remote sensing, immediate field response, and direct engagement with deforestation agents represents a material advance over the independent community patrols conducted during the

hibernation period and is the primary mechanism through which the observed emission reductions were achieved.

Activities planned but not yet commenced.

Three activities described in the PD were not implemented during this monitoring period. Their absence reflects planned sequencing rather than abandonment and does not affect the validity of the emission reductions reported.

Gazettement of Village Land Forest Reserves: Gazettement is a government-led process requiring ministerial approval and formal consultation under Tanzania's Forest Act 2002 and is outside the project's direct control in terms of timing. VCSL has engaged with district and regional authorities to initiate gazettement processes for eligible villages. Gazettement remains a priority activity for the next baseline validity period.

Performance-based payments to communities: Payments require executed carbon trade contracts as a legal prerequisite and a verified credit issuance as a financial prerequisite. The 40-year carbon trade contract was signed 18 October 2024, after the close of this monitoring period. The benefit-sharing template has been drafted and will be customized at village level prior to the next monitoring period, enabling payments to commence once credits from this monitoring period are issued. The expectation of these payments has been a significant motivating factor for community participation in project activities throughout this monitoring period.

Farm extension services: Extension services to improve agricultural productivity and reduce deforestation pressure from farming expansion are sequenced to follow the establishment of community management structures and benefit-sharing arrangements, which were the priority of this monitoring period. Extension services have commenced during the next monitoring period.

Carbon stock losses during the monitoring period

Carbon stock losses occurred during the monitoring period as a result of unavoided unplanned deforestation within the project area. These losses are fully quantified in section 3.2 as project emissions (ΔCUDdPAt) and have been deducted from gross emission reductions in calculating net VCUs. The total area of deforestation detected within the project area during the monitoring period was 3006 ha, resulting in carbon stock changes of -416,938 tCO_2e as reported in VM0015 Ex-Post Table 47. The losses were tracked in near real time throughout the monitoring period as part of the project's regular monitoring of encroachment and were communicated to forest patrol teams who then went directly to the areas of encroachment to stop further encroachment.

These losses do not constitute a reversal as defined under the VCS Standard. The monitoring framework covers the full project area including areas credited during the previous baseline validity period (2012–2022). Any deforestation detected within previously credited areas is counted as project emissions against the current period's baseline allocation — such areas carry no baseline deforestation allocation in the new baseline validity period, so losses there

reduce net VCUs rather than generating offsetting credits. This ensures losses in any part of the project area are penalized in the accounting rather than ignored. The positive net VCU total for this monitoring period (see VM0015 Ex-Post Table 64) confirms that cumulative emission reductions exceed cumulative project emissions and leakage, and that no reversal has occurred.

2.2.2 Baseline Reassessment (VCS, 3.2.6, 3.2.7)

Did the project undergo baseline reassessment during the monitoring period?

☒ Yes ☐ No

The project has submitted an entirely new PD for this and future monitoring periods. The previous baseline validity period expired at the start of this monitoring period, and the project has undergone major changes necessitating a new PD. The updated PD applies the latest version of VM0015 v1.2, and a new baseline has been established for the 2022–2028 baseline validity period. The details of the new baseline are described in the methodological annex.

Extended Historical Reference Period Analysis

In accordance with Section 6.3.2.1 of VM0015 v1.2, the historical reference period (HRP) was extended to include the original reference period and all subsequent monitoring periods up to the beginning of the current monitoring period. For the original reference region (used for Project Instance 1 in the original PD), this produced an extended HRP, encompassing the original HRP of 2000-2012 and the first baseline validity period of 2012–2022.

Table 2 Annual Deforestation Rate Comparison — Original Reference Region

Period	Context	Total Deforestation (ha)	Duration (years)	Annual Rate (ha/yr)	vs. 2001–2010 Rate
A | Original HRP — Excluded sub-period (2001–2010)					
Sub-total: May 25, 2001 – Sep 23 2010	**Excluded period**	**42,810**	9.34	4,585	-
B | Transition period (Oct 2010 – Apr 2012) — appears in both original HRP and new reference period					
Sep 23, 2010 – Apr 21, 2012	Original HRP / New RP overlap	8,737	1.58	5,536	21%
C | New Reference Period (2010–2022) — used for 2022–2028 baseline validity period					

Period	Context	Total Deforestation (ha)	Duration (years)	Annual Rate (ha/yr)	vs. 2001–2010 Rate
Sep 23, 2010 – Jul 24, 2016	New reference period	37,800	5.84	6,474	41%
July 24, 2016 – Aug 28, 2022	New reference period	39,131	6.10	6,413	40%
Sub-total: Sept 23, 2010 – Aug 28, 2022	**New reference period**	**76,931**	**11.94**	**6,445**	**41%**

Notes:

1. Annual rates for the original HRP rows are calculated from Table G from the methodological annex of the original VCS project document which validated in 2015.

2. 'vs. 2001–2010 Rate' column compares the annualized rate for each period against the 2001–2010 sub-period average (4585 ha).

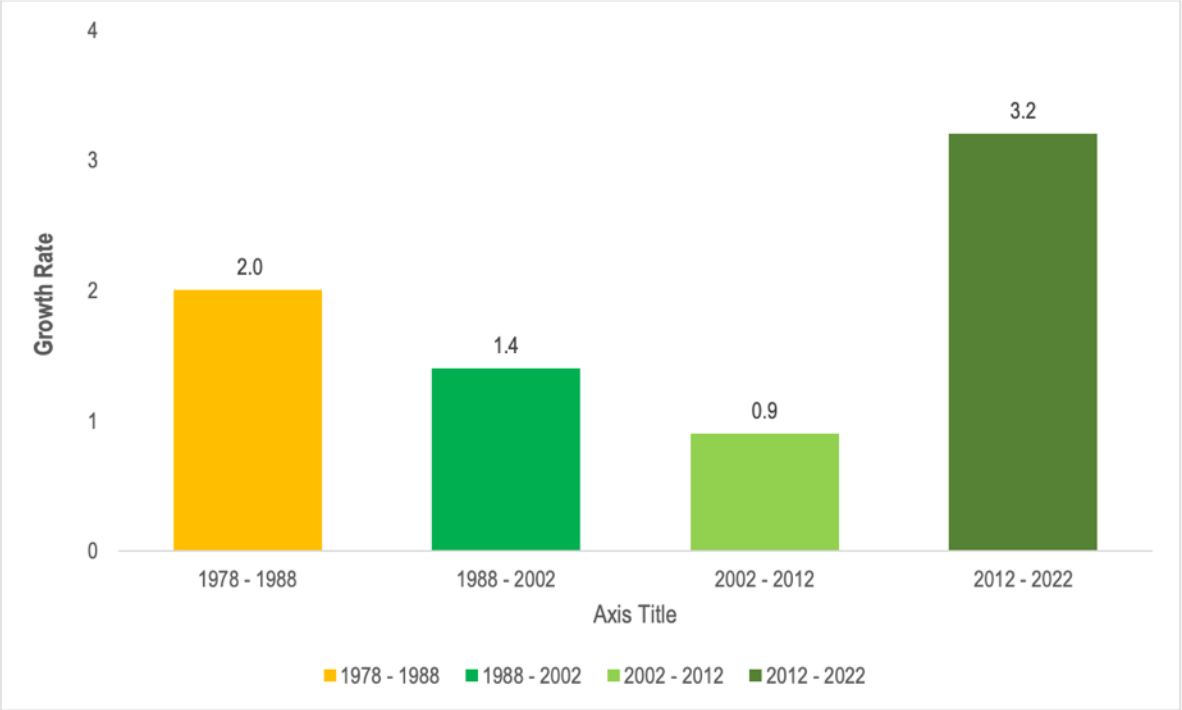
3. Data in Section C covers the original reference region (developed for Instance 1) only. The expanded reference region added to accommodate Project Instance 2 is addressed separately. The numbers were calculated using a zonal histogram and multiplying the number of pixels in the 2010-2016 and 2016-2022 map classes by pixel area (0.0625 ha). The map accuracy assessment conducted on the new expanded reference region for the loss for 2010-2022 found that the map estimated (see Table 32 in the methodological annex), and bias corrected figures (see Table 36 in the methodological annex) were essentially identical and there is no reason to suspect that those results do not generalize to the original reference region, which is a subset of the expanded reference region.

4. The 2010 start date for the new reference period corresponds to the last year of available PALSAR-1 data mosaics (ALOS-1 ceased operations April 2011) which are essential for mapping the wider new reference region. PALSAR-2 data is not available until 2015.

5. The specific start and end dates of different periods correspond to dates of, or median dates of satellite imagery used in the mapping. The median PALSAR data for 2022 is Aug 28, 2022, which is less than 1 year from the end of the baseline validity period on April 20, 2022. Additionally, the same PALSAR imagery was used to map deforestation during the 2013-2022 monitoring period without extending the baseline to cover the extra 4 months. Thus, deforestation in instance 1 and leakage belt between April and Aug 2022 was already conservatively counted against the project in the previous monitoring period and there are no monitoring gaps even though the imagery dates (which are not under the project's control in annual global mosaic products) do not align perfectly with the end of the previous baseline validity period.

The extended HRP analysis reveals a material shift in deforestation dynamics within the original reference region between the first historical reference period and the first baseline validity period. The annual deforestation rate in the original reference region during 2010–2022 was 41% higher than during 2001–2010 (6,445 vs. 4,485 ha/yr) (Table 2). This exceedance is not attributable to random variation but reflects a structural intensification of deforestation pressure consistent with the updated driver analysis described in Section 2.2 of the methodological annex — in particular, the population growth rate in Lindi Region between 2012 and 2022 was much higher than previous inter-census periods (Figure 2).

Figure 2 Historical Lindi Region Population Growth Rates from the Tanzania 2022 Census Report



This population growth was driven by both local population increase and immigration. As described in Section 2.2 of the methodological annex, cash crop cultivation (particularly Sesame) now makes up the majority of cultivation by area in new deforestation in the project area. This is likely due to improved infrastructure better connecting Lindi to other parts of Tanzania than it was historically and thus making cash crop cultivation more economically attractive. Historically, Lindi working age adults were highly skewed female as many men shifted to cities like Dar es Salaam to look for work. Now, with farming being more economically attractive, these men are shifting back or not leaving in the first place and thus the population skew is now much reduced (see Figure 12 and Figure 13 in the methodological annex). This is important since as evidenced in Section 2.2 of the methodological annex, most deforestation activities are done by men.

In accordance with Verra and the methodology's accuracy principle, the first 9 years of the original HRP were determined to be unrepresentative of current and anticipated future deforestation dynamics. Therefore, as a more accurate methodological deviation, the reference period used for projection was defined as 2010-2022, representing the 12-year sub-period for which observed deforestation dynamics most accurately reflect the threat environment facing the project area during the 2022–2028 baseline validity period.

Application to the New Reference Region

The addition of Project Instance 2 during this monitoring period substantially expanded both the project area and the reference region (Figure 3). The new reference region is approximately 46 times larger than the original, with the expanded area defined to serve as a credible proxy for deforestation patterns in the Instance 2 project areas, consistent with the requirements of Section 5.1.1 of VM0015 v1.2.

The extension requirement of Section 6.3.2.1 is predicated on the existence of a prior project baseline and monitoring history for the reference region in question. The expanded portions of the reference region added to accommodate Project Instance 2 have no prior baseline history under this project — there is no original HRP to extend from, and no prior baseline validity period monitoring data for these areas within the project's MRV framework. Consequently, the 6.3.2.1 extension requirement does not reasonably apply to these areas. The appropriate HRP for the new reference region extent is instead governed by the initial HRP requirements of Section 5.2.1 of VM0015 v1.2, under which the HRP start date should not be more than 10 years before the project start date. That would mean an HRP starting in 2012.

However, PALSAR I global mosaic data availability ends in 2010 and PALSAR II global mosaics are not available until 2015. The PALSAR global mosaics are essential for obtaining the minimum forest benchmark map accuracy (90%) in the wider reference region which is difficult to map with optical imagery due to persistent cloud cover and seasonally dry and deciduous Miombo woodland. Furthermore, further compounding the optical data challenges, the Landsat 5 thematic mapper failed in 2011. Thus, the only wall to wall data in 2012 was Landsat 7, which due to SCL failure in 2003 was missing 22% of each scene. Thus, 2010 was chosen instead as the start year for the historical reference period so that PALSAR mosaics could be used. The use of a 12-year reference period is consistent with and exceeds the minimum 10-year duration specified in the VCS Methodology Requirements v5.0, confirming that the chosen period satisfies the applicable requirements.

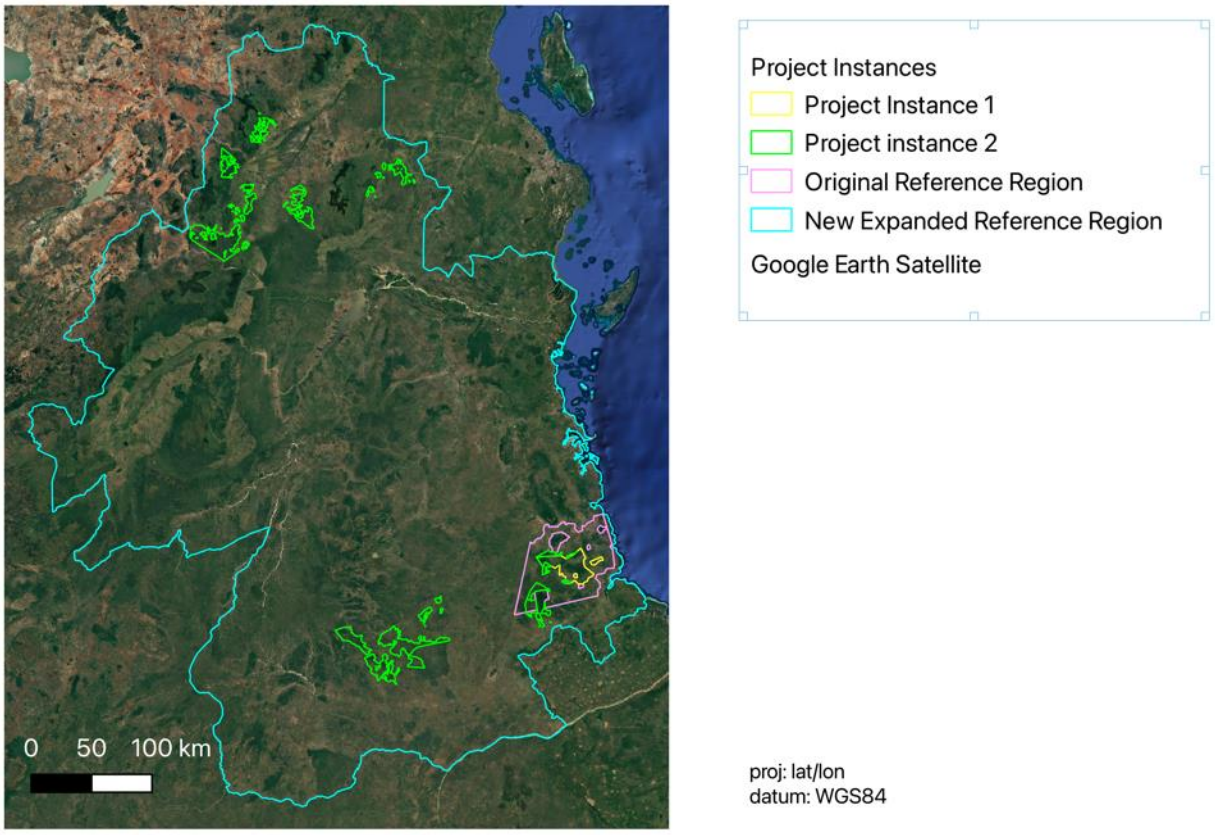


Figure 3 Original and Expanded Reference Regions

Justification Summary

The reference period of 2010-2022 applied in the new baseline reflects the intersection of two independently justified determinations: (i) for the original reference region, it represents the sub-period identified through extended HRP analysis as most accurately representing current deforestation dynamics, consistent with the accuracy principle of VM0015 v1.2 and the driver-based evidence of a structural shift in deforestation pressure; and (ii) for the expanded reference region, it represents the maximum feasible and methodologically appropriate period given the absence of prior baseline history and the technical constraints on historical data availability. The selected period satisfies the minimum duration requirements of the VCS Methodology Requirements.

There have been no changes to national or sectoral policies affecting the baseline validity. Apart from the increase in deforestation agents and focus on cash crop cultivation, the baseline scenario is mostly unchanged, with conversion to smallholder crop cultivation remaining the most likely land-use change in the absence of the project in both the original and expanded reference region. With the addition of Project Instance 2, the project area is approximately 7.8 times larger than the original, and baseline emissions have increased accordingly. Average annual baseline emissions for the first baseline validity period (10 years) were 114,667 tCO_2e.

Average annual baseline emissions for the new baseline validity period (6 years) are 692,768 tCO_2e, representing a 504% increase, primarily attributable to the inclusion of Instance 2.

To prevent recrediting of 931 ha already credited to instance 1 during the previous baseline validity period (see Figure 24 in the methodological annex), the deforestation projected for these areas in the updated risk map was subtracted from the project baselines for the new baseline validity period.

2.2.3 Methodology Deviations (VCS, 3.20)

In section 6.3.2.1 of VM0015 v1.2, the methodology says the historical reference period should be extended to include the original reference period and all subsequent monitoring periods up to the beginning of the current monitoring period. As described in section 2.2.2, an examination of the historical reference period including both the original period and the 2012-2022 baseline validity period shows that for the original reference region, there was 41% more deforestation per year from 2010 to 2022 compared to from 2001-2010. The new baseline established as described in the methodological annex therefore uses the historical average annual deforestation from 2010-2022 because it is a more accurate representation of the current deforestation risk than the historical average annual deforestation from 2001-2022. Since this deviation only affects the measurement of deforestation risk and results in estimates that more accurately reflect the risk level during the next baseline validity period, this is an acceptable deviation.

VM0015 calls for future deforestation to be predicted in terms of specific pixels. The pixels are selected by working backwards from the highest risk pixels until the projected number of pixels to be deforested in year *t* in the reference region have been selected. The project deviated from this approach in favor of the approach from VT0007 where future deforestation location is predicted as a density map where each pixel in the map is assigned a density representing the proportion of pixels in the same risk class projected to be deforested in each year of the baseline validity period. The proportions are represented in terms of fractions of a hectare so they can be summed to calculate the predicted area of projected deforestation for any discrete area in the landscape. This approach was chosen to align the baseline with that which will be produced by Verra under VM0048, which the project will adopt in 2025 subject to data availability from Verra. The accuracy of both approaches was assessed using polygon level Figure of Merit (FOM) as recommended by VM0015 (see section 4.2.2 of the methodological annex). The FOM for the best model using the VT0007 approach was 0.658, whereas the FOM for the same model using the VM0015 approach was 0.507. Therefore, since this is only a deviation in deforestation risk measurement and the VT0007 approach is more accurate than the prescribed approach in VM0015, this is an acceptable deviation.

One consequence of adopting the more accurate VT0007 approach is that the project cannot produce a VM0015-style map of cumulatively credited pixels, since no specific pixels are identified as projected for deforestation within the baseline validity period. In lieu of this, the project applies the equivalent safeguard under VMD0055 section 5.3.2.6 — the methodology to which the project will transition during the current baseline validity period — ensuring that the

cumulative allocated baseline to each stratum does not exceed the total area of that stratum. As shown in the Table 3, both strata have exhaustion timelines (65 years and 52 years respectively) well in excess of the 42 years of crediting remaining after 2022, confirming no risk of overallocation.

Table 3 Forest Strata Areas as of 2022 and 2022-2028 Annual Allocations

Forest Strata	Area (ha) as of 2022 less 931 ha credited during first baseline validity period.	Annual allocation (ha) during 2022-2028 baseline validity period excluding previously credited areas	Years to stratum exhaustion at 2022–2028 allocation rate
1 – High Carbon	274,055	4222	64.91
2 – Low Carbon	52,444	1009	51.98

In section 8.3.1.2 of the methodology, it states that ex ante activity displacement leakage should be calculated, "multiplying the estimated baseline carbon stock changes for the project area by a Displacement Leakage Factor (DLF) representing the percentage of deforestation expected to be displaced outside the project boundary. Where deforestation agents do not participate in leakage prevention activities and project activities, the DLF is 100 percent. Where leakage prevention activities are implemented, the factor is equal to the proportion of baseline agents estimated to be given the opportunity to participate in leakage prevention activities and project activities". However, this ignores the fact that the project is not expecting 100% effectiveness and unavoided deforestation in the project area during the with-project scenario is deforestation which does not leak because it was not displaced. Thus, rather than multiplying the DLF by the baseline carbon stock changes, the DLF was multiplied by the difference between the baseline and the ex-ante estimates of project scenario carbon stock changes (which changes over time as anticipated effectiveness changes). Therefore, as the participating project villages become more effective at preventing deforestation, leakage would also rise since a greater number of deforestation agents will be displaced.

This is a much more realistic means of estimating leakage ex ante. However, as this has no effect on the calculation of emissions ex post, it does not negatively affect the conservativeness of ex-post estimates.

As a methodological deviation, the project adopted the land-cover change monitoring approach from VMD0055 Section 5.3.3.2 in place of wall-to-wall LULC change mapping for estimating deforestation in the project area and leakage belt during the monitoring period. This framing is conservative: Section 8.2.2.2 of VM0015 v1.2 specifies the required outputs of monitoring period land cover change estimation — ex-post activity data tables by stratum, forest class, and post-deforestation zone — but does not specify the detection method by which these outputs must be

produced. The sample-based approach adopted here satisfies these output requirements. Nonetheless, the deviation is declared in the interest of transparency, since the technique differs from that used for the historical reference period LULCC mapping.

The approach was adopted for two reasons. First, the 2024 PALSAR-2 mosaic was not available at the time this report was prepared, precluding production of a wall-to-wall LULC change map consistent with the techniques used for the 2010–2022 historical reference period. Second, and more fundamentally, the sample-based approach produces activity data, and uncertainty estimates that are more directly applicable to the project area and leakage belt than would be obtained by applying a bias correction to a wall-to-wall map of the broader reference region. Thus, the deviation can be justified as a more accurate means of estimating deforestation during the monitoring period. The approach uses visual inspection of high-resolution imagery covering a stratified sample of points within the project area and leakage belt, with stratification based on the deforestation risk map to ensure sampling effort is proportional to the relative likelihood of observing deforestation. Consistent with Verra and VM0015 uncertainty requirements, where uncertainty of the estimated deforestation exceeds 10% at the 90% CI, estimates are adjusted upwards and sufficient sampling is utilized to keep uncertainty below 20% at the 90% CI.

The 2024 PALSAR-2 mosaic has since become available. However, its median composite date does not align with the monitoring period end date and substituting it for the sample-based estimates would require a complete reinterpretation of the stratification and sample design — it cannot serve as a direct replacement for the monitoring period deforestation estimates already reported. The mosaic has nonetheless been used to confirm that deforestation in the reference region as a whole during the 2022–2024 period exceeded the historical average, indicating that the historical deforestation rate used to generate the risk density map was conservative.

There is a small discrepancy between the reference region boundary and the leakage belt near Malolo A village in Kilosa. The required leakage belt buffer would extend outside the reference region and cover 316 ha of forest outside the reference region falling in Mpwapwa district. This is equivalent to 0.09% of the forest in the leakage belt. This occurred because the project forgot that the leakage belt might extend more than 2km from the project area in some areas. Fixing the mistake would require redoing all the GIS work from the risk mapping step. However, the forest in that area was not included for the purpose of calculating the leakage belt buffer, so the leakage buffer for that section of the project was expanded to capture an equivalent amount of forest from the reference region. Then, one random land-cover monitoring point was added in missing portion of the leakage belt and considered to be part of the LB-A-4 strata. This is a conservative deviation since there were only 58 sample points in the LB-A-4 strata prior to adding the extra point and almost no deforestation projected for the strata since it is in the lowest risk strata.

When mapped deforestation for the reference region during a monitoring period falls below the projected baseline deforestation, the project will use a dynamic baseline instead. The procedure is described in section 3.1.3. This deviation only affects the method of calculating baseline deforestation and is conservative because it can only decrease baseline deforestation compared to the baseline from the applied methodologies.

2.2.4 Minor Changes to Project Description (CCB Program Rules, 3.5.6)

This monitoring report is based on the updated PD which is being revalidated for CCB concurrently with the verification of this monitoring report. There are no minor changes between the updated project description and what is presented in this monitoring report.

2.2.5 Project Description Deviations (VCS, 3.21; CCB Program Rules, 3.5.7 – 3.5.10)

This monitoring report is based on the updated PD which is being revalidated for CCB since the project's original CCB validation expired. In the CCB context, there are no deviations between the updated project description and what is presented in this monitoring report.

However, since there is no such thing as revalidation in the VCS context, the following deviations describe substantive changes to the project relative to the originally validated project description (MJUMITA Community Forest Project (Lindi), VCS Version 3.2, v01.2, February 2015).

PD Deviation 1 — Project name

The project name has been changed from MJUMITA Community Forest Project (Lindi) to Village Climate Solutions. This change is necessitated by the departure of MJUMITA from the project and the transfer of its functions to Village Climate Solutions Limited (VCSL). Retaining MJUMITA's name in the project title would misrepresent the current governance and operational structure of the project. This deviation does not affect the applicability of the methodology, project additionality, or the appropriateness of the baseline scenario. The outcome is a project title that accurately reflects the current proponent and governance structure.

PD Deviation 2 — Project proponent

In the originally validated PD, the ten participating village councils were listed individually as project proponents, with MJUMITA acting as their authorized representative under a series of MoUs. The project proponent has been changed to a single entity, Village Climate Solutions Limited (VCSL), a company registered in the United Kingdom. This restructuring was executed through two sets of legal instruments: VCSL signed a Deed of Accession in respect of the VCS Registration Deed of Representation with the original village proponents, and each original proponent village subsequently signed a Deed of Partial Release to remove itself as a named project proponent. Since VCSL is not the landowner of the project area, it additionally entered into 40-year carbon agreements with the participating managing authorities, establishing effective control over the project carbon assets. The change to a single corporate proponent is justified by the significant expansion of the project to approximately 60 participating communities across multiple districts, making individual village co-proponent status administratively impractical. This deviation does not affect the applicability of the methodology, project additionality, or the appropriateness of the baseline scenario. The outcome is a simplified and legally secure proponent structure that enables effective management of the expanded project.

PD Deviation 3 — Other entities involved in the project

Several changes have been made to the entities involved in the project relative to the originally validated PD. MJUMITA, which served as the authorized representative and primary implementing entity under the original structure, is no longer involved in the project and has been removed. Reterra Limited, which provides monitoring, remote sensing, and technical expertise, has been added. The University of Dar es Salaam, which is the managing authority for a 172-ha forest parcel within the former Nandambi village area, has been added. Mikumi Township Council, which is a managing authority for a portion of the second project instance, has been added. The original ten project proponent villages have been recharacterized as project stakeholders and are listed in Section 2.1.5 of this monitoring report along with all managing authorities for the second project instance. Village Climate Solutions Limited is now listed as project proponent as described in Deviation 2 above. This deviation does not affect the applicability of the methodology, project additionality, or the appropriateness of the baseline scenario. The outcome is an entity roster that accurately reflects the current organizational structure of the project.

PD Deviation 4 — Administrative authority

Lindi District Council, listed as a supporting authority in the originally validated PD, no longer exists as an administrative unit. The district was divided into Lindi Municipality and the newly created Mtama District. All original project villages fall within Lindi Municipality, which is retained in the updated project structure. The relevant district and municipal authorities for the current project area are listed in Section 2.1.5 of this monitoring report. This deviation does not affect the applicability of the methodology, project additionality, or the appropriateness of the baseline scenario. The outcome is an administrative authority listing that reflects the current administrative geography of Tanzania.

PD Deviation 5 — Project crediting period

The original validated PD established a 30-year crediting period from April 21, 2012 to April 20, 2042. The crediting period has been extended to 52 years, from April 21, 2012 to April 20, 2064, reflecting new 40-year carbon agreements signed in 2024 with all participating managing authorities. The extension satisfies the VCS Standard v4.7 requirements of a minimum 20-year crediting period renewable up to 100 years and a minimum 40-year project longevity for AFOLU projects. This deviation does not affect the applicability of the methodology, project additionality, or the appropriateness of the baseline scenario. The outcome is a crediting period that provides long-term tenure security for the project and meets VCS Standard longevity requirements.

PD Deviation 6 — Project start date

The original validated PD listed a single project start date of May 28, 2011 for the original ten village project instance, though April 21, 2012 as the start of the crediting period. The updated PD reflects the addition of a second project instance with a start date of February 9, 2023,

representing the date of the first on-the-ground forest patrols supported by the project in the new instance. This deviation does not affect the applicability of the methodology, project additionality, or the appropriateness of the baseline scenario for the original project instance. The outcome is a project start date record that accurately reflects both project instances.

PD Deviation 7 — Project scale and participating communities

The originally validated PD described a project comprising 10 villages covering approximately 41,924 ha in Lindi Rural District. A second project instance was added on February 9, 2023, comprising 50 additional participating communities (villages and mitaa) across Mtama, Nachingwea, Morogoro, Mvomero, and Kilosa Districts, bringing the total to 60 participating communities. The total project area as of the end of this monitoring period is 327,234 ha as documented in Section 1.1.2 of the Methodological Annex (Appendix 2). The participating communities, their roles and responsibilities, and the relevant managing authorities are documented in Section 2.1.5 of this monitoring report and further referenced in Sections 2.1.1, 2.5.7, and 4.3.1. The geographic extent of the current project area is shown in Figures 4, 5, and 6. This expansion was executed in accordance with the grouped project provisions of the VCS Standard and the eligibility criteria documented in Section 2.2.6.1 of this monitoring report. This deviation does not affect the applicability of the methodology or project additionality. The baseline scenario has been updated to reflect the expanded project area, as documented in the Methodological Annex (Appendix 2). The outcome is a substantially expanded project covering 327,234 ha with significantly greater potential for GHG emission reductions.

PD Deviation 8 — Governance of Nandambi and Mkanga 1

Two communities from the original project instance, Nandambi and Mkanga 1, were converted by Lindi Municipality to mitaa (urban ward) governance in 2018 under the Local Government (Urban Authorities) Act (Cap 288 RE 2002), transferring land management authority from the village councils to the municipality. The project area boundaries for these two communities have not changed; however, Lindi Municipality is now the landowner and has entered into a 2024 carbon agreement with VCSL to maintain these areas within the project. Community-based organizations have been established within the two mitaa to participate in forest management and benefit sharing in place of the former village councils. These changes are documented in Section 2.2.6.2 of this monitoring report. This deviation does not affect the applicability of the methodology, project additionality, or the appropriateness of the baseline scenario. The outcome is continued inclusion of the Nandambi and Mkanga 1 forest areas within the project under a revised governance structure that reflects their current administrative status.

PD Deviation 9 — Project boundary

The project boundary section of the updated PD has been restructured to align with VM0015 v1.2, which treats emissions as either stock changes in carbon pools or emissions from non-CO2 greenhouse gases. The carbon pool inclusion/exclusion table and GHG sources table have

been reformatted to match the VM0015 v1.2 template tables (VM0015 Tables 2 and 3). The substantive content — the pools included and excluded and the justifications — remains consistent with the originally validated PD. This deviation does not affect the applicability of the methodology, project additionality, or the appropriateness of the baseline scenario. The outcome is a project boundary description that is fully aligned with VM0015 v1.2 without any change to the carbon pools or GHG sources included in the project.

PD Deviation 10 — Template-driven structural updates

The updated PD has been prepared using the current combined VCS/CCB project description template (VCS v4.4, CCB v3.0), which differs structurally from the VCS Version 3.2 template used for the original validated PD. Sections addressing grouped project eligibility criteria, project ownership, transfer project eligibility, audit history, and the project risk table have been added or substantially restructured to comply with current template requirements. These structural additions reflect template evolution since the original validation and do not represent substantive changes to project design or implementation. This deviation does not affect the applicability of the methodology, project additionality, or the appropriateness of the baseline scenario. The outcome is a project description that complies with current VCS and CCB template requirements.

PD Deviation 11 — Updated methodology version

The originally validated PD was prepared under VM0015 v1.1. The updated baseline and monitoring calculations apply VM0015 v1.2. The specific deviations from standard methodology requirements arising from this update are documented in Section 2.2.3 of this monitoring report. The transition to VM0015 v1.2 does not affect project additionality or the appropriateness of the baseline scenario determination approach, but does affect the specific procedures used to calculate baseline emissions, project emissions, and leakage, as described in Section 2.2.3. The outcome is a methodology application that complies with the most current version of VM0015 and produces more accurate emission reduction estimates.

PD Deviation 12 — Updated baseline

The originally validated PD established a baseline for the 2012–2022 crediting period based on the 2001–2012 historical reference period. An updated baseline has been established for the 2022–2028 crediting period as documented in the Methodological Annex (Appendix 2). Specific methodology deviations applied in the updated baseline are documented in Section 2.2.3 of this monitoring report. The updated baseline does not affect project additionality, which has been reassessed and confirmed as documented in Section 3.1.5 of the updated PD. The outcome is a conservative and methodologically sound baseline for the 2022–2028 crediting period that accurately reflects current deforestation risk in the project area.

PD Deviation 13 — Updated monitoring procedures

The monitoring procedures applied during the 2022–2024 monitoring period differ from those specified in the originally validated PD, reflecting updates to the methodology and the adoption of sample-based monitoring approaches. The updated procedures are documented in Section 3.1 of the MR and revised PD with additional detail in the Methodological Annex (Appendix 2). Specific methodology deviations are documented in Section 2.2.3 of this monitoring report. The updated monitoring procedures do not affect project additionality or the appropriateness of the baseline scenario. The outcome is a monitoring system that satisfies the output requirements of VM0015 v1.2 and produces activity data and uncertainty estimates that are directly applicable to the project area and leakage belt.

PD Deviation 14 — Updated methodological annex

The methodological annex in the originally validated PD has been replaced in full. The updated Methodological Annex, included as Appendix 2 of this monitoring report, reflects the updated methodology version, the updated baseline, and the updated monitoring procedures described in Deviations 11–13 above. The impacts on methodology applicability, additionality, and the baseline scenario are as described under Deviations 11–13. The outcome is a comprehensive methodological annex that documents all baseline and monitoring calculations for the current baseline validity period in a single traceable document.

PD Deviation 15 — Project activities

The project activities described in the updated PD differ in framing and specification from those in the originally validated PD, reflecting changes in project scale, governance structure, and implementation experience over the intervening period. The originally validated PD described nine activities focused on governance, land use planning, community-based forest management, benefit sharing, agricultural improvement, microfinance, beekeeping, woodlot cultivation, and social services investment. The updated PD respecifies these under a revised activity framework centered on FPIC, forest reserve boundary management, forest management plan development, managing authority restructuring, patrol technology and forest protection, gazettement support, performance-based payments, flexible benefit sharing, and agricultural extension services. The core activities — community-based forest management, forest governance, benefit sharing, and agricultural support — are retained in substance though reframed to reflect the operational reality of managing a grouped project spanning approximately 60 communities across multiple districts. The shift from a startup readiness framing to an operational management framing is appropriate given that the project is now over a decade into implementation. Some activities from the original PD, including microfinance and village savings and loan associations, beekeeping, and woodlot cultivation, are not currently being actively implemented by the project but have not been formally discontinued and may be revived as the project evolves. The updated activity list does not preclude communities from continuing these activities independently. This deviation does not affect the applicability of the methodology, project additionality, or the appropriateness of the baseline scenario. The outcome is a project activity framework that accurately reflects current implementation priorities and the operational scale of the project.

2.2.6 Grouped Projects (VCS, 3.6; CCB, G1.13-G1.15, G4.1)

2.2.6.1 New Project Areas and Communities (VCS, 3.6; CCB, G1.13)

This monitoring report is based on the updated PD which is being revalidated for CCB and verified for VCS concurrently with the verification of this monitoring report. The updated PD documents the new project areas, stakeholders and the analyses used to identify the stakeholders which have been added since the original CCB/VCS project validation. There are no differences between the project areas and stakeholders presented in the updated PD and in this monitoring report.

2.2.6.2 Removed Project Areas and Communities (CCB, G1.13)

The first project instance included two villages, Nandambi and Mkanga 1, which are no longer part of the project because they no longer exist. In 2018, Lindi Municipality converted these two villages to mitaa governments as described in THE LOCAL GOVERNMENT (URBAN AUTHORITIES) ACT, CAP 288 RE 2002. Mitaa governments do not have the same power of land management as village councils, so this effectively transferred control of the project areas in these two villages to Lindi Municipality. The municipality sold off portions of the project area to agricultural investors resulting in the loss of 1860 ha of project area between 2018 and 2022 as documented in the last VCS monitoring report. Once VCSL started engaging with the project in 2022, it managed to convince the municipality to reverse course and agree to conserve the remaining forest in these two mitaa and to sign a contract in 2024 with VCSL to include these forests in the project for another 40 years. Additionally, VCSL secured an agreement with the University of Dar es Salaam, which had been given a 172 ha of forest from within Nandambi village by the Municipality, to put the forest in protection. Finally, VCSL worked with the municipality and mitaa governments to establish community-based organizations consisting of households living near the remaining forests to take over responsibility for managing these forests with support from VCSL. As such, apart from the 1860 ha sold to and cleared by investors, VCSL has engaged with the owners and appropriate stakeholders to return most of the municipalized land to the project.

These changes have been documented and justified in the updated PD which is being revalidated for CCB concurrently with the verification of this monitoring report. There are no differences between the project areas and communities presented in the updated PD and in this monitoring report.

2.2.6.3 Eligibility Criteria for Grouped Projects (VCS, 3.6.14; CCB, G1.14)

A new project instance was added during this monitoring period starting February 9th, 2023. A description of how it meets the eligibility criteria for grouped projects is documented in section 2.1.6.1 of the updated PD which is being revalidated for CCB and verified for VCS concurrently with the verification of this monitoring report.

2.2.6.4 Risk Mitigation for Grouped Projects (VCS, 3.6; CCB, G1.15)

There is no new project area covered in this monitoring report compared to the updated PD which is being revalidated for CCB and verified for VCS concurrently with the verification of this monitoring report. Risks associated with the current project areas are already described in the updated PD in section 2.1.20.

2.2.6.5 Project Zone Map (CCB, G1.13)

There are no changes to the project zone between what has been presented in the updated PD which is being revalidated for CCB and verified for VCS and this monitoring report.

Project zone maps for the current project instances are shown in Figure 4, Figure 5, and Figure 6. The project zones consist of the project area and leakage management

area depicted in the maps. These areas have been uploaded to the Verra registry as a kml. The main population centers for each project community are also shown. The project areas consist of the areas labeled as forest within the project area polygons. These forests are all at least 10 years old. The project leakage management areas are where farm extension services will be targeted when the area is part of an existing farm clearing and not part of a protected area. Forests with high conservation values for biodiversity noted in section 5.1.4 are labeled in red. There are no areas with offsite climate impacts, stakeholders, or biodiversity impacts.

Due to scale limitations, the maps do not show the full extent of potential new project instances. As described in section 2.1.6.1 of the PD, new project instances before transition to VM0048, must fall within the reference region described in section 1.1.1 of the methodological annex and depicted in Figure 1. After transitioning to VM0048, new instances can be anywhere in mainland Tanzania meeting the other eligibility requirements specified in section 2.1.6.1 of the PD.

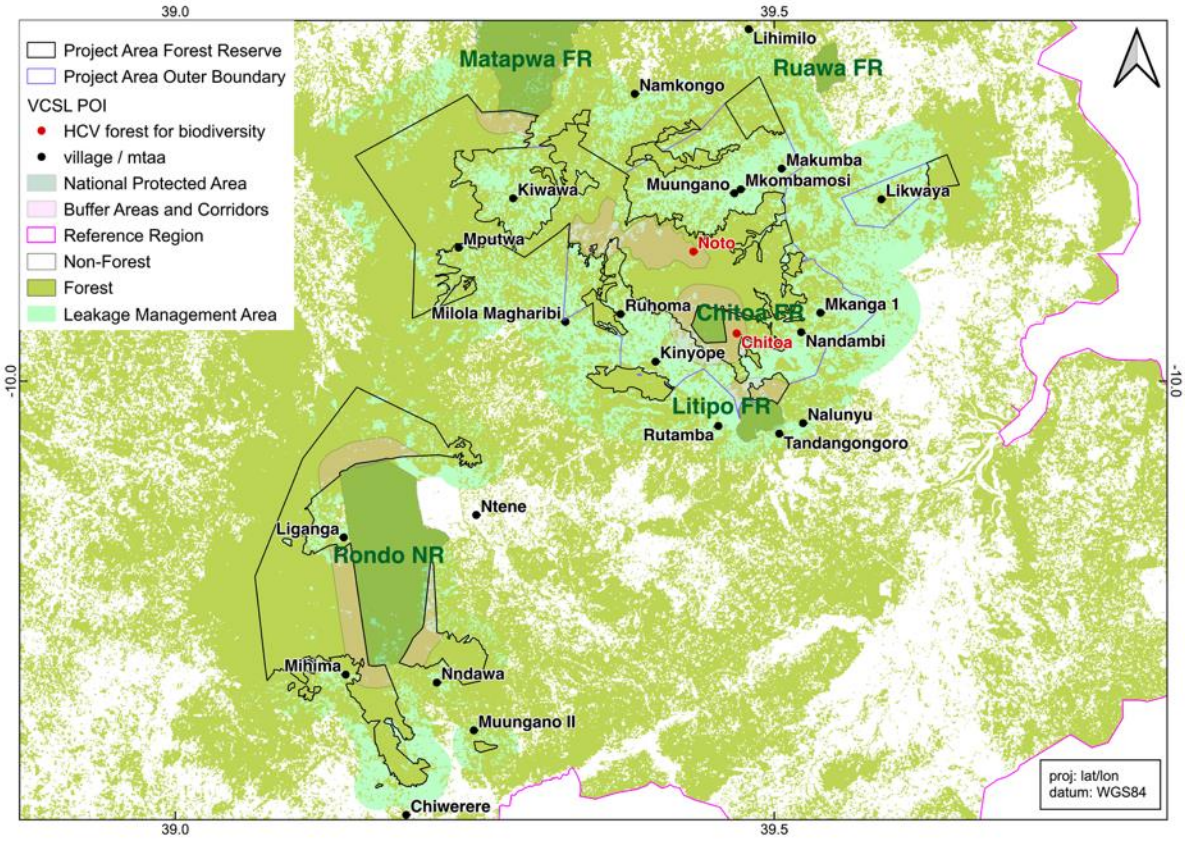


Figure 4 Project Zone in Lindi Municipality and Mtama District

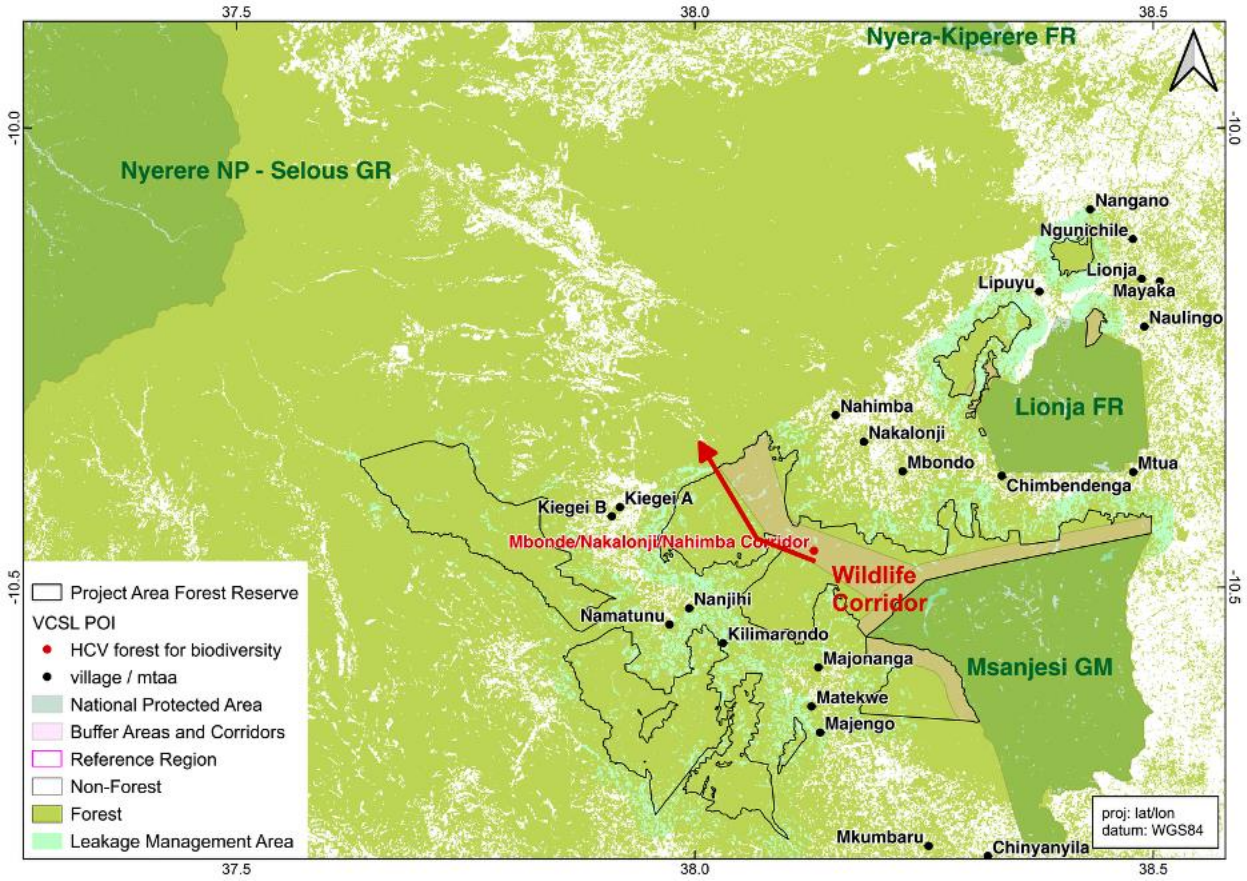


Figure 5 Project Zone in Nachingwea District

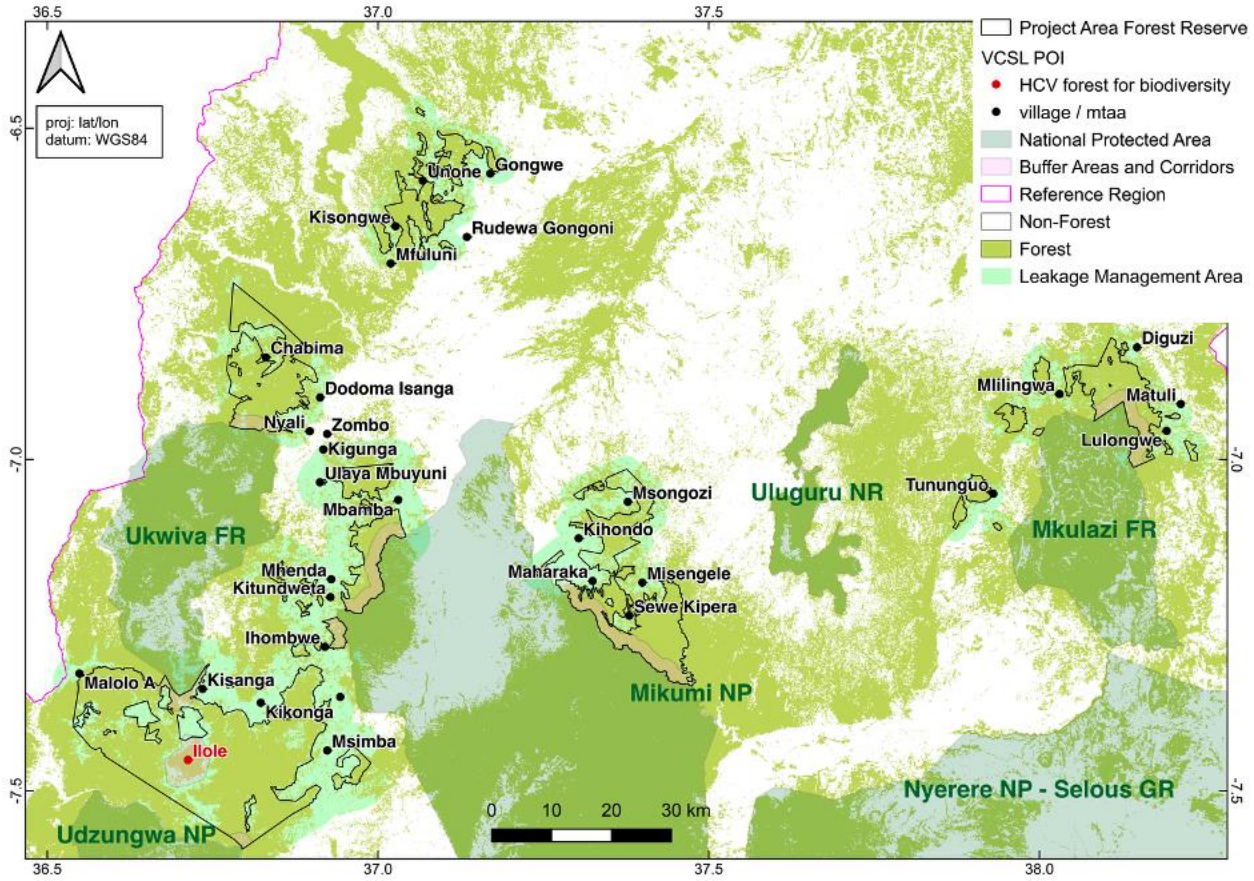


Figure 6 Project Zone in Morogoro, Mvomero, and Kilosa Districts

2.2.6.6 Changes to Management (CCB, G4.1)

The new project instance has 48 new managing authorities (owners). The changes in project management structure, roles, and responsibilities since the original validation are documented in the updated PD which is being revalidated for CCB and verified for VCS concurrently with verification of this monitoring report.

2.2.7 Risks to the Project (CCB, G1.10)

The table below outlines the likely natural and human-induced risks to the expected climate, community, and biodiversity benefits throughout the project's lifetime. It also describes the measures needed and implemented to mitigate these risks.

As described in the PD, the project did not use armed enforcement during the monitoring period; therefore, no risks related to armed enforcement were identified for stakeholders, local communities, or workers.

Identified Risk	Potential impact of risk on climate, community and/or biodiversity benefits	Actions needed and designed to mitigate the risk
Governance issues within the Managing Authorities	Weak governance Structures or poor community participation in decision-making processes may result in elite capture, where benefits from the REDD+ project primarily accrue to a small group of individuals. Limited transparency and accountability in project management can undermine trust and legitimacy within communities.	During this monitoring period, the project developed a grievance reporting guideline, summarized and displayed on notice boards at each village center. Grievance resolutions are documented and stored in dedicated files at village offices, with regular monitoring by the project's Extension Officers. Additionally, the project refined MJUMITA's benefit-sharing model, which will be submitted for approval by the village general assembly. Once approved, the model will guide the equitable distribution of carbon revenues, with dividends divided among households, promoting good governance and preventing elite capture or corruption.
Boundary conflicts.	Conflicts may arise between forest conservation efforts and farmers cultivating land inside or adjacent to the Village Land Forest Reserves (VLFRs), especially where boundary markers are unclear or not visible. These conflicts could escalate if managing authorities attempt to evict individuals from the reserves, potentially undermining efforts to prevent further forest clearing. Such actions could jeopardize both biodiversity and emission reduction goals, while also diminishing the potential for generating income through carbon trading for community development.	The project has collaborated with Managing Authorities to refine the boundaries of Village Land Forest Reserves, reducing 7811 hectares of land previously part of village forest reserves and 12,388 from new VLFRs established from the proposed Ndonda Wildlife Management Area in project villages. This adjustment has significantly minimized conflicts across much of the project area. Additionally, the project has supported 14 Managing Authorities to employ 566 community members (527 men and 39 women) to establish cutlines. This initiative, which will continue annually across the entire project area, enhances protection efforts and further reduces conflicts. Additionally, the project will promote the issuance of gazettement orders for the village land forest reserves, and title deeds to

		communities, ensuring more stable land ownership within the project area.
Continuing deforestation or above baseline in the leakage belt	This risk undermines the objectives of the project, aimed at reducing emissions from deforestation and forest degradation, as well as conserving and enhancing forest carbon stocks	The project has initiated outcome-based patrols, establishing a cloud-based system during this monitoring period and funding 745 patrols (including some patrols in VLFRs in the leakage belt) between February 2023 and June 2024 that covered 5,271 unique points of disturbance that occurred before June 2024. To mitigate potential leakage, in future, the project will facilitate farm extension services and promote climate-smart technologies to enhance productivity on existing arable land. Notably, 100% of farmers interviewed by patrol teams during this monitoring period expressed interest in participating in the program.
Forest degradation due to resource extraction	It compromises the carbon sequestration capacity, biodiversity value, and ecosystem services provided by forests, undermining the objectives of REDD+ initiatives aimed at conserving and enhancing forest carbon stocks for generating carbon credits.	During the monitoring period, the project made it a contractual obligation that Managing Authorities will limit wood harvesting within the project area to no more than 1% of the standing tree biomass annually[12]. Timber and Charcoal harvesting data from participating villages from July 2023 – June 2024 indicates that only 0.03% of project area above ground tree biomass was harvested in that period.
Excessive late dry season fire or fire in areas that are not fire adapted	Uncontrolled fire in non-fire adopted areas threatens ecosystem integrity and carbon sequestration capacity.	The created cutline in 14 villages around areas adjacent to agricultural and residential areas serves as Fireline as well. In future the project will continue to create fire lines, controlled burning practices and education and awareness campaigns

[12] Clause 6.2 (d) of the carbon trade contract

Municipalization of the project area Expropriation of project land by government or urban elites	The expansion of existing townships or municipalities, or the creation of new ones, may encompass the Project Area, leading to the dissolution of the respective Village Councils. Consequently, management of the village land forest reserve becomes ineffective.	During this monitoring period, the project established five community-based organizations to manage gazetted community forests within Mikumi Township, forest on municipal land in Lindi Municipality, and 172 ha forest block owned by the University of Dar es Salaam. Owners will work with the CBOs through Joint Management Agreements, as mandated by Clause 6.2 (k) of the Carbon Trade Contract. Additionally, the project will promote the gazettement of all Village Land Forest Reserves to strengthen the permanence of their legal tenure security.
Expropriation of project land by government or urban elites	This action disrupts project activities, undermine community ownership and trust, and compromise conservation efforts, potentially	The project area comprises mostly, land formally designated as Village Land Forest Reserves under the Forest Act (CAP 323) of the Laws of Tanzania, as detailed in Section 2.5.5 of the Project Document, which is being revalidated for CCB and verified for VCS alongside verification of this monitoring report. During this monitoring period, the project facilitated the formalization of three new Village Land Forest Reserves in accordance with Sections 32(1)(a) and 33 of the Forest Act, ensuring these areas are transformed from open access to communal tenure, hence legally protected from expropriation. Moving forward, the project will promote the gazettement of all Village Land Forest Reserves. Furthermore, the project will encourage communities to prioritize the issuance of Certificates of Customary Rights of Occupancy, particularly within the leakage belt, as part of their plans for utilizing carbon trade revenues. This strategy aims to strengthen land tenure security for local communities involved in the project.

Changes in policy	This risk entails shifts in government regulations, and laws, that could affect the project's ability to generate and sell carbon credits. For example, alterations in carbon pricing mechanisms or national forest conservation policies may impact the project's revenue streams and its capacity to meet emission reduction targets. Additionally, uncertainties in policy can undermine investor confidence, hinder project scalability, and ultimately jeopardize the project's efforts to reduce deforestation and generate revenues for communities.	There has been exemplary cooperation between carbon trade developers and the Permanent Secretary (PS) of the Vice President's Office (VPO), who oversees the Designated National Authority for carbon trading in Tanzania. VCSL participated in two meetings convened by the PS to discuss the prospects and challenges of carbon trade. VCSL also officially raised several issues with the PS through an official letter, Ref. No. VCSL/VPO/PS/L.2024/09/12. These issues included delays in issuing the Letter of No Objection (LONO), the imposition of Value Added Tax (VAT) on registration fees (which contradicts the provisions of the Value Added Tax Act, Chapter 148), the requirement to pay heavy registration fees before approval (at the concept note stage), a non-business-friendly registration fee calculation (based on projected average annual income over the project's lifetime and projected VERs, with a fixed price of $10 per VER), and revenue sharing based on gross revenue instead of profit. In response, the PS resolved the issue of the delayed LONO immediately and established a task force to address the remaining issues and provide further advice.
Market changes	Market changes can affect the project's revenue streams, making it difficult to secure buyers for carbon credits or achieve favorable prices.	The project will thrive to secure a long-term buyer as a crucial mechanism for managing market dynamics. This approach will involve establishing stable, enduring relationships with buyers committed to offsetting their carbon emissions sustainably
Injury Risks to Patrol Teams During Forest Patrols:	Patrols are conducted in forested areas that are home to snakes, felids, and elephants. In addition to potential encounters with these dangerous animals, patrol teams are exposed to	During the monitoring period, the project introduced mobile technology (Mergin Maps) across all participating villages and Mitaa. Each village and Mtaa was provided with smartphones preloaded with Mergin Maps, along with a specific village land forest reserve map and a questionnaire for recording patrol

	environmental hazards such as thorny vegetation and sharp, dry wood. Heavy rainfall can also create challenging weather conditions, further complicating their work.	data. This technology enabled the patrol teams to identify deforested areas and plan their routes in advance, contrasting to the previous approach where teams would aimlessly patrol the reserve, increasing the likelihood of missing illegal activities or encountering unforeseen risks, such as dangerous animals. By leveraging GPS and Mergin Maps, patrol teams can accurately navigate to identified deforested polygons, reducing the time spent searching for illegal activity and improving overall efficiency. Furthermore, the technology allows teams to proactively assess and manage potential risks, such as dangerous wildlife or challenging terrain, along their patrol routes, enhancing both safety and operational effectiveness. In addition, the project recommended that each patrol team consist of at least four members to ensure a robust response to any risks or threats encountered during patrols.

2.2.8 Benefit Permanence (CCB, G1.11)

To ensure the long-term sustainability of climate, community, and biodiversity benefits beyond the project lifetime, the project has refined the boundaries of the Village Land Forest Reserves (VLFRs) by removing heavily encroached areas, aligning the boundaries with more visible natural features, and expanding them to include additional unreserved forests older than 10 years. These adjustments enhance the clarity and defensibility of the boundaries, making them easier for stakeholders to recognize and respect, thus deterring illegal activities such as deforestation. Additionally, the creation of cutlines along the refined boundaries has been initiated, and these markers will continue to be stabilized over time. These visible markers aim to improve identification and understanding of the boundaries among local communities and stakeholders, further strengthening the protection of these areas. It is anticipated that, over time, stakeholders will become accustomed to these markers and habituated to respecting them as designated reserved areas.

In accordance with the Forest Act (CAP 323) of the Laws of Tanzania, the project has initiated the formal gazettement of the VLFRs. This legal recognition reinforces the protection of these areas and ensures their management in line with national regulations, promoting long-term conservation and active community engagement.

The project has also introduced new patrol technology to enhance the Village Patrol Teams' ability to detect and monitor deforested areas. This proactive approach enables early detection and intervention, helping to prevent further deforestation and forest degradation. Over time, it is expected that communities will become increasingly aware that the forests are remotely monitored, making any illegal activities easily detectable and transparent. This increased awareness will discourage unlawful actions, as it will be clear that avoiding such activities is the safest course of action.

To further ensure the sustainability of the reserves, five Community-Based Organizations (CBOs) have been established to manage the municipalized VLFRs in Lindi and Kilosa. These CBOs will enter into Joint Management Agreements with local authorities to ensure the collaborative, sustainable management of the forest reserves. This initiative is designed to foster community ownership and stewardship, ensuring that local communities remain motivated to protect the reserves, even with the shift in land ownership.

In addition, the project's benefit-sharing strategy will prioritize promoting secondary education for both boys and girls. As outlined in the project document, this initiative aims to transform the younger generation from relying on slash-and-burn farming to pursuing more stable, sustainable livelihoods as they grow into adulthood.

These measures are designed to ensure that the climate, community, and biodiversity benefits generated by the project are not only sustained but also enhanced beyond its lifetime. By strengthening legal frameworks, improving management capacity, and fostering local community involvement, the project seeks to create lasting positive impacts.

2.3 Stakeholder Engagement & Safeguards

2.3.1 Stakeholder Identification (VCS, 3.18, 3.19; CCB, G1.5)

There are no changes to the Stakeholders description table provided in Appendix 1 and Section 2.3.2 of the updated Project Description, which is being revalidated for CCB concurrently with this monitoring report.

2.3.2 Stakeholder Access to Project Documents (VCS, 3.18, 3.19; CCB, G3.1)

The project provided smartphones to each participating village, along with a monthly data bundle to enable access essential online information related to the project. Dedicated WhatsApp groups have been formed in each district where members can access link to the project’s Verra registry page and view the full project documentation as they wish. Village Council, Natural Resources Committee members and community members who have smartphones are also linked to these groups.
The project document has been submitted to the Designated National Authority for review and endorsement, as required by Regulation 28 of the national Carbon Trading Regulations (2022)

and amendments of 2023. The proponent will also provide annual reports to the Designated National Authority throughout the project's lifetime, as stipulated in Regulation 41.

The Project Document has been uploaded to the Verra account for public comment. It has also been emailed to legal and forest officers, as well as the Executive Directors of all participating Local Authorities for review, comments, and feedback. The document was also emailed to the Focal Persons from the University of Dar es Salaam for their review and feedback. This Monitoring report has been shared with the same stakeholders along the same channels.

Links to the project VCS registry page will be made available on the Village Climate Solutions Limited website, which is currently under development.

2.3.3 Dissemination of Summary Project Documents (VCS, 3.18, 3.19; CCB, G3.1)

A detailed summary of the project document, translated into Swahili, has been shared with all participating villages and mitaa[13] and will be kept in their offices throughout the project's lifetime. Additionally, a one-page summary has been posted in all public places within the participating village and sub-village centers. Each village office maintains a specific file containing summaries of project reports and related guidelines. Similarly, summaries of this monitoring report, translated into Swahili, have been distributed through the same channels.

Summaries are also presented at Village Council Meetings, CBO/mtaa Meetings, and general assemblies, where the proponent participates, as required by Clause 14.3 of the Carbon Trading Contract. A Swahili summary of this Monitoring report has been shared to the communities along the same channels.

2.3.4 Informational Meetings with Stakeholders (VCS, 3.18, 3.19; CCB, G3.1)

Informational meetings with local communities were conducted to establish and register project activities and gather baseline information essential for developing the project document. The introductory meetings for the Village Climate Solutions Limited (VCSL) project began in September 2022, targeting the President's Office, Regional Secretariat, and Local Government Authorities (LGAs) in the Lindi and Morogoro regions. These sessions provided foundational training on the REDD project and included key local stakeholders, such as Council Management Teams (CMT), District Commissioners, and Executive Directors. The project team held a series of meetings to secure consent from village councils for REDD+ project registration. They also trained patrol teams to combat deforestation and supported the establishment of Community-Based Organizations (CBOs) for forest management. Furthermore, the team facilitated the drafting and approval of carbon trade contracts with LGAs and village authorities, culminating in the endorsement of the project's carbon trading framework at both village and LGA levels. The details of the informational meeting are as follows.

[13] Mitaa are subdivisions of a municipal government in Tanzania. In this case, the mitaa were formerly villages that were part of the project.

Introductory Trainings at President's Office, Regional Secretariat and Local Government Authorities level.

The project began with an introductory meeting with the Lindi Regional Administrative Secretary (RAS) on September 5, 2022. This was followed by a series of Council Management Team (CMT) meetings, accompanied by the Regional Natural Resource Officer. These meetings were held in Lindi Municipality, Mtama, Ruangwa, Nachingwea, Liwale, and Kilwa District Councils between September 5 and 9, 2022. A total of 195 members attended, comprising 36 females and 159 males. The CMT meetings highlighted the need for more capacity building for CMT members and requested introductory meetings with councilors before VCSL began engaging with the villages.

Following the CMT meetings in Lindi, the project team conducted training sessions on the basics of the REDD project for CMT members in Kilwa, Lindi Municipality, and Nachingwea in October 2022. These sessions were attended by 80 members, including 15 females and 65 males. Additionally, meetings with councilors were held in Liwale, Ruangwa, Nachingwea, and Lindi Municipality, attended by 134 members, comprising 35 females and 99 males.

On October 3, 2022, the project team had an intensive discussion with the Lindi District Commissioner to secure his consent to start engagement with 10 villages in the municipality. Subsequently, October 31, 2022, the project team met with the District Executive Director, Village Executive Officers, and Ward Executive Officers from the potential project areas to obtain consent to begin engaging with the 6 villages in Mtama District Council.

On January 31, 2023, VCSL conducted an introductory meeting at the President's Office, Regional Administration, and Local Government, attended by five officers. In the Morogoro region, the project was introduced in a technical meeting organized by the Regional Administrative Secretary on February 23, 2023. This meeting was attended by 26 participants, including 9 females and 17 males, comprising the Council Chairperson, District Executive Directors, District Commissioners, and District Forest Officers from Malinyi, Ulanga, Morogoro Rural, Mvomero, and Kilosa. Furthermore, the project conducted introductory meetings with the district natural resource departments and executive Directors in Kilosa, Mvomero and Morogoro District Councils before starting engagement with the villages.

In general, the introductory meetings covered introduction to Village Climate Solutions Limited (VCSL), highlighting its background, experience, and capacity to design and implement REDD projects in Tanzania, as well as its specific model for such projects. The meetings also addressed the impacts of climate change, its linkage with CO2, trees, and emission reductions through reducing deforestation and forest degradation. Basic mathematics around the calculations of carbon credits under the REDD framework were explained, along with the basic requirements for implementing REDD projects and the opportunities available in Lindi and Morogoro. Additionally, national regulations for carbon trading and the procedures for project registration were discussed. After these series of meetings at Local Government Authority, Regional and national Level, the project started to engage with the villages.

Obtaining Consent Letters from the Participating Villages

After introductory meetings and training at the Local Government Authority levels, the proponent began engaging with the villages. A total of 60 community meetings were conducted, attended by 1,610 members, including 507 women, 1,103 men, and 259 youth. Through these meetings, the proponent introduced the company, its work model and experience, its commitment to collaborating with the respective Managing Authorities to design and implement a carbon trade project through the REDD+ mechanism, and the envisaged benefits for the village.

Additionally, participants had the opportunity to discuss the maps of the existing village land forest reserve (VLFR) or wildlife management area, the existing threats, and potential expansion or reduction areas. Following these discussions, the Village Councils and the Ndonda AA meeting authorized the Executive Officer to draft a consent letter to allow the registration of the project idea note. This consent was subsequently approved by the respective village general assemblies, which were attended by 5,456 people, comprising 2,270 women, 3,186 men, and 886 youth.

Meeting for introducing Patrol technology and data collection

The patrol technology was introduced to the village councils and general assembly during the introductory meetings as part of the proponent's proposal to the Managing Authorities to collaborate on reducing deforestation and forest degradation. Subsequently, a total of 454 patrol team members, including 136 females, 318 males, and 126 youth, received practical training sessions on using this technology. Smartphones equipped with closed-based technology for implementation were provided to the teams.

The patrol teams were tasked with conducting thorough surveys of proposed expansion and reduction areas, documenting potential changes and details using Point of Interest (POI) and Tract of Interest (TOI) tools in the mapping software. Additionally, between February 2023 and June 2024, the teams were facilitated to conduct patrols in 4,853 patches deforested between February 2022 and Dec. 2023. Among these, individuals accused of recent deforestation within the reserves were found in 4,276 patches. They were informed about the new REDD initiative and warned against further deforestation. It was emphasized that the intention was not to evict them but to encourage compliance with conservation efforts.

Meetings for Establishment of CBOs

Between September and December 2023, the proponent conducted a series of meetings with Local Authorities and communities in Nandambi and Narunyu (streets) and Rutamba (village) based in Lindi Municipality, and Msimba and Ihombwe (vitongoji) based in Mikumi Township, Kilosa District. The main agenda of these meetings was the legality of managing authorities for the existing Village Land Forest Reserves (VLFRs), in the municipality and townships where there is no village council as a managing authority, but the Municipal/Township Council acts as a corporate body instead.

It was resolved that the existing VLFRs would be transformed into Local Authority Forest Reserves (LAFRs) as provided by Section 4(b) of the Forest Act (CAP 323 of the laws of Tanzania). Community-Based Organizations (CBOs) would be formed and would sign Joint Management Agreements (JMAs) with the respective Local Authorities, as provided in Section 16 of the Forest Act (CAP 323 of the laws of Tanzania). These JMAs would entitle the CBOs to manage the forests and retain benefits equivalent to those which would have been obtained by village councils.

Five CBOs have been established and registered, and a JMA has been drafted. A sum of 27 meetings attended by 1,054 people, comprising 327 women, 727 men, and 180 youth were conducted in the process of establishing these CBOs. A total of 545 members, consisting of 196 females and 349 males, reside in 385 households, with 54 headed by females and 331 by males have been registered as members of the Community-Based Organization (CBO). They live within the forest or at least 300 meters from the forest edge. The mean and median age of these members is 47 years. Their education levels comprise 41% with no formal education, 53% with primary education, 3% with secondary education, and 1% with tertiary education

Meetings to Obtain Approval of the Revision Maps and boundary clearing

Between the 8th and 19th of September 2023, 14 village general assemblies were conducted to obtain approval for the VLFR boundary revisions and boundary clearing work plan. The meetings were attended by a total of 1,159 people, comprising 377 females, 782 males, and 196 youth under 25 years. Between the 8th of August and December 2023, a total of 536 community members (39 women and 499 men) were engaged in creating cutlines, covering 323.39 acres in 14 villages.

Meetings to Obtain Resolutions for Ndonda Wildlife Management Area.

The project conducted a GIS analysis of forest cover status in the Ndonda Wildlife Management Area (WMA). Over the past 15 years, the original WMA area declined by 51%, from 73,554 hectares stated in the WMA's constitution to 36,156.76 hectares currently available for potential REDD+ projects. A total of 29,993.96 hectares are potential Village Land Forest Reserves (VLFRs) for seven villages in Nachingwea, while 6,162.8 hectares are potential VLFRs for one village in Nanyumbu district.

The WMA area was significantly reduced due to agricultural encroachment and overlaps with Msanjesi Game Reserve and two VLFRs in Nahimba and Majonanga villages. Since the WMA was proposed 15 years ago, it has not been formalized, and follow-up with the Ministry between May and August 2023 did not result in substantial progress towards granting statutory wildlife user rights to communities as required by Section 32 of the Wildlife Conservation Act No. 5 of 2009. Discussions with Nachingwea Local Authority and WMA leaders during this period led to a consensus to protect the remaining woodlands within Ndonda WMA by adopting a community-based forestry approach and registering it in carbon trading.

On September 9, 2023, the proponent introduced this alternative pathway and REDD+ initiatives to the WMA secretariat and chairpersons of the nine member villages in a meeting attended by

21 stakeholders (3 women, 19 men, and 3 youth). The meeting resolved to allow individual member villages to issue consent letters for including WMA areas in the REDD+ project registration. Between September 10 and 14, 2023, the project obtained four consent letters from Matekwe, Nahimba, Mtua, and Chimbendenga, villages. The consents were issued by village council and Village Natural Resources Committee (VNRC) meetings attended by 175 members (46 female, 129 males, and 39 youth) and endorsed by village general assembly meetings attended by 502 adult villagers (132 female, 371 males, and 86 youth).

Additionally, the project obtained consent letters from three other WMA member villages, namely Kilimarondo, Majonanga, and Mbondo. These villages have been declared VLFRs apart from the WMA area. The project supported the villages in implementing community-based forestry, including boundary marking, participatory forest resource assessment, preparing sustainable harvesting plans, developing forest management bylaws, and Forest Management Plans (FMPs), which were approved along with the carbon trade contract.

Informational Meetings on Carbon trade contract drafting.

On February 6th and 7th, 2024, the project held a meeting with 12 Forest and Legal Officers (2 female and 10 male) from Lindi Municipality and the Nachingwea, Mtama, Mvomero, Morogoro Rural, and Kilosa District Councils to draft a carbon trade contract between the proponent and the Managing Authorities. This was followed by another review meeting from May 22nd to 24th, 2024, attended by 5 female and 10 male participants, including the Carbon Trade Coordinator and legal officers from the President's Office – Regional Administration and Local Government (PO-RALG), Vice President's Office – Division of Environment (VPO-DoE), Lindi and Morogoro Regional Secretariats (RS), as well as Nachingwea, Mtama, Lindi, Mvomero, Morogoro, and Kilosa Local Authorities. The purpose of this meeting was to align the contract with government guidelines.

Meetings to Obtain Endorsement of contracts at village level

Between February 21st and May 10th, 2024, the proponent, alongside Local Authority Lawyers and Forest officers, conducted meetings with 57 Managing Authorities to obtain approval for the Carbon Trade Contract and revised Forest Management Plans (FMPs). The approval process began with 57 community Meetings attended by 1,815 members, comprising 549 female, 1,266 male, and 183 youth. This was followed by general assembly meetings attended by 4,939 community members, comprising 1,744 female, 3,195 male, and 891 youth. The main agenda of these meetings was to discuss the carbon trade contract, including the final project area, which was subsequently incorporated into the revised FMPs.

Meetings to Obtain Endorsement of contracts at Local Government Authority (LGA) level

Between April 22nd and June 26th, 2024, the proponent participated in Local Authority meetings attended by 589 people (164 female and 425 male). Attendees included a representative from the Regional Secretariat, Council Management Team (CMT) members, ward councilors, and other local authority officers from the offices of the district commissioner and division officers in

Nachingwea, Lindi, Mvomero, Morogoro Rural, and Kilosa. Discussions regarding the carbon trade contract in Mtama Local Authorities took place independent of the proponent's participation. During these meetings, the carbon trade contract with Managing Authorities under the jurisdiction of these Local Authorities was approved for signing.

2.3.5 Risks from the Project and No Net Harm (VCS, 3.18, 3.19)

List of natural and human-induced risks resulting from project activities and their mitigation or preventative measure(s) taken during the monitoring period are described in the Project Risks Table (see Appendix 2).

Natural and human-induced risks have been identified in relation to the project activities, each presenting significant challenges to its success. A key risk is the mismanagement of funds, particularly those generated from carbon trading and forest reserve management. Such mismanagement could lead to ineffective community development projects, eroding trust and diminishing local participation in forest conservation efforts. Additionally, low attendance at decision-making meetings undermines the legitimacy of forest management policies, weakening their effectiveness in addressing deforestation. The failure to ensure effective participation of women, youth, and the elderly from key decision-making processes and forest management activities further exacerbates this issue, undermining community cohesion and reducing the impact of conservation efforts. Gender-based discrimination, especially in patrol activities, can demotivate women and girls, eroding their trust in the project and diminishing their participation. The unequal distribution of benefits also risks deepening divisions within the community, further hindering engagement in conservation initiatives. Similarly, legislative changes that restrict local communities' access to REDD revenues could further discourage participation, weakening the project's overall impact. Unmet expectations regarding the distribution of REDD revenues could also decrease motivation for conservation, potentially leading to increased deforestation and degradation.

Human-wildlife conflict presents another potential risks, with farmers voicing concerns about crop damage caused by wildlife. Although this issue has not been prominent during the monitoring period, there remains a potential risk from predators, snakes, and elephants, which can also pose direct harm to patrol teams.

Disputes over land boundaries may emerge, further complicating forest management activities, creating tensions within communities and hindering effective conservation efforts. The municipalization of Village Land Forest Reserves introduces a risk of demoralizing local communities. When control over forest reserves shifts from village-level management to municipal and township authorities, it can reduce local ownership and motivation to protect forest resources. Internal conflicts over forest access rights could also arise, especially if project activities are seen as undermining customary land rights. These disputes may lead to illegal and unsustainable resource use, escalating tensions between the project and residents. Furthermore, boundary disputes can impede forest patrols, allowing illegal land clearing to continue unchecked, exacerbating deforestation and forest degradation.

The clearing of boundaries, while necessary for effective forest management, poses additional environmental risks. It can lead to habitat fragmentation, disrupting wildlife movement and impairing critical ecological processes. This fragmentation isolates species populations, weakening the resilience and functionality of the ecosystem. Moreover, boundary clearing may exacerbate soil erosion and degradation, particularly around the project area, further affecting soil quality and agricultural productivity in the leakage belt.

The turnover of Village Natural Resource Committee (VNRC) members also presents a threat to the project's sustainability, as the loss of institutional knowledge undermines the consistency of forest patrols, jeopardizing efforts to protect the forest from degradation.

During the monitoring period, the project team revised and improved the benefit-sharing guidelines, maintaining a dividend model designed to ensure transparency and accountability. This model emphasizes active community participation, empowering all community groups, including women and youth, to directly control income and reduce the risk of corruption. Between January and June 2025, the guidelines will be further customized for each village, with incentives for attending decision-making meetings and encouraging sub-village gatherings to ensure broader community involvement in decisions related to Verified Emission Reductions and related revenues. The guideline will empower Women to collect dividends for themselves and their dependents.

As described in the PD, during the monitoring period; the project did not use armed patrols therefore, no risks related to armed enforcement were identified for stakeholders, local communities, or workers.

To enhance the effectiveness of forest patrols, the project introduced mobile technology (Mergin Maps) for all participating villages and Mitaa. This tool helps patrol teams plan patrol routes and identify potential risks, such as dangerous wildlife, in advance. The project also encouraged patrol teams to consist of at least four members, ensuring safety and effective response to threats. Patrol technology is transferable, enabling consistent operations even as committee membership changes. Additionally, the project promotes youth participation in the Village Natural Resource Committees (VNRC), with a focus on gender balance during elections.

The project took significant steps to address gender inclusivity, ensuring that at least 30% of patrol team members are women. A sum of 136 women and 126 youth were trained on the patrol technology. It also introduced grievance reporting systems to address issues such as discrimination and sexual harassment.

Financial equity is a cornerstone of the project, with workers at the same rank such as Extension Officers, Patrol Teams and Boundary Clearers, receiving equal pay. Funding allocation for patrol teams are based on deforestation baselines and forest area. Extension Officers were recruited from former TFCG staff, with male to female ratio of 50:50. The project also focused on reducing 7,810 hectares of heavily encroached land from the instance 2 village forest reserves,

establishing clearer, more defensible boundaries for patrol teams and avoiding potential conflicts with local communities.

The project adheres to national regulations in its establishment and registration. It provided communities with copies of the regulations to ensure they understand their rights and obligations. It has also established community-based organizations (CBOs) to manage forests in areas where land has been transferred from village to municipal ownership, ensuring these communities continue to benefit from the forests under the same terms as before the transfer.

A key achievement was the conversion of 97,919 hectares of open access state-owned land into community-managed forest reserves. Working with village councils, the project revised forest boundaries, removed encroached areas, and strengthened this land ownership for local communities. Through the work of patrol teams, the project also raised awareness among farmers about the forest reserve boundaries and encouraged them to participate in agricultural extension services in future, with all farmers expressing willingness to engage.

The project promoted no-burning approach during boundary clearing, repurposing cleared grasses as mulch to prevent soil erosion. It ensured that no trees larger than 15 cm in diameter were cut and encouraged farmers to avoid clearing trees older than 10 years. The project supported the establishment of three new Village Land Forest Reserves, improving connectivity between Mikumi and Nyerere National Parks, as well as the Selous Game Reserve. Finally, the project conducted an opportunity cost survey, prior to its commencement, setting a minimum payment rate of $4.10 per Verified Emission Reduction, starting from this monitoring period.

2.3.6 Community Costs, Risks, and Benefits (CCB, G3.2)

The project effectively provided communities with relevant and adequate information regarding the potential costs, risks, and benefits associated with the REDD+ initiative through a participatory and transparent process. This information was gathered via an opportunity cost survey and discussed during consent and contract negotiation meetings. Findings were visually documented on flip charts, and participants received printed copies of the carbon trade contract for review. Key points emphasized included a commitment to protect forests for a minimum of 40 years and the identification of potential risks, such as governance challenges and market fluctuations. National carbon trade regulations were also printed and disseminated to the villages. The project ensured communities understood that at least 51% of gross revenue from carbon trading would be allocated to them, in line with national regulations. Visual aids, including discussion maps, and patrol maps, facilitated comprehension, ensuring timely and clear communication before communities made decisions regarding project participation.

The following are details of the methods and tools used to ensure that communities received relevant and adequate information about potential costs, risks, and benefits, identified through a participatory and transparent process. This information was provided to the communities in a clear and timely manner before they were asked to make, or consider making, any decisions regarding their participation in the project:

i) Discussion Maps

Discussion maps outlined the boundaries of the Village Land Forest Reserves (VLFRs) and identified potential expansion areas which are compatible with conservation and carbon trade, such as grazing, investments, and water resources. The key message conveyed was that suitable areas for REDD+ included natural forests older than 10 years that are under threat. Besides, the discussion maps highlighted heavily encroached areas that have been consistently farmed, recommending their reduction due to their unviability for carbon trading and susceptibility to conflicts. Additionally, these maps proposed boundary revisions aligned with natural features such as roads, rivers, and mountains, aiding in forest protection. They were printed and shared with village council members or presented via PowerPoint during baseline surveys, patrol technology training, boundary revisions meetings, and the approval of revised Forest Management Plans (FMPs) and carbon trade contracts.

ii) Patrol Maps

Patrol maps, derived from the discussion maps, were uploaded onto smartphones provided to each village. These maps indicated areas of past deforestation (prior to 2022) and new deforestation occurring after the project's initiation. Patrol teams were trained to identify these features and utilize GPS within the Mergin maps to navigate to newly deforested areas. The patrol maps also enabled teams to locate proposed boundary revision areas and report findings to village councils and the general assembly during the approval of revised FMPs and carbon trade contracts.

iii) Patrol Education Forms

The project team developed patrol education forms containing a brief message about the REDD+ project, which patrol teams used to inform individuals responsible for recent deforestation. The message conveyed that the deforested area was part of the reserved land approved by the village for conservation and potential carbon trading. The aim was not to evict individuals but to restrict further clearing of trees older than 10 years within the reserve. Those responsible for clearing were encouraged to contact the village office to obtain farming land in designated areas. Additionally, the project promised future agricultural extension services to help increase productivity without the need for further forest clearing.

iv) Boundary Clearing Maps

Boundary clearing maps enhanced the discussion and patrol maps by indicating areas for creating cutlines, particularly adjacent to farms and settlements. These maps were divided into blocks with calculated lengths and areas, simplifying the tasks of village natural resource committees and extension officers regarding labor allocation, monitoring, and payment administration. The cutline maps allowed communities to visualize the project area and make informed decisions about conservation areas.

v) CBO Membership Registration Maps

These maps assisted communities in Nandambi, Narunyu, Rutamba (Lindi), Msimba, and Ihombwe (Kilosa) in identifying and registering members living within or adjacent to the forests. Registered members include those residing within 350 meters of the forest edge. These community members form the Community-Based Organizations (CBOs) that will sign Joint Management Agreements with respective Local Authorities to manage the forests in the township and municipal land, but which were originally designated as Village Land Forest Reserves. During membership review meetings in Ihombwe and Msimba, communities resolved to include all residents in these areas, recognizing their historical responsibility for managing the VLFRs.

vi) Data Collection Forms

The project developed data collection tools, uploaded to ODK and Mergin maps, to inform village councils and patrol teams about necessary information for developing project documents and guiding informed decisions. These tools include baseline survey forms, carbon inventory forms, cutline forms, and patrol forms. Village patrol teams and extension agents were trained to collect this information effectively.

vii) Printed Manuals, Flip Charts, and PowerPoint Presentations

The project team prepared PowerPoint presentations outlining the project model, including details about the proponent's experience, the basics of REDD+, major participation requirements, carbon credit generation, and VCSL's implementation model. These presentations were delivered to Local Authorities and Village Councils. Printed manuals with the same information were disseminated to village councils and Village Natural Resource Committee (VNRC) members in participating villages. Carbon trade contracts were also printed and shared with all village council members for thorough review. Flip charts were frequently employed to elaborate on key concepts of the project model.

2.3.7 Information to Stakeholder on Verification Process (VCS, 3.18.6, 3.19; CCB, G3.3)

The potential for verification and validation site visits was communicated to all participating Managing Authorities during the initial introductory meetings of the project activities prescribed under section 2.2.1 of this Monitoring report. This obligation is also outlined in Clauses 6.1 and 9 of the Carbon Trade Contract, as part of the proponent's responsibilities. An official notification letter regarding the site visit plan was sent to the Managing Authorities on 20th January 2025, and notification of the arrival of External Auditors was sent to the Managing Authorities at on 09th March 2025, which was at least a week before actual visit which started on 17th March 2025.The purpose of the visit, which is to verify the accuracy of the proponent's project description and monitoring reports and ensure commitments are being fulfilled, was clearly communicated. A brief printed notice about the MRI was also posted on public noticeboards or designated areas where such announcements are typically displayed, ensuring the community is informed. In addition, Villages made verbal announcements, a common practice in Tanzanian villages, and traditional word-of-mouth communication to spread news of the verification visits within the community, ensuring transparency and fostering understanding.

2.3.8 Site Visit Information and Opportunities to Communicate with Auditor (VCS, 3.18.6, 3.19; CCB, G3.3)

Meetings were scheduled in February and March with each community to inform them of MR the auditor's upcoming site visit. To ensure timely communication, villages used verbal announcements, a widely practiced method in Tanzanian villages, to notify communities about the MR and the visit. Sub villages leaders, members of the village council and natural resource committees from the selected villages, who are all elected by village general assembly attended the meeting with the auditors. To facilitate direct and independent communication between communities, stakeholders, or their representatives and the auditor, the auditor had dedicated opportunities to meet with them independently, without the presence of VCSL or Local Authorities. This ensures that stakeholders can freely express their views and concerns directly to the auditor, promoting open and transparent communication.

2.3.9 Stakeholder Consultation (VCS, 3.18; CCB, G3.4)

The following tables describe how communities, including all community groups and other stakeholders, have influenced the project design to be implemented by VCSL. It does not include the stakeholder consultation work done by TFCG and MJUMITA to establish the first project instance in 2012. This is because VCSL redid the stakeholder engagement process in those villages. The tables document consultations and highlight how stakeholder input has shaped the project.

Ongoing consultation	During the monitoring period, the proponent secured consent to develop and register the Project Idea Note with the Designated National Authority. This consent was obtained from all participating managing authorities and key stakeholders through a series of meetings involving Local Government Authorities (LGAs), village councils, Community-Based Organizations (CBOs), and Village General Assemblies. In these meetings, the proponent introduced the basic concepts of REDD+, outlined the key activities under the VCSL model, explained the procedures for establishing a REDD+ project, and highlighted the anticipated benefits. To support informed decision-making, the project developed illustrative maps identifying potential project areas and introduced forest patrol technology. These tools enabled managing authorities to better understand the proposed sites, detect new deforestation polygons, and navigate to affected areas. The project also refined the existing Forest Management Plans to align with the changes in the VLFR

	areas and enable managing authorities to reinforce the protection of remaining natural forests within village lands. In addition, the project funded village patrol teams to engage with individuals involved in deforestation, raising awareness about forest conservation and REDD+. It also supported sub-village meetings in the mitaa to clarify the distinction between Village Land Forest Reserves (VLFRs) and other forests found in the Mtaa, while guiding communities through the formation of CBOs to strengthen collaboration between local authorities and community members in protecting forests within village lands. The project drafted the carbon trade contract with Forest and Legal Officers from participating Local Government Authorities (LGAs), which was subsequently presented and endorsed by village councils, Village General Assemblies, and the relevant Local Government Authorities. A Swahili summary of the monitoring results was prepared. The findings were presented in table format, allowing for a comparative analysis of each managing authority's performance and their potential earnings under the VCSL model. To further illustrate performance, deforestation maps were developed, alongside patrol maps, which were made accessible to each participating village through mobile phones provided by the project.
Date(s) of stakeholder consultation	The dates of stakeholder consultation meetings during this monitoring period are shown in Table 17 and Table 18 in Appendix 2.
Communication of monitored results	The monitoring results, enclosed with covering letters, were shared with managing authorities and Local Government Authorities in January and February 2025, immediately after their completion. In accordance with Clause 14.3 of the Carbon Trade Contract, the proponent then presented the Monitoring Report (MR) to the village councils and Village General Assemblies of each managing authority during February and March 2025. To ensure broader community outreach, sub-village leaders were requested to first present the report in sub-village meetings prior to the Village General Assembly. Besides, a one page summery was posted on the village notice boards.

Consultation records	The results of stakeholder consultations were documented through village meeting minutes and stakeholder engagement forms, which were uploaded to the project's server.
Stakeholder input	There have been no inputs from the stakeholders that would have attributed changes in the PD or MR.

2.3.10 Continued Consultation and Adaptive Management (VCS, 3.18; CCB, G3.4)

Consultations and their impact on the project design before the end of the monitoring period are detailed in section 2.3.10 of the updated PD which is being revalidated for CCB and verified for VCS concurrently with this monitoring report.

Since the end of the monitoring period, the project has consistently shared updates on new deforestation with participating villages through Mergin maps. Extension Officers have engaged monthly with patrol teams and community leaders to discuss forest management activities. Village patrol teams have also worked continuously to educate encroachers within VLFRs, aiming to deter further deforestation.

Additionally, the project has maintained regular engagement with Local Government Authorities (LGAs) through designated Focal Persons who serve as liaisons. On 30th August 2024, the project sent an official letter to the Managing Authorities and LGAs, providing a progress update. The Project Description (PD) and Monitoring Report (MR) were formally shared with the Managing Authorities, and subsequently presented during village council meetings, CBO sessions, and general assemblies in February and March 2025. Presentation of the draft PD and MR summaries to villages did result in some minor changes to the project areas as documented in the table below.

In addition to formal meetings between the project and various stakeholders, the project extension agents are constantly interacting with community members from the forest patrol teams and village leadership.

Summary of comments received	Actions taken
After the presentation of the draft monitoring report, Nakalonji Village Council requested to reduce the project area on the side of the Village Forest Reserve closest to the village center claiming that they had not intended to include all the area in their new village forest reserve.	The project reviewed the requestion, removed the area from the project area, added it to the leakage belt and updated the PD and MR accordingly. Note that this is a second project instance village, so this change occurs pre-validation.

After the presentation of the draft monitoring report, Majonanga village council requested to remove one of the proposed expansion areas from their village forest reserves.	The area was reviewed by the project. It had been part of the proposed Ndonda WMA according to WWF maps but was heavily encroached with farms before 2023. The project removed the area from the project area, added it to the leakage belt and updated the PD and MR accordingly. Note that this is a second project instance village, so this change occurs pre-validation.
After the presentation of the draft monitoring report, Sewe Kipera village claimed that they had not intended to include some of the proposed expansion areas added to their village forest reserve with support from VCSL.	The expansion areas were reviewed, and boundaries adjusted to allow for some continued expansion of farms in the village. The project removed the area from the project area, added it to the leakage belt and updated the PD and MR accordingly. Note that this is a second project instance village, so this change occurs pre-validation.

2.3.11 Stakeholder Consultation Channels (CCB, G3.5)

All consultative meetings have involved local authorities, farmers within the Village Land Forest Reserves (VLFRs), Village Natural Resource Committees (VNRCs), Village Councils (VC), and communities through Village General Assemblies.

Farmers in the VLFRs and wider Reference Region: During the project design phase, partially overlaps with this monitoring period, a significant focus was placed on engaging with farmers accused of contributing to deforestation. The opportunity cost survey consulted 102 farmers across 10 randomly selected deforestation points from the period of 2017-2020. At each site, village representatives identified the farm owner and the owners of the 10 nearest farms cleared within the past three years. Data was collected using ODK tools. Additionally, village forest patrol teams consulted farmers across 2,501 deforested polygons, gathering information on their gender, land ownership, origin, knowledge of the VLFR and carbon trade, and interest in agricultural extension services to boost arable land productivity rather than expanding new farms. Farmers involved in cutline making were also consulted about their preferences for utilizing income generated from the project.

Village Natural Resource Committees, Village Councils, and Village General Assemblies: These key community stakeholders were integral to the consultative process. Meetings focused on collecting baseline data, securing consent to join the project, agreeing on Project Area

boundaries, and discussing the carbon trade contract. VNRC and VC meetings were attended by 1,610 participants, including 507 women, 1103 men, and 259 youths under 25 years. Village General Assemblies engaged 5,456 community members, including 2,270 women, 3,186 men, and 886 youths under 25.

The project has developed a socio-monitoring tool to track social indicators outlined in Section 4.4 of the Project Document, as well as non-performance risks identified in the adaptive management strategy. Data collection was primarily conducted by Managing Authorities themselves using ODK tools provided by the project. The proponent is contractually obligated to participate in annual meetings of each Managing Authority's highest decision-making body to present feedback on collected data. During these meetings, the proponent will present and discuss this monitoring report, while Managing Authorities will report on their implementation progress and discuss future actions.

2.3.12 Stakeholder Participation in Decision-Making and Implementation (VCS, 3.18, 3.19; CCB, G3.6)

The project has adhered to statutory obligations for Managing Authorities' decision-making processes, as outlined below:

District and Municipal Councils: The carbon trade contract was approved during Quarterly Meetings held in the third and fourth quarters of the 2024/25 fiscal year. These proceedings were conducted in accordance with Sections 63 and 64 of the Local Government Act (District Authorities) CAP 287. A total of 589 participants (164 women and 425 men), including members of the Regional Secretariat, Council Management Teams (CMT), ward councilors, and other local authority officers, attended these meetings.

Village Councils and General Assemblies: Consent for project establishment, decisions to refine forest boundaries, and approval of the carbon trade contract were obtained through Village Council and General Assembly meetings, convened as stipulated under Sections 103, 104, and 105 of the Local Government Act (District Authorities) CAP 287. These meetings, facilitated by the project between 2022 and 2024, are detailed in section 2.2.1 of the Monitoring Report.

Community-Based Organizations (CBOs): In collaboration with Local Authority Officers, the proponent organized 27 meetings to establish CBOs, attended by 1,054 individuals, including 327 women, 727 men, and 180 youth. These meetings finalized resolutions to establish the CBOs, develop and approve their constitutions, and sign the carbon trade contract. Quarterly meetings are conducted in line with their respective constitutions.

The carbon trade contract mandates the inclusion of the project agenda in statutory meetings of the Managing Authorities. Equal opportunities are provided for women and men to participate in elections for Ward Councilors, Village Councils, and Natural Resource Committees. Additionally, a dividend-based benefit-sharing mechanism will be established at the village level to promote attendance at annual meetings. Drawing from the proponent’s experience with the MJUMITA

Community Forest Project in Lindi, the dividend model has proven effective in increasing women's participation, as they often collect dividends on behalf of their families' dependents. During these meetings, the project proponent will present and discuss the project's progress and performance.

2.3.13 Anti-Discrimination Assurance (VCS, 3.19; CCB, G3.7)

The proponent's Human resource manual has established a zero-tolerance policy against harassment, ensures prompt and fair investigation of reported cases, and provides support mechanisms for victims. The manual mandate that all new staff members, both permanent and temporary, are briefed on the company's anti-discrimination policy. When a permanent employee is recruited, the new hire is notified of the policy by the Director of Operations. When groups of temporary workers are brought on board in the field, they are informed of the policy by the Extension Agents.

VCSL's Human Resource policy states:

Non-Discrimination: Treat every person with respect and tolerance, regardless of gender, race, religion or sexual orientation; must not discriminate in its labor and hiring policies and procedures along the lines of race, color, gender, age, religion, social class, political tendencies, nationality, syndicate membership, sexual orientation, civil status or any other motive as indicated by applicable laws, ILO Conventions 100 and 111. VCSL must offer equal pay, training and promotion opportunities and benefits to all employees for the same type of work. The company must not influence the political, religious, social or cultural convictions of employees.

No Harassment: VCSL and its supervisors must not threaten, sexually abuse or harass, or verbally, physically or psychologically mistreat employees for any reason. VCSL must encourage the respectful treatment of employees and have a formal mechanism to act upon employees' claims of mistreatment.

2.3.14 Grievances (VCS, 3.18.4; CCB, G3.8)

During the monitoring period, only two grievances were recorded in the registry, and addressed promptly through inclusive dialogue, ensuring resolutions aligned with stakeholder interests.

Grievances received	Resolution and outcome
A family in Nndawa Village (Mtama) claimed ownership of a proposed expansion village land forest reserve area and opposed its inclusion.	The project and District Natural Resource Officer met with the village leader and claimant14, confirming no proof of ownership and that the area has been forested for many years. It was concluded that the claimant will consult his family and provide feedback to the village council for consideration in the next monitoring period.

[14] Minutes attached

Some farmers in Kinyope village (Lindi Municipality) who had encroached on the Village Land Forest Reserve claimed ownership of the cleared area after being instructed to stop farming activities.	It was confirmed and clarified that the encroached area lies within the gazetted VLFR, where farming activities are legally prohibited. However, the project emphasizes refraining from further clearing rather than evictions. This approach was understood and agreed upon.

2.3.15 Worker Training (VCS, 3.19; CCB, G3.9)

During the monitoring period, the Proponent finalized the development of the company's Human Resource Policy, which includes a comprehensive capacity-building program for new employees. Employees receive structured on-job training from the Operations Director on the project's philosophy and operational duties, and from the Finance Director on financial and human resource policies. This approach ensures employees are well-prepared for their roles while minimizing the loss of capacity through staff turnover.

Four Extension Agents were recruited and trained on REDD and the VCSL model, including the use of the project's Mergin Map technology for forest patrols. These agents, in turn, trained 454 patrol team members, including 44 females per 100 males and 126 youth (18–25 years), on using the technology. Demonstrating their competence, the patrol teams identified and visited 4,853 newly deforested patches, educated deforestation agents, and collected critical data. Additionally, the project strengthened the community leaders, comprising 1,610 members (507 females, 1,103 males, and 259 youth aged 18–25), to understand the requirements and prospects of REDD. This effort resulted in the formalization of three new Village Land Forest Reserves, and expansion of existing reserves by over 97,919 hectares, and the signing of a carbon trade contract with the Proponent.

The project's capacity-building model is outcome-focused, with acquired knowledge easily transferable among members. Youth engagement and leadership retention are central to its philosophy. The project promotes the election of young people to Village Natural Resources Committees (VNRCs) and ensures continuity by retaining at least half of the outgoing VNRC members during each election cycle. This approach fosters fresh perspectives while safeguarding institutional memory and local capacity. Additionally, the integration of smartphone-based technology in patrols and record-keeping ensures traceable records and facilitates smooth transitions for new employees and VNRC leaders. This technology, favored by youth for its adaptability and ease of use, is a cornerstone of the project's operational success.

2.3.16 Community Employment Opportunities (VCS, 3.19.13; CCB, G3.10)

The Proponent relies on the accuracy of the information provided by candidates during the hiring process. Any falsifications, misrepresentations, or material omissions may result in exclusion from consideration, or if already employed, termination of employment. The project is committed to providing equal opportunities for all community members, including management roles,

provided they meet the job requirements. This commitment also extends to promoting gender equity and ensuring equal pay for equal work. The selection process is transparent, merit-based, and includes clear criteria for each role. Job announcements are widely disseminated through various channels, including community meetings, notice boards, and social media, ensuring that all eligible candidates are aware of the opportunities. Outreach activities are also conducted to encourage applications from women and underrepresented groups, ensuring a diverse pool of candidates. These principles are outlined in Section 1.3 of the VCSL Human Resource Policy (2022).

During this monitoring period, the project recruited four Extension Agents, all former TFCG volunteers, with one from the Project Area. Additionally, 454 patrol team members, including 44 females per 100 males and 126 youth (ages 18–25), were trained in the use of the project's technology.

To further support equal opportunities, the project will implement measures to ensure community members, including women and marginalized groups, have fair access to training and employment. For casual labor, such as creating cutlines, the project shares the plan and budget at the village general assembly and advertises the opportunities through notice boards and sub-village leaders. All community members are eligible for hire and receive equal pay for the area cleared. Patrols are coordinated by the village natural resource committee, following procedures outlined in the Forest Management Plans (FMPs), with all committee members eligible to participate. The project will also encourage graduates from relevant fields within the project area to apply for internships at TFCG and MJUMITA, offering mentoring, skill development, and increased competitiveness for future vacancies. The Project's Extension officers will track forestry graduates from project villages and encourage them to apply for internships.

2.3.17 Occupational Safety Assessment (VCS, 3.19; CCB, G3.12)

As described in the PD, during the monitoring period; the project did not use armed patrols therefore, no risks related to armed enforcement were identified for stakeholders, local communities, or workers.

The project understands the significant safety risks during implementation, particularly in activities such as forest patrolling, boundary clearing, and fire management. These risks include physical injuries from equipment handling, encounters with wildlife, and exposure to harsh environmental conditions.

To mitigate these risks, the project equipped all patrol teams with smartphones loaded with cloud-based technology during the monitoring period. This technology enables teams to identify newly deforested polygons or areas at risk of deforestation. Such identification helps patrol teams plan their routes, assess potential safety risks, and take precautionary measures in advance.

Additionally, the project's patrol budget includes motorcycle transportation, improving safety and navigation compared to pre-project conditions. Smartphones also serve as communication devices, ensuring connectivity during emergencies.

The project has further introduced a buddy system, requiring patrol teams to operate in groups of at least four members to enhance safety and provide immediate assistance when necessary.

Looking ahead, the project will prioritize effective budget allocations for essential safety measures. These include first aid kits, health insurance for patrol teams, patrol gear (helmets, gloves, raincoats, and rain boots), and continued transportation support.

2.4 Management Capacity

2.4.1 Required Technical Skills (VCS, 3.19; CCB, G4.2)

Remote Sensing: Experts in remote sensing have provided critical, large-scale data on land cover, forest density, and vegetation changes. Using satellite imagery, they assessed forest health, tracked deforestation, and detected land-use changes in the project area throughout the monitoring period. Their expertise was essential for project design, carbon stock estimations, and monitoring the impact of conservation efforts.

Community-Based Forestry: Professionals in community-based forestry worked closely with local authorities and villages to promote sustainable forest management. Their role included engaging communities in forest protection, such as removing heavily encroached patches, implementing VCSL's patrol technology, creating 507 km of cutlines, formalizing 5 new Village Land Forest Reserves, and expanding existing ones by approximately 97,919 hectares. These experts built the capacity of Village Forest Management Institutions, ensuring local knowledge and participation are central to the project's success. Moving forward, they will assist communities in developing benefit-sharing guidelines that promote good governance in forest management and community development programs.

Carbon Measurement: The carbon measurement specialist focused on assessing carbon stocks in forest ecosystems. By collecting and analyzing data on biomass, soil carbon, and forest growth rates, he estimated carbon sequestration. These measurements were crucial for monitoring progress in reducing greenhouse gas emissions and ensuring the project meets its carbon reduction targets.

Biodiversity Monitoring: The biodiversity monitoring expert was responsible for evaluating the health and diversity of flora and fauna within the project area. Through field surveys, species inventories, and habitat assessments, he tracked the biodiversity status of the project area, as detailed in Section 5 of this Monitoring Report and the Project Description. His work ensured that conservation efforts support not only carbon goals but also the protection of critical ecosystems and wildlife.

Agricultural Extension Services: While agricultural extension services were not provided during this monitoring period, they will be crucial moving forward. Extension officers will bring expertise in sustainable farming practices and land management, training farmers in techniques that improve productivity while minimizing environmental impact, such as agroforestry, soil conservation, and climate-resilient farming. Their role is vital in promoting sustainable livelihoods that align with the project's broader objectives of reducing deforestation and enhancing ecosystem services.

2.4.2 Management Team Experience (VCS, 3.19; CCB, G4.2)

The management team at Village Climate Solutions Limited (VCSL) brings extensive expertise in land management and carbon projects.

Charles Meshack, the Managing Director, has over 27 years of experience, having served as the Executive Director of the Tanzania Forest Conservation Group (TFCG). A civil society leader in Tanzania, Charles has played a key role in national forest conservation initiatives, including participatory forest management, Tanzania's first REDD+ project, and advocacy for improved forest governance. He joined TFCG as a field officer in 1996, became the Executive Director in 2005, and led the establishment of sustainable charcoal value chains that incentivize rural communities to reduce deforestation. Charles has also raised awareness both locally and internationally about the need for equitable and effective forest management. He holds a BSc in Forestry from Sokoine University of Agriculture, Morogoro, Tanzania (1995), and an MSc in Ecology and Environmental Management from the University of York (2003).

Dr. Wilson Ancelm Mugasha, a Senior Lecturer at Sokoine University of Agriculture, is Tanzania's leading expert in forest biomass measurement. His academic and research background ensures scientific rigor in the project, especially in carbon measurement. He joined VCSL in 2023, also as a Managing Director where he has been assisting in designing the methodology, collecting and analyzing data on biomass, soil carbon, and forest growth rates, he estimated carbon sequestration.

Aklei Albert has over 12 years of experience in community-based forestry in Tanzania. He joined MJUMITA in 2011 as Zonal Coordinator and led the development of a forest governance dashboard tool for 300 villages across Tanzania. As Program Manager in 2015, he oversaw land use planning and forest management in Lindi and Ruvuma and developed MJUMITA's 2019-2023 strategic plan. In 2020, Aklei became Project Manager for TFCG's Forest Justice in Tanzania project, supervising forest condition monitoring, community forest crime tracking, and advocacy efforts. Since 2018, he has led consultancies on capacity building, climate risk assessment, and forest management planning in Tanga, Morogoro, and Lindi. He joined VCSL in 2022, as Director of Operations, he coordinated the establishment of a REDD+ project with 65 Managing Authorities and Community based organizations (CBOs) across 7 LGAs in Morogoro, and Lindi, . Aklei holds a bachelor's degree in wildlife management from Sokoine University of Agriculture (2009) and a master's degree in Natural Resource Assessment and Management from the University of Dar es Salaam (2018).

Emmanuel Walala, a Certified Public Accountant (CPA) with 20 years of experience in commercial operations, brings strong financial expertise. He specializes in budget management, financial strategy, planning, auditing complex projects, and administering payments to beneficiaries. He joined VCSL in 2022, where he has been helping in designing the project's business model, and internal operational policies.

Magdalene Boniface, a young scientist, holds a bachelor's degree in environmental science and management from Sokoine University of Agriculture (2019) and is currently pursuing a master's in environmental and Natural Resource Economics at the same institution (2022-2025). Between 2020 and 2022, she worked as an intern with TFCG, helping establish a network of community village forest reserves (VFR) to complement the national protected areas network and ensure landscape connectivity in the Lindi region. She joined VCSL in 2023 as an Extension Agent, where she assisted 16 villages in Kilosa District and 2 sub-villages in Mikumi Township to implement VCSL's patrol technology during this monitoring period. Magdalene also supported 10 villages in creating cutlines around their forest reserves and conducted surveys with CBO members in Ihombe and Msimba (Mikumi).

Fatuma Rashidi graduated with a B.A. in Geography and Environmental Studies from the University of Dar es Salaam in 2009. With 14 years of experience working with TFCG, MJUMITA, CARE International, and INADES, Fatuma's technical knowledge enhances sustainable agriculture, forest management, and climate-resilient practices in community-based projects. She joined VCSL in 2023 as an Extension Agent, helping 10 villages in Morogoro and Mvomero districts operationalize VCSL's patrol technology and verify proposed expansion areas.

Nebby Venance holds a BSc in Forestry from Sokoine University of Agriculture (SUA) (2017) and has over 6 years of experience in community-based initiatives. Between 2017 and 2020, he volunteered with Lindi District Council, working on community-based forestry and human-wildlife conflict mitigation in VCSL project villages. In 2021, Nebby volunteered with TFCG's Scaling Up CBFM project at Lindi District. He currently serves VCSL as an Extension Agent, helping 16 villages and 3 CBOs implement patrol technology and assisting 6 villages in creating cutlines around their VLFRs during this monitoring period.

Emmanuel Mwakajumba graduated with a Bachelor of Arts in Geography and Environmental Studies from the University of Dodoma in 2011. He worked for 8 years as a TFCG volunteer in the Transforming Charcoal Sector Project in Kilosa (2015-2018) and as a Project Officer in the Water, Forest, and Resource Management and Climate Change Resilient Udzungwa Mountain project (2018-2020), covering Kilolo, Mafinga, and Kilombero districts with 17 villages. Since 2023, Emmanuel has been part of VCSL, where he assisted 17 villages in Nachingwea and Nanyumbu in marking proposed expansion areas for the VLFRs and implementing VCSL's patrol technology.

2.4.3 Project Management Partnerships/Team Development (VCS, 3.19; CCB, G4.2)

Village Climate Solutions Limited (VCSL) has formed strategic partnerships with Reterra Ltd, a UK-based company established in 2021, which focuses on developing nature-based solutions for

climate change mitigation, and the Tanzania Forest Conservation Group (TFCG), an NGO that has pioneered community-based forest management in Tanzania's biodiversity-rich forests since 1991.

VCSL has greatly benefited from Reterra's technical support in the development of the Project Document and this Monitoring Report. One of Reterra's directors, Dr. Theron Morgan-Brown, provided invaluable expertise in GIS and remote sensing, helping to design the patrol technology and conduct climate and biodiversity analyses. He authored the methodological sections of the Project Document and Monitoring Report, guiding them through validation and verification processes. Dr. Morgan-Brown is an experienced tropical forest scientist, remote sensing expert, and specialist in carbon project monitoring, reporting, and verification. Notably, he authored Tanzania's first REDD+ project, the MJUMITA Community Forest Project in Lindi, which was validated and verified under the VCS and CCB standards in 2015. His technical support has also extended to other REDD+ projects in Zambia, Angola, Kenya, Liberia, and Vietnam. Dr. Morgan-Brown holds a PhD in Interdisciplinary Ecology from the University of Florida (2014).

VCSL has also benefited from the expertise of Tanzania Forest Conservation Group (TFCG), the majority shareholder in the company. As a founding partner of MJUMITA, TFCG has a proven track record in developing successful REDD+ projects and has contributed valuable knowledge to planning and monitoring project areas, including the project's biodiversity values. TFCG maintains a representative on VCSL's board, ensuring continued strategic collaboration. TFCG will also benefit from VCSL through the generation of carbon revenue, which will be reinvested into community-based forestry initiatives in alignment with TFCG's strategic plan.

These partnerships have enabled VCSL to bridge gaps in knowledge and experience, reinforcing its commitment to effective climate action and sustainable development.

2.4.4 Financial Health of Implementing Organization(s) (CCB, G4.3)

VCSL has focused on securing reliable early funding and developing a sustainable revenue model. Currently, VCSL's primary funding comes from advance sales of carbon credits. This upfront revenue is allocated to support the initial stages of project development, community engagement, and biodiversity protection activities.

Available Cash Reserves: $150,000 (from advance carbon credit sales)

Annual Projected Operating Budget: $250,000 (for the first three years)

Total Funding Required for the First Three Years: $1.65 million (secured through pre-sale agreements and funding from the Nature Conservancy's (TNC) - African Forest Carbon Catalyst (AFCC), Palladium and UBS Optimus foundation.

VCSL has entered into pre-sale agreements with a committed buyer, securing advance payment for future carbon credits. This financing structure allows us to cover all initial costs related to the REDD project. Key details include:

Pre-Sale Agreements with Long-Term Buyers: VCSL has contracts with a reputable off-taker, providing guaranteed early-stage funding. This advance sale strategy mitigates financial risk and ensures sufficient cash flow for early project development.

Allocation of Funds: Funds from pre-sale agreements are allocated toward establishing project infrastructure, setting up community programs, biodiversity monitoring, and conservation activities. By prioritizing these foundational elements, VCSL can implement the project effectively and position itself for future growth.

Revenue Timeline: Advance sales are structured to provide consistent cash inflows over the first three years, after which regular carbon credit sales are projected to generate sufficient revenue.

The financial projections show that from year 4 (FY 2026), revenue from carbon credits sales will be sufficient to cover all operational costs, achieving self-sufficiency, this allows for reinvestment in ongoing project activities. This sustainable revenue model ensures long-term viability and funding adequacy for the project's duration.

The following table presents 10-year revenue and costs forecasts for carbon credits sales

Financial Year	Projected VCU Sale (tCO2e)	Price ($ / tCO2e)	Projected Base Revenue $	Projected Costs $	Surplus / (Deficit) $
2023		-		(28,639)	(28,639)
2024		-		(389,710)	(389,710)
2025		-		(247,766)	(247,766)
2026	693,055	6.62	4,586,196	(4,500,461)	85,735
2027	441,099	6.87	3,028,886	(2,981,613)	47,272
2028	454,803	7.04	3,199,960	(3,147,376)	52,584
2029	459,751	7.21	3,314,805	(3,258,558)	56,246
2030	450,556	7.39	3,328,781	(3,271,565)	57,216
2031	441,361	7.58	3,343,310	(3,284,960)	58,349
2032	441,361	7.77	3,427,168	(3,365,534)	61,634

Financial Risk Management

Given VCSL's reliance on presales of carbon credits, we have implemented several risk management strategies to mitigate potential financial uncertainties and safeguard project continuity:

Reserve Fund: A portion of the advance sale revenue is allocated to a contingency reserve, designed to cover unexpected expenses or financial shortfalls during the start-up period.

Diversified Partnerships: VCSL actively seeks partnerships with conservation NGOs, development agencies, and governmental bodies to secure additional support for community and biodiversity programs. These partnerships provide both in-kind resources and financial support to supplement carbon credit revenue.

Adaptive Financial Planning: As the market for carbon credits evolves, VCSL regularly revisits its pricing strategy and revenue projections to adapt to changes. This flexibility ensures VCSL can maximize income while maintaining competitive rates for future credit sales.

2.4.5 Avoidance of Corruption and Other Unethical Behavior (VCS, 3.19; CCB, G4.3)

The VCSL's Code of Ethics and Code of Conduct, as outlined in the company's HR manual, provides assurance that the project proponent and any other entities involved in the project design and implementation are not involved in, nor complicit in, any form of corruption, including bribery, embezzlement, fraud, favoritism, cronyism, nepotism, extortion, and collusion. The standards of ethics and conduct at Village Climate Solutions Limited encompass the principles and guidelines of the Company's Business Integrity Policy, Ethical Guidelines, Whistleblowing Policy, and Confidentiality Agreement. Employees are expected to adhere to these codes and standards in conducting the Company's business. Any deviation from these rules can lead to disciplinary action, including termination of employment.

Section 5.1.2 of the company's HR Manual establishes a "Zero Tolerance Policy" regarding corruption. In Village Climate Solutions Limited's employment contracts and any legal agreements with partners, VCSL includes provisions to ensure compliance with local and international laws and best practices. Specifically, VCSL does not tolerate:

Making or receiving payments meant to achieve undue advantages, including through agents or consultants, nor facilitation payments intended to secure or expedite actions to which one has a legal entitlement.

Giving or receiving gifts that could be interpreted as influencing business decisions.

Making political contributions to political parties or candidates.

Abusing confidential or material non-public information.

Financial or economic crimes, including money laundering.

Illegal or deceitful recording and reporting of financial or tax information.

Business transactions where the price for goods or services is artificially manipulated.

Clause 5.2 outlines nine provisions regarding Ethical Guidelines, including non-discrimination, no harassment, adherence to the rule of law (observing national and international law), prohibition of gifts for business influence, no facilitation fees or illegal payments, and policies against patronage of sex workers, along with mandates for transparency and accountability.

2.4.6 Commercially Sensitive Information (VCS, 3.5.2-3.5.4; CCB Program Rules, 3.5.13 – 3.5.14)

This document does not contain any commercially sensitive information.

2.5 Legal Status and Property Rights

2.5.1 National and Local Laws (VCS, 3.1, 3.6. 3.7, 3.14, 3.18, 3.19; CCB, G5.6)

During this monitoring period, Tanzania enacted The Environmental Management (Control and Management of Carbon Trading) Regulations, 2022, which were published in Government Notice (GN) 636 on October 28, 2022. These Regulations were amended on October 6, 2023, through GN 721. The project complies with all national and local laws and regulations, because, based on these national regulations, it has secured the following approvals:

Approval of the Project Idea Note: Consent letters from all participating villages were obtained to register for the Project Idea Note, as required under Regulation 26. These letters were accompanied by the meeting minutes from the respective village councils and general assemblies. The project received formal approval of the idea note, confirmed through a letter (reference number SUA/NCMC/CT.1/10/10) dated January 22, 2024, from the Designated National Authority.

Approval of the Concept Note: After submitting the complete Concept Note, along with the required registration fee, the project received a Letter of No Objection (reference number CBC.78/200/01/22) dated September 20, 2024, from the Designated National Authority, in compliance with Regulation 27 of the regulations.

Approval of the Long-Term Carbon Trade Contract: The project has entered into a 40-year carbon trade contract with the Managing Authorities. These contracts were approved by the respective Village Councils, Village General Assemblies, and Local Authorities, as required by Regulation 29.

Obtaining Letter of Endorsement: The project submitted the Project Document to the Designated National Authority (DNA) to obtain the Letter of Endorsement, as required under Regulation 28 in November 2024. The Letter of Endorsement with reference No. CBC.78/200/01/159 was obtained on Sept 23, 2025.

2.5.2 Relevant Laws and Regulations Related to Worker's Rights (VCS, 3.18, 3.19; CCB, G3.11)

Tanzania's framework for worker rights includes key legislation such as the Employment & Labor Relations Act No. 6 (2004), the Occupational Health and Safety Act (No. 5, 2003), the Public Health Act (Act No. 01/09, 2009), the Social Security Regulatory Authority Act (2008), the Workers' Compensation Act (2008), and the Vocational Education and Training Act (1994). Together, these laws ensure workers' rights to fair treatment, non-discrimination, and health and

safety protections. Employers are mandated to make statutory payments to the National Social Security Fund (NSSF) for employee pensions, the Workers Compensation Fund to cover work-related injuries, and the Skills Development Levy to support workforce training and development.

When a new full-time employee is contracted, they are informed of their rights, including working hours, paid holidays, and union membership rights. Additionally, employees have the right to join unions, negotiate working conditions, and access skills development programs. These regulations align with VCS (3.18.2) and CCB (G3.11) requirements by promoting fair labor practices, safe work environments, and comprehensive worker protections.

2.5.3 Human Rights (VCS, 3.19)

The project follows a decentralized forestry approach that empowers local communities (LCs) by vesting in them the rights and responsibilities of forest management. Through village general assemblies, these communities act as the final decision-makers regarding forest protection and the utilization of benefits derived from these resources. This model respects and strengthens the role of Local Communities (LCs) as customary rights holders, ensuring their direct involvement in governing their lands and natural resources.

In alignment with applicable international human rights law, including the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) and ILO Convention 169 on Indigenous and Tribal Peoples, the project actively promotes the protection of customary rights. Specifically, it addresses Article 14 of ILO Convention 169, which recognizes the rights of local communities to their natural resources, and Article 26 of UNDRIP, which affirms the right of communities to own, use, develop, and control their traditionally occupied lands. The project advocates against the eviction of individuals residing within forest reserves and incentivizes them to protect remaining natural forests through carbon revenues, ensuring that these communities are rewarded for safeguarding the forests. Without this initiative, they could face eviction under national laws or village bylaws.

In situations where communities do not own the forests they inhabit; the project has initiated partnerships with forest owners by assisting in the formation of community-based organizations (CBOs). These CBOs will enter Joint Management Agreements (JMAs) with forest-owning village councils, thereby protecting the rights of communities living near forests. This approach aligns with Article 6 of ILO Convention 169, which emphasizes the importance of consultation and good-faith cooperation with local communities to ensure their participation in land management decisions.

Furthermore, farmers within the leakage belt will receive agricultural extension services aimed at improving crop yields without expanding into forested areas, thereby preventing further encroachment and securing their livelihoods. The project will also promote the issuance of Certificates of Customary Rights of Occupancy (CCROs) to households, which will secure their statutory land rights and enhance tenure security in accordance with international standards.

The revenue-sharing model of the project allows villages to utilize income generated to enhance local services such as health, education, water, and transport, or for individual households to invest in their livelihoods. This model respects the rights of women, youth, and dependents, encouraging women to manage finances related to these payments, thus aligning with international commitments to gender equality and inclusive participation.

Overall, the project's design adheres to key principles of international human rights law and ILO Convention 169 by recognizing and promoting the rights of local communities and customary rights holders, ensuring their participation in decision-making, securing land tenure, and facilitating equitable benefit-sharing while supporting sustainable forest management and community livelihoods.

2.5.4 Indigenous Peoples and Cultural Heritage (VCS, 3.18, 3.19)

The project preserves and has protected cultural heritage by building on existing community structures and promoting participatory governance of Local Communities' conserved areas, the Village Land Forest Reserves. It has leveraged village forest management institutions such as the village general assembly, village council, and village natural resource committees, all of which are statutorily recognized, democratically elected, and accountable to community members. This has ensured that local knowledge and traditions are integrated into project activities, alongside modern cloud-based techniques for forest protection. The project's approach has avoided the displacement of people living within or near the reserved lands, recognizing that forced relocation would negatively impact their cultural heritage.

The project is promoting a dividend model for benefit-sharing, ensuring that village councils invest REDD+ revenues in community-approved projects or distribute funds directly to households. This model empowers communities to make decisions that sustain their livelihoods and preserve their cultural practices. Using the revenues to be generated from this monitoring report, the project will start promoting villages to prioritize issuing Certificates of Customary Rights of Occupancy (CCROs) to individual households, thereby safeguarding traditional land rights and customs. Additionally, the project will develop an extension services strategy that integrates traditional agricultural methods, such as mulching, cover cropping, the use of organic fertilizers like compost, and intercropping, with modern sustainable practices. This combination of traditional and contemporary approaches ensures that the cultural heritage and sustainable livelihoods of the communities are preserved and enhanced.

2.5.5 Recognition of Property Rights (VCS, 3.7, 3.18, 3.19; CCB, G5.1)

Disputes over rights to territories and resourcesThe	A family in Nndawa Village (Mtama) claimed ownership of a proposed expansion village land forest reserve area and opposed its inclusion. The project and District Natural Resource Officer met with the village leader and claimant , confirming no proof of ownership and that the area has been forested for many years. It was concluded that the

	claimant will consult his family and provide feedback to the village council for consideration in the next monitoring period. Some farmers in Kinyope village (Lindi Municipality) who had encroached on the Village Land Forest Reserve claimed ownership of the cleared area after being instructed to stop farming activities. It was confirmed and clarified that the encroached area lies within the gazetted VLFR, where farming activities are legally prohibited. However, the project emphasizes refraining from further clearing rather than evictions. This approach was understood and agreed upon. Encroachment into village forest reserves is common in Tanzania, though rarely represents a genuine dispute over ownership. Instead, most encroachment is due to a lack of awareness or people expanding farms knowing they are breaking the rules and simply expecting that the rules will not be enforced. Furthermore, project areas and VCSL support for improved enforcement of forest management plans are limited to natural forest at least 10 years old. Forests on village land are communal lands under the management of the village council. It is very rare for people to fallow lands for longer than 10 years, so new deforestation inside a forest reserve is almost always the result of illegal encroachment rather than based on a genuine dispute over ownership predating the establishment of the reserve. VCSL's key project activities since 2023 have focused on revising forest management plans in all villages to remove heavily encroached areas before adding them to the project area, then improving awareness of forest reserve boundaries and enforcement of the forest management plans.

Respect for property rights	Approximately 88% of the Project Area is owned by Local Communities (LCs), with legal ownership vested in the Village Council as a corporate body under the Village Land Act CAP 114. Of this, 96% have been formally designated as Village Land Forest Reserves (VLFRs) under Sections 4(c), 32, 33, and 35 of the Forest Act CAP 323, ensuring legal protection of community property rights. The remaining 4% of village land is still under Village Council authority but has yet to be legally protected. To further safeguard stakeholder rights, including those of customary rights holders, the project negotiated agreements with Municipalities and Townships for four VLFRs originally established on village land but later transferred the Municipality under the Land Act CAP 113 of 1999. These negotiations ensured that legally registered community-based organizations (CBOs), composed of community members residing near these forests, manage these areas covering 10.3% of the total project area. In accordance with Clause 6.2(k) of the Carbon Trade Contract, Joint Management Agreements between the CBOs and Municipalities or Townships ensure that communities retain decision-making authority and revenue rights comparable to those under village-based management. These measures collectively protect and preserve the property rights of LCs and customary rights holders while promoting sustainable forest management.

2.5.6 Benefit Sharing Mechanism (VCS, 3.18, 3.19)

Summary of the benefit sharing plan	As outlined in Regulation 34 of the Environmental Management (Control and Management of Carbon Trading) Regulations, 2022, along with the 2023 amendments, benefit sharing among stakeholders will be distributed based on gross revenues as follows: A minimum of 61% of gross revenues will be paid to the managing authority, allocated as:

	A minimum of 51% to the villages, 8% to the local authority, 1% to the regional administration, and 1% to the President's Office - Regional Administration and Local Government. The carbon trading contract provide that the revenue sharing to the managing authority will be based on the stock-flow accounting calculations Also, 8% of gross revenues will go to the Designated National Authority/Focal Point. 31% of gross revenues will be retained by the project proponent. The regulations allow flexibility for the proponent to provide additional benefits to communities as needed and based on opportunity cost surveys. According to Sections 22 and 26 of the Local Government Act (CAP 287 of the Laws of Tanzania), each village council is issued a certificate of incorporation, making it a corporate body with perpetual succession and a common seal. This legal status enables village councils to sue, be sued, and acquire both movable and immovable property. This provision also allows communities to maintain privacy around certain elements of the benefit-sharing plan if they choose. With support from the project, each village will develop clear guidelines to govern the benefit-sharing process. These guidelines will define transparent, participatory procedures for making decisions on revenue allocation, ensuring funds are used for forest management, community development projects, and/or household dividends. Typically, the benefit-sharing system is designed to treat all villagers as equal owners of the village forest reserve, entitling them to equal dividends. Each year, villages will

	compile household lists according to residence eligibility criteria set in their guidelines. The total revenue from REDD+ projects will be divided by the number of eligible residents to calculate a per-person dividend. In a village assembly, community members will discuss how much of their dividends to allocate to previously agreed-upon development projects and forest protection efforts. The remaining amount will be distributed as dividends. Each resident will collect and sign for their dividend in front of their sub-village. The project will encourage communities to prioritize village development activities with the potential for long-term impact, particularly those that support forest conservation. Increasing secondary school attendance and completion is seen as especially critical for fostering sustainable development and ensuring lasting benefits from the project.
Benefit sharing during the monitoring period	Benefit sharing was not implemented during the monitoring period due to the absence of revenue from carbon credits. Revenues to be generated through this monitoring report will be distributed according to the outlined plan.

2.5.7 Free, Prior, and Informed Consent (VCS, 3.18, 3.19; CCB, G5.2)

Consent	The consent process involved three structured steps: participatory land-use planning, formalization of conservation areas as Village Land Forest Reserves (VLFRs) and securing community approval for a long-term carbon trade contract. These steps ensured transparent engagement with Local Communities (LCs), customary rights holders, and other stakeholders. The participatory land-use planning phase enabled communities to identify and designate areas for conservation, completed prior to this monitoring period. Conservation areas were formalized as VLFRs following Sections 32–35 of the National Forest Act, CAP 323, and the National Guidelines for Community-Based Forest Management. Many villages had established VLFRs earlier, but during this monitoring period, VCSL

collaborated with Local Authorities and Villages to revise VLFR boundaries using GIS, remote sensing and ground truthing. These revisions addressed encroachments and identified opportunities for expansion, prioritizing grazing, water source protection, and beekeeping areas. Heavily encroached polygons were removed to avoid potential conflicts with farmers, while ensuring the efforts concentrated into areas with potential for reducing deforestation and forest degradation, thereby generate tradable VER units

Maps outlining proposed changes were shared in Village Council meetings and uploaded to Mergin Maps for verification by the village forest patrol teams. Patrols engaged affected individuals, including farmers and residents living inside or near reserves, to address concerns. In some cases, like Mhenda (Kilosa), communities proposed additional forest areas, while in others, such as Mbondo (Nachingwea), portions of proposed expansions were rejected by both village councils and general assemblies.

For VLFRs in Mkanga 1, Nandambi (Lindi), Ihombwe and Msimba (Kilosa), which were moved to Municipality and Township respectively, sub-village consultative meetings were held to secure consent for creating Community-Based Organizations (CBOs), developing constitutions, electing leaders, and formalizing boundary adjustments.

To enhance inclusivity, community members were hired to create boundary cutlines in 14 villages, demonstrating the project's commitment to extend this effort across the entire project area. Patrol teams marked new VLFR boundaries with visible paint. The process emphasized dialogue, transparency, and consensus-building, culminating in obtaining endorsement of Village Councils, and General Assemblies for the revised VLFR maps, and approval of the bylaws of the new VLFRs by the Full Council of the Local Authority in Nachingwea.

To obtain approval for the carbon trade contract, VCSL initiated the process by introducing the project to district and village councils. VCSL collaborated with District Forest Officers to present the idea to 60 communities, attended by 1,610 members (507 female, 1,103 male, and 259 youth). This was followed by general assemblies in the same villages, with 5,456 participants (2,270 female, 3,186 male, and 886 youth).

	The initial draft of the long-term contract was developed on February 6–7, 2024, with input from 12 Legal and Forest Officers (2 female, 10 male) from Nachingwea, Mtama, Lindi Municipality, Mvomero, Morogoro Rural, and Kilosa Local Authorities. It underwent detailed review on May 22–24, 2024, by 15 officers (5 female, 10 male) from PO-RALG, VPO-DoE, Regional Secretariats, and respective Local Authorities. Between February and June 2024, VCSL presented the draft contract at Village Council meetings attended by 1,815 members (549 female, 1,266 male, and 183 youth) and Village and CBO general meetings attended by 4,991 members (1,761 female, 3,230 male, and 900 youth). Local Authority meetings were attended by 609 Councilors and Council Management team members (170 female, 439 male). These meetings approved the project progress report, carbon trade contract, and final maps of old and new VLFRs.
Outcome of FPIC	Outcome of the FPIC Process and Transparent Agreements were as follows: Approved Revision Maps and Forest Management Plans: Revised maps removed heavily encroached polygons (7811 ha of VLFRs and 12388 ha from proposed Ndonda WMA) to avoid displacement of encroachers, while expanding VLFRs by 97,919 hectares, including the three new VLFRs. These changes were endorsed by Village Councils, General Assemblies, and local authorities. Approved Carbon Trade Contract: VCSL secured approval for a 40-year carbon trade contract with Village Councils, general assemblies, five CBOs, seven Local Government Authorities, and the University of Dar es Salaam. Registered Carbon Trade Project: Community consent enabled the registration of the Project Idea Note and Project Concept Note. VCSL secured a Letter of No Objection and submitted the Project Document to the Designated National Authority for a Letter of Endorsement. Information Disclosure and Assurance To obtain community FPIC, the following information was disclosed. Knowledge on REDD Principles: VCSL trained Village Councils, Village Natural Resource Committees, and Local Authority Councilors on REDD, emphasizing incentives for protecting natural forests over 10

years old, achieving measurable impacts on reducing deforestation, forest degradation, and emissions, while prioritizing community benefits. The initiative requires proof of long-term forest protection and a minimum 40-year carbon trade commitment.

VCSL Offer: VCSL introduced cloud-based patrol technology, providing smartphones with Mergin Maps, training, and monthly payments for patrol teams to monitor deforestation. The project also supported VLFR boundary clearing in 14 villages and planned future agricultural extension services for farmers in leakage belts.

VCSL Philosophy: The project followed a no-eviction approach, removing 7,811 hectares of heavily encroached polygons from VLFRs and prioritizing education for deforestation prevention. Structured messages on conservation and REDD were shared with patrol teams for farmer engagement. Additionally, the project model permits sustainable wood harvesting for timber and charcoal, provided it does not exceed 1% of the standing biomass annually.

Carbon Trade Payments: VCSL committed to monitoring, verification, and selling VERs, with payments based on reductions in deforestation and carbon stocks relative to baselines.

Benefit Sharing: Participating authorities were informed that benefit and cost-sharing would follow GN 636 (October 28, 2022) and amendments in GN 721 (October 6, 2023). Contracts will last 40 years, with renegotiation options.

The process adhered to FPIC guidelines, ensuring no land encroachment, forced relocations, or displacements. Communities were actively involved, providing feedback and rejecting unfavorable proposals. These efforts ensured transparency, equity, and compliance with FPIC principles.

2.5.8 Property Right Protection (VCS, 3.18, 3.19; CCB, G5.3)

The project recognizes, respects, and supports all property rights through various approaches. First, it assisted village councils in identifying and reserving additional forests outside existing Village Land Forest Reserves (VLFRs), transforming these areas from open access forests (controlled by state) to communal property (controlled by local communities). During this monitoring period, 97,919 hectares of natural forests, including three new VLFRs established with the project's support, benefited from this initiative. Conversely, the project promotes a no-eviction philosophy for people who have encroached on the VLFRs before 2023 when VCSL introduced the improved forest patrol system. In heavily encroached patches covering 7,811 hectares in existing VLFRs and 12,388 ha in the proposed Ndonda WMA, the project collaborated

with Local Authorities and Villages to exclude these areas from the VLFRs, allowing smallholder farmers to continue farming without jeopardizing their property rights. For those farming within the remaining reserves, the project's philosophy permits them to stay in the reserve provided they refrain from causing new forest clearing. During this monitoring period, the project instructed patrol teams to educate these farmers about their illegal deforestation activities within reserved areas, emphasizing that they would not face eviction or other legal penalties unless they cleared additional natural trees older than 10 years. Despite the warnings, new deforestation has continued in some places and villages may start to evict some farmers as a result, though none have occurred so far. Instead, the next step in enforcement is fines. According to patrol data from Mergin Maps, rule breakers were fined a total of 3,053,000 TSH during this monitoring period.

To further secure statutory rights, the project will facilitate the gazetting of all VLFRs through the Ministry of Natural Resources and Tourism. Additionally, the project plans to promote the issuance of Certificates of Customary Rights of Occupancy (CCROs) to individual households, particularly those residing in the leakage belt, to secure their statutory land rights. This will be achieved by encouraging villages to prioritize the use of their carbon revenues to support the CCRO issuance process, starting with revenues generated during this monitoring period.

2.5.9 Identification of Illegal Activity (VCS, 3.19, CCB, G5.4)

Possible illegal activities that could negatively impact the project include land clearing for farming, illegal wood harvesting for charcoal and timber, and arson. These actions undermine the potential for generating carbon credits, preventing the realization of project benefits. During the monitoring period, the project employed cloud-based patrol technology and provided consistent funding to patrol teams to address these challenges. By June 2024, forest patrol teams had recorded 4,853 forest disturbance agent entries in the Mergin Map system. Disturbance agents were educated to cease deforestation activities, and fines were imposed in cases of repeated offenses.

The project also supported boundary marking to deter or promptly address illegal activities. Sixteen villages in Kilosa and Lindi were assisted in creating cutlines where VLFRs border residential and agricultural areas, while 15 villages in Nachingwea were supported in marking boundaries with color paint.

To prevent forest fires, the project will implement early burning measures to reduce fuel loads along forest edges, thereby limiting fire intensity and spread within the project area. Furthermore, the project adheres to the Ten Principles of the UN Global Compact, ensuring that no victims of human trafficking, forced labor, or child labor are involved in its operations, as outlined on the UN Global Compact website.

2.5.10 Ongoing Disputes (VCS, 3.18, 3.19; CCB, G5.5)

The entire project area currently has no disputes over land, territory, or resource rights. During the second phase of the project, potential disputes were identified and resolved, particularly in

gazetted Village Land Forest Reserves (VLFRs) that had been encroached upon and consistently farmed. During the monitoring period, disputes could have arisen with farmers accused of deforestation, and conflict was anticipated if eviction attempts were made. To prevent such conflicts, the project's approach has been to avoid evictions and prioritize other legal penalties if these individuals cause to further deforestation. Additionally, to better clarify boundaries and reduce potential disputes, during the monitoring period, the project collaborated with managing authorities to remove 7,811hectares of heavily encroached areas from village forest reserves, revise boundaries to better align with visible ground features and supported 14 villages to create clear-cut lines along forest boundaries.

3 CLIMATE

3.1 Monitoring GHG Emission Reductions and Removals

3.1.1 Data and Parameters Available at Validation (VCS, 3.16)

Note that this methodology potentially has hundreds of parameters available at validation, but many are not used to calculate the baseline, project or leakage emissions, or are simply summaries of combinations of other parameters which are not used elsewhere in the methodology. Others are fixed defaults provided by the methodology. The parameters listed here are those which are not fixed defaults, and which are necessary to repeat the calculations baseline, project and leakage emissions. They are listed in order of appearance in the methodological annex.

Data / parameter	wd_j
Data unit	tCO_2e/ha
Description	Wood density for species *j*.
Source of data	BIOMASS package in R.
Value applied	See VCSL_density and COFOREST_density_sheets in VCSL_COFOREST_Biomass_Plot_Forms_Merged_Final.xlsx
Justification of choice of data or description of measurement methods and procedures applied	Calculated by the BIOMASS package in R which matches species or genus names to species, genus, or family average wood density values from published literature.
Purpose of data	Calculation of baseline, project, and leakage emissions

Comments	Only used for plots in lowland forest where the allometric equation that includes wood density is more accurate.

Data / parameter	rs_j
Data unit	tCO_2e/ha
Description	Root to shoot ratio for species *j*.
Source of data	Mokany, K., Raison, R. J., & Prokushkin, A. S. (2006). Critical analysis of root: shoot ratios in terrestrial biomes. Global change biology, 12(1), 84-96.
Value applied	0.27
Justification of choice of data or description of measurement methods and procedures applied	Lower bound of the root to shoot ratio for tropical dry forests with > 20t/ha. IPCC 2019 refinement provides a much higher root to shoot value for tropical dry forests in Africa but has very high uncertainty.
Purpose of data	Calculation of baseline, project, and leakage emissions
Comments	Only used for plots in lowland forest where there was no reliable allometric equation to directly calculate belowground biomass.

Data / parameter	*EI*
Data unit	%
Description	Ex ante estimated Effectiveness Index (%)
Source of data	Previous project experience
Value applied	35-75%
Justification of choice of data or description of measurement methods and procedures applied	The initial effectiveness is based on experience from the first year of the first project instance. Effectiveness is then expected to increase over 3 years to eventually reach 75% once all project activities are being implemented on a regular basis.
Purpose of data	Calculation of ex-ante project emissions
Comments	

Data / parameter	DLF
Data unit	%
Description	Displacement leakage factor (%)
Source of data	Previous project experience and future projections
Value applied	15%
Justification of choice of data or description of measurement methods and procedures applied	Project did not have any leakage previously but was also not very effective. With regular REDD income and implementing the new project activities, effectiveness will increase, as will the potential for displacement leakage. Project leakage prevention activities will reach nearly every deforestation agent, but some leakage is still possible.
Purpose of data	Calculation of baseline emissions
Comments	

3.1.2 Data and Parameters Monitored (VCS, 3.16)

The parameters listed below comprise all data and parameters monitored during the project crediting period that are used to quantify emission reductions in Section 3.2. Parameters from Section 9.1 of VM0015 v1.2 that are not listed here are either: (a) intermediate calculations derived from the parameters listed below; (b) cumulative summations of annually monitored parameters listed below; or (c) applicable only to project modules or activities not implemented under this project.

Data / parameter	$ABSLRR_{i,t}$
Data unit	ha
Description	Annual area of baseline deforestation in stratum *i* within the reference region at year *t* (ha/yr)
Source of data	See section 4.1 of the methodological annex
Description of measurement methods and procedures to be applied	Calculated by applying the risk density map approach to the updated historical reference period at the beginning of each new baseline validity period, following the approach described in section 4.1 of the methodological annex.

Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See VM0015 Table 9 in the methodological annex
Monitoring equipment	Remote sensing tools (QGIS, JAXA PALSAR mosaics, Dinamica EGO)
QA/QC procedures to be applied	Bias correction of the deforestation estimate using the approach described in section 4.1 of the methodological annex. Cross-checking results against prior baseline period estimates.
Purpose of data	Calculation of baseline emissions
Calculation method	Calculated by dividing the bias corrected estimate of historical reference period deforestation (Table 36 in methodological annex) by the length of the historical reference period in years (12 years).
Comments	

Data / parameter	$ABSLPA_{icl,t}$
Data unit	ha
Description	Annual area of baseline deforestation in initial forest class icl within the project area at year *t* (ha/yr)
Source of data	See section 4.2.3 of the methodological annex
Description of measurement methods and procedures to be applied	Calculated by summing pixel values in the updated risk density map for each initial forest type within the project area at the beginning of each new baseline validity period, following the approach described in section 4.2.3 of the methodological annex.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See VM0015 Table 14 in the methodological annex
Monitoring equipment	Remote sensing tools (QGIS, JAXA PALSAR mosaics, Dinamica EGO)
QA/QC procedures to be applied	Ensure that the risk density map covers the full project area and that pixel values are summed correctly within each initial forest class stratum.

Purpose of data	Calculation of baseline emissions
Calculation method	Calculated by summing the pixel values in the risk density map for each initial forest type within the project area.
Comments	

Data / parameter	$ABSLLK_{icl,t}$
Data unit	ha
Description	Annual area of baseline deforestation in initial forest class icl within the leakage belt at year *t* (ha/yr)
Source of data	See section 4.2.3 of the methodological annex
Description of measurement methods and procedures to be applied	Calculated by summing pixel values in the updated risk density map for each initial forest type within the leakage belt at the beginning of each new baseline validity period, following the approach described in section 4.2.3 of the methodological annex.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See VM0015 Table 15 in the methodological annex
Monitoring equipment	Remote sensing tools (QGIS, JAXA PALSAR mosaics, Dinamica EGO)
QA/QC procedures to be applied	Ensure that the risk density map covers the full leakage belt area and that pixel values are summed correctly within each initial forest class stratum.
Purpose of data	Calculation of baseline emissions
Calculation method	Calculated by summing the pixel values in the risk density map for each initial forest type within the leakage belt.
Comments	

Data / parameter	Cab_{icl}
Data unit	tCO_2e/ha
Description	Average carbon stock per hectare in aboveground biomass carbon pool of initial forest class icl
Source of data	Stratified forest plot data. See section 6.1 of the methodological annex and carbon_stocks.xls

Description of measurement methods and procedures to be applied	Forest biomass plots are measured and analysed using the equations and approaches described in section 6.1 of the methodological annex. Plots are stratified by initial forest class and the average carbon stock per hectare is calculated for each stratum.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See VM0015 Table 25 in methodological annex
Monitoring equipment	Field measurement equipment (diameter tapes, clinometers, GPS units); R software (BIOMASS package) for allometric calculations
QA/QC procedures to be applied	Target precision of less than 10% uncertainty at the 90% confidence interval for aboveground forest carbon stock estimates, as per VM0015. QA/QC procedures described in section 6.1 of the methodological annex.
Purpose of data	Calculation of baseline, project, and leakage emissions
Calculation method	Calculated using the equations listed section 6.1 of the methodological annex depending on the plot forest type.
Comments	

Data / parameter	Cbb_{icl}
Data unit	tCO_2e/ha
Description	Average carbon stock per hectare in belowground biomass carbon pool of initial forest class icl
Source of data	Stratified forest plot data. See section 6.1 of the methodological annex and carbon_stocks.xls
Description of measurement methods and procedures to be applied	Forest biomass plots are measured and analysed using the equations and approaches described in section 6.1 of the methodological annex. Belowground biomass is estimated using root-to-shoot ratios or direct allometric equations as appropriate for the plot forest type.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See VM0015 Table 25 in methodological annex

Monitoring equipment	Field measurement equipment (diameter tapes, clinometers, GPS units); R software (BIOMASS package) for allometric calculations
QA/QC procedures to be applied	Target precision of less than 10% uncertainty at the 90% confidence interval for belowground forest carbon stock estimates, as per VM0015. QA/QC procedures described in section 6.1 of the methodological annex.
Purpose of data	Calculation of baseline, project, and leakage emissions
Calculation method	Calculated using the equations listed section 6.1 of the methodological annex depending on the plot forest type.
Comments	

Data / parameter	Cab_{fcl}
Data unit	tCO_2e/ha
Description	Average carbon stock per hectare in aboveground biomass carbon pool of final post-deforestation class fcl
Source of data	Stratified forest plot data. See section 6.1 of the methodological annex and carbon_stocks.xls
Description of measurement methods and procedures to be applied	Post-deforestation biomass plots are measured and analysed using the equations and approaches described in section 6.1 of the methodological annex. Plots are stratified by post-deforestation class and the average carbon stock per hectare is calculated for each stratum.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See VM0015 Table 26 in methodological annex
Monitoring equipment	Field measurement equipment (diameter tapes, clinometers, GPS units); R software (BIOMASS package) for allometric calculations
QA/QC procedures to be applied	Where the target precision of 10% uncertainty at the 90% confidence interval is not achieved, estimates are adjusted for uncertainty as per VM0015. QA/QC procedures described in section 6.1 of the methodological annex.
Purpose of data	Calculation of baseline, project, and leakage emissions
Calculation method	Calculated using the equations listed section 6.1 of the methodological annex depending on the plot forest type.

Comments	

Data / parameter	Cbb_{fcl}
Data unit	tCO_2e/ha
Description	Average carbon stock per hectare in belowground biomass carbon pool of final post-deforestation class fcl
Source of data	Stratified forest plot data. See section 6.1 of the methodological annex and carbon_stocks.xls
Description of measurement methods and procedures to be applied	Post-deforestation biomass plots are measured and analysed using the equations and approaches described in section 6.1 of the methodological annex. Belowground biomass for post-deforestation classes is estimated using root-to-shoot ratios or allometric equations as appropriate.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See VM0015 Table 26 in methodological annex
Monitoring equipment	Field measurement equipment (diameter tapes, clinometers, GPS units); R software (BIOMASS package) for allometric calculations
QA/QC procedures to be applied	Where the target precision of 10% uncertainty at the 90% confidence interval is not achieved, estimates are adjusted for uncertainty as per VM0015. QA/QC procedures described in section 6.1 of the methodological annex.
Purpose of data	Calculation of baseline, project, and leakage emissions
Calculation method	Calculated using the equations listed section 6.1 of the methodological annex depending on the plot forest type.
Comments	

Data / parameter	$\Delta Cab_{icl,t}$
Data unit	tCO_2e/ha
Description	Average change in carbon stock per hectare in aboveground biomass carbon pool in initial forest class I in year t
Source of data	VM0015 Table 25 in methodological annex

Description of measurement methods and procedures to be applied	Derived from updated Cab_{icl} values obtained from forest biomass plots at the beginning of each new baseline validity period. All aboveground stock assumed to be lost immediately during deforestation as per the methodology.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See versions of VM0015 Table 33 in methodological annex
Monitoring equipment	Derived from field measurement data and allometric calculations; no additional equipment required beyond that used for Cab_{icl}
QA/QC procedures to be applied	Values cross-checked against previous baseline period estimates. QA/QC procedures for the underlying Cab_{icl} values apply.
Purpose of data	Calculation of baseline, project, and leakage emissions
Calculation method	All aboveground stock assumed to be lost immediately during deforestation as per the methodology.
Comments	

Data / parameter	$\Delta Cbb_{icl,t}$
Data unit	tCO_2e/ha
Description	Average change in carbon stock per hectare in belowground biomass carbon pool in initial forest class I in year t
Source of data	Table VM0015 Table 25 in methodological annex
Description of measurement methods and procedures to be applied	Derived from updated Cbb_{icl} values obtained from forest biomass plots at the beginning of each new baseline validity period. As per the methodology, 1/10 of initial belowground biomass is expected to be lost per year post deforestation.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See versions of VM0015 Table 33 in methodological annex
Monitoring equipment	Derived from field measurement data and allometric calculations; no additional equipment required beyond that used for Cbb_{icl}
QA/QC procedures to be applied	Values cross-checked against previous baseline period estimates. QA/QC procedures for the underlying Cbb_{icl} values apply.

Purpose of data	Calculation of baseline, project, and leakage emissions
Calculation method	As per the methodology, 1/10 of initial belowground biomass is expected to be lost per year post deforestation
Comments	

Data / parameter	$\Delta Cab_{fcl,t}$
Data unit	tCO_2e/ha
Description	Average change in carbon stock per hectare in aboveground biomass carbon pool in final post-deforestation class in year t
Source of data	VM0015 Table 26 in methodological annex
Description of measurement methods and procedures to be applied	Derived from updated Cab_{fcl} values from post-deforestation biomass plots at the beginning of each new baseline validity period. Assumed to accumulate at 1/10 of final average post-deforestation stock per year. Adjusted for uncertainty by adding 10% error at the 90% confidence interval for the project area and subtracting for the leakage belt.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See versions of VM0015 Table 33 in methodological annex
Monitoring equipment	Derived from field measurement data and allometric calculations; no additional equipment required beyond that used for Cabfcl
QA/QC procedures to be applied	Values cross-checked against previous baseline period estimates. Uncertainty adjustments applied per VM0015 where target precision is not achieved.
Purpose of data	Calculation of baseline, project, and leakage emissions
Calculation method	As per the methodology, assumed to accumulate at 1/10 of final average post deforestation stock per year post deforestation. Adjusted for uncertainty by adding 10% error at the 90% confidence interval for project area and subtracting for the leakage belt.
Comments	

Data / parameter	$\Delta Cbb_{fcl,t}$

Data unit	tCO_2e/ha
Description	Average change in carbon stock per hectare in belowground biomass carbon pool in final post-deforestation class in year t
Source of data	VM0015 Table 26 in methodological annex
Description of measurement methods and procedures to be applied	Derived from updated Cbb_{fcl} values from post-deforestation biomass plots at the beginning of each new baseline validity period. Assumed to accumulate at 1/10 of final average post-deforestation stock per year. Adjusted for uncertainty by adding 10% error at the 90% confidence interval for the project area and subtracting for the leakage belt.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See versions of VM0015 Table 33 in methodological annex
Monitoring equipment	Derived from field measurement data and allometric calculations; no additional equipment required beyond that used for Cbb_{fcl}
QA/QC procedures to be applied	Values cross-checked against previous baseline period estimates. Uncertainty adjustments applied per VM0015 where target precision is not achieved.
Purpose of data	Calculation of baseline, project, and leakage emissions
Calculation method	As per the methodology, assumed to accumulate at 1/10 of final average post deforestation stock per year post deforestation. Adjusted for uncertainty by adding 10% error at the 90% confidence interval for project area and subtracting for the leakage belt.
Comments	

Data / parameter	$\Delta CBSLPA_t$
Data unit	tCO_2e
Description	Total baseline carbon stock change within the project area at year *t* (t CO_2e)
Source of data	VM0015 Table 36 in methodological annex
Description of measurement methods and procedures to be applied	Recalculated at the beginning of each new baseline validity period using updated values of ABSLPAicl,t, ΔCabicl,t, ΔCbbicl,t, ΔCabfcl,t, and ΔCbbfcl,t in VM0015 Equation 10.

Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See VM0015 Table 64 in methodological annex
Monitoring equipment	Derived calculation from other monitored parameters; no additional equipment required
QA/QC procedures to be applied	Results cross-checked against previous baseline period estimates and reviewed for consistency with input parameters.
Purpose of data	Calculation of baseline emissions
Calculation method	Calculated with VM0015 Equation 10 in methodological annex
Comments	

Data / parameter	$\Delta CBSLLK_t$
Data unit	tCO_2e
Description	Total baseline carbon stock change within the Leakage Belt at year *t* (t CO_2e)
Source of data	VM0015 Table 37 in methodological annex
Description of measurement methods and procedures to be applied	Recalculated at the beginning of each new baseline validity period using updated values of ABSLLKicl,t, ΔCabicl,t, ΔCbbicl,t, ΔCabfcl,t, and ΔCbbfcl,t in VM0015 Equation 10.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See VM0015 Table 63 in methodological annex
Monitoring equipment	Derived calculation from other monitored parameters; no additional equipment required
QA/QC procedures to be applied	Results cross-checked against previous baseline period estimates and reviewed for consistency with input parameters.
Purpose of data	Calculation of baseline emissions
Calculation method	Calculated with VM0015 Equation 10 in methodological annex

Comments	

Data / parameter	$Fburnt_{icl}$
Data unit	%
Description	Proportion of forest area burned during the historical reference period in forest class *icl* (%)
Source of data	Table 24 in the methodological annex
Description of measurement methods and procedures to be applied	Estimated from the project's updated disturbance data at the beginning of each new baseline validity period as being proportionate to the percent of forest disturbances where agriculture was a driver of deforestation, since slash-and-burn is the standard practice for all agriculture in the baseline scenario.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See VM0015 Table 41
Monitoring equipment	Remote sensing tools used to map disturbance data during the updated historical reference period
QA/QC procedures to be applied	Values cross-checked against previous baseline period estimates and consistency with observed fire occurrence in the historical reference period.
Purpose of data	Calculation of baseline emissions, project and leakage emissions
Calculation method	Estimated from the project's disturbance data (Table 24) as being proportionate to the percent of forest disturbances where agriculture was a driver of deforestation since slash-and-burn is the standard practice for all agriculture in the baseline scenario
Comments	

Data / parameter	$Pburnt_{icl}$
Data unit	%
Description	Proportion of forest area burned during the historical reference period in forest class *icl* (%)
Source of data	VM0015 Table 25 and VM0015 Table 26

Description of measurement methods and procedures to be applied	Estimated as the difference between updated starting AGB (Cab_{icl}) and uncertainty-adjusted long-term average post-deforestation AGB (Cab_{fcl}) in each forest class at the beginning of each new baseline validity period.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See VM0015 Table 41
Monitoring equipment	Derived from field biomass measurement data; no additional equipment required
QA/QC procedures to be applied	Values cross-checked against previous baseline period estimates and consistency with updated carbon stock data.
Purpose of data	Calculation of baseline emissions, project, and leakage emissions
Calculation method	Estimated as the difference between starting AGB and uncertainty adjusted long term average post deforestation AGB in each forest class
Comments	

Data / parameter	$ERCH_4$, ERN_2O, NCR, $CE_{p,icl}$
Data unit	dimensionless
Description	Emission ratio for CH4 ($ERCH_4$ = 0.012), emission ratio for N_2O (ERN_2O = 0.007), nitrogen to carbon ratio (NCR = 0.01), and combustion efficiency by carbon pool p and forest class icl ($CE_{p,icl}$; default 0.5 where no pool-specific value is available). Used in VM0015 Equations 12, 13, and 14.
Source of data	IPCC default values as specified in VM0015 v1.2. Combustion efficiencies are sourced from IPCC GPG LULUCF Table 3.A.14 and since the table does not cover the project scenario, the VM0015 default of 0.5 is applied.
Description of measurement methods and procedures to be applied	Default values are taken directly from the IPCC guidelines as referenced in VM0015 v1.2. Values are reviewed at the beginning of each new baseline validity period to confirm they remain current under the applicable methodology version.
Frequency of monitoring/recording	Each renewal of baseline validity period
Value applied	$ERCH_4$ = 0.012; ERN_2O = 0.007; NCR = 0.01; $CE_{p,icl}$ = 0.5

Monitoring equipment	No equipment required; values sourced from IPCC guidelines and VM0015 v1.2
QA/QC procedures to be applied	Cross-check against current version of VM0015 and any applicable Verra errata or clarifications at each baseline renewal to confirm values remain unchanged.
Purpose of data	Calculation of baseline, project, and leakage non-CO_2 emissions from biomass burning
Calculation method	Applied directly in VM0015 Equations 12, 13, and 14
Comments	These are fixed IPCC and methodology defaults considered unlikely to change independently of a methodology revision. They are listed here for completeness.

Data / parameter	GWP_{CH4}, GWP_{N2O}
Data unit	dimensionless
Description	100-year global warming potential for CH4 (GWP_{CH4}) and N2O (GWP_{N2O}), used to convert non-CO_2 biomass burning emissions to CO2e in VM0015 Equations 12 and 13.
Source of data	IPCC Fifth Assessment Report (AR5), as required by VCS Standard v4.7 for reductions and removals occurring on or after 1 January 2021.
Description of measurement methods and procedures to be applied	GWP values are determined by the IPCC assessment report specified in the applicable version of the VCS Standard. Values are reviewed at the beginning of each new baseline validity period to confirm that the correct IPCC assessment report is being applied per the current VCS Standard requirements.
Frequency of monitoring/recording	Each renewal of baseline validity period
Value applied	GWP_{CH4} = 28; GWP_{N2O} = 265 (AR5 values, applied per VCS Standard v5 for the 2022–2028 baseline validity period)
Monitoring equipment	No equipment required; values sourced from IPCC AR5
QA/QC procedures to be applied	Cross-check against the current VCS Standard at each baseline renewal to confirm the applicable IPCC assessment report and corresponding GWP values. Note that VCS Standard v5 requires AR5 values for all reductions and removals occurring on or after 1 January 2021.
Purpose of data	Calculation of baseline, project, and leakage non-CO2 emissions from biomass burning
Calculation method	Applied directly in VM0015 Equations 12 and 13

Comments	VM0015 v1.2 references IPCC first assessment report / AR2 GWP defaults (GWP_{CH4} = 21, GWP_{N2O} = 310). However, VCS Standard v4.7 explicitly requires AR5 GWP values for reductions and removals occurring on or after 1 January 2021, which supersedes the methodology defaults. AR5 values (GWP_{CH4} = 28, GWP_{N2O} = 265) are therefore applied for this and all subsequent baseline validity periods. This also necessitates recalculation of all non-CO_2 biomass burning emission estimates relative to values that would have been obtained using the AR2 defaults stated in VM0015 v1.2.

Data / parameter	$EBBtot_{icl}$
Data unit	t CO_2e / ha
Description	Total GHG emissions from biomass burning in forest class *icl* in year *t* (t CO_2e/ha)
Source of data	Calculated
Description of measurement methods and procedures to be applied	Recalculated at the beginning of each new baseline validity period using updated values of Fburnt and Pburnt with VM0015 Equation 11.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See VM0015 Table 41
Monitoring equipment	Derived calculation from other monitored parameters; no additional equipment required
QA/QC procedures to be applied	Results cross-checked against previous baseline period estimates and reviewed for consistency with Fburnt and Pburnt input values.
Purpose of data	Calculation of baseline emissions, project, and leakage emissions
Calculation method	See VM0015 Equation 11
Comments	

Data / parameter	$EBBBSLPA_t$
Data unit	tCO_2e
Description	Sum of (or total) baseline non-CO_2 emissions from forest fires at year *t* in project area

Source of data	See VM0015 Table 41
Description of measurement methods and procedures to be applied	Recalculated at the beginning of each new baseline validity period using updated values of ABSLPAicl,t and EBBtoticl in VM0015 Table 42.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See VM0015 Table 42
Monitoring equipment	Derived calculation from other monitored parameters; no additional equipment required
QA/QC procedures to be applied	Results cross-checked against previous baseline period estimates and reviewed for consistency with ABSLPA and EBBtot input values.
Purpose of data	Calculation of baseline emissions
Calculation method	Calculated in VM0015 Table 42
Comments	

Data / parameter	$EBBBSLLK_t$
Data unit	tCO_2e
Description	Sum of (or total) baseline non-CO_2 emissions from forest fires at year *t* in Leakage Belt
Source of data	See VM0015 Table 41
Description of measurement methods and procedures to be applied	Recalculated at the beginning of each new baseline validity period using updated values of ABSLLKicl,t and EBBtoticl in VM0015 Table 42.
Frequency of monitoring/recording	Updated at the beginning of each new baseline validity period
Value applied	See VM0015 Table 42
Monitoring equipment	Derived calculation from other monitored parameters; no additional equipment required

QA/QC procedures to be applied	Results cross-checked against previous baseline period estimates and reviewed for consistency with ABSLLK and EBBtot input values.
Purpose of data	Calculation of baseline emissions
Calculation method	Calculated in VM0015 Table 42
Comments	

Data / parameter	$\Delta CPAdPA_t$
Data unit	t CO_2e
Description	Cumulative decrease in carbon stock due to all planned activities at year *t* in project area
Source of data	Project boundary clearing records
Description of measurement methods and procedures to be applied	Mapping the boundaries that require clearing is done by Reterra Ltd using project boundaries and visual interpretation of recent high resolution satellite imagery. Boundary clearing records are then recorded by extension officers in the project's Mergin maps Patrol_Data project. The stock changes associated with these clearings are then calculated using an ex-post version of VM0015 Table 43 in the methodological annex where significant.
Frequency of monitoring/recording	Annually. However, changes are assumed to be permanent and thus only accounted for the first time a particular boundary area is cleared.
Value monitored	0 – the length of boundary clearing during this monitoring period did not exceed the planned clearing in the PD which was demonstrated to cause insignificant emissions.
Monitoring equipment	Remote sensing for the boundary mapping and mobile phones for the clearing records
QA/QC procedures to be applied	Ensure that each boundary to be cleared is mapped accurately by comparing to the latest high-resolution imagery and filtering clearing records by unique values to make sure that each boundary section is only counted once in the first year that it is cleared.

Purpose of data	Calculation of project emissions
Calculation method	See VM0015 Table 43 in the methodological annex
Comments	

Data / parameter	$\Delta CUDdPA_t$
Data unit	t CO_2e
Description	Total actual carbon stock change due to unavoided unplanned deforestation at year t in project area
Source of data	Estimated unplanned deforestation at year *t* in the project area in each initial forest class and baseline the emissions factors for deforestation in the project area for each class from VM0015 Table 33 in the methodological annex.
Description of measurement methods and procedures to be applied	The procedure for monitoring unplanned deforestation ex-post will follow VMD0055 and is described in section 7.2.1 of the methodological annex. These are then combined with the emissions factors for the project area from VM0015 Table 33 to create VM0015 Ex-Post Table 47 for unplanned deforestation.
Frequency of monitoring/recording	Annually
Value monitored	See VM0015 Ex-Post Table 47
Monitoring equipment	Remote sensing done in QGIS using Planet.com basemaps for monitoring changes in sample points.
QA/QC procedures to be applied	Sample size must be sufficient to achieve a total deforestation estimate for the project area and leakage belt which has below 20% error at the 90% confidence interval. Where there appears to be a shift in the Planet.com imagery near the edge of deforestation, Sentinel-2 imagery is used to determine whether the sample pixel is affected.

Purpose of data	Calculation of project emissions
Calculation method	Ex post version of VM0015 Table 43 in the methodological annex
Comments	

Data / parameter	$EBBPSPA_t$
Data unit	t CO_2e
Description	Sum of actual non-CO_2 emissions from forest fires at year t in project area
Source of data	Areas of estimated unplanned deforestation in each forest class and $EBBtot_{icl}$ for each class from VM0015 Table 41.
Description of measurement methods and procedures to be applied	The procedure for monitoring unplanned deforestation ex-post will follow VMD0055 and is described in section 7.2.1 of the methodological annex. These are then combined with the emissions factors for non-CO2 emissions from biomass burning in the project area VM0015 Table 41.
Frequency of monitoring/recording	Annually
Value monitored	See VM0015 Ex-Post Table 42
Monitoring equipment	Remote sensing done in QGIS using Planet.com basemaps for monitoring changes in sample points.
QA/QC procedures to be applied	Sample size must be sufficient to achieve a total deforestation estimate for the project area and leakage belt which has below 20% error at the 90% confidence interval. Where there appears to be a shift in the Planet.com imagery near the edge of deforestation, Sentinel-2 imagery is used to determine whether the sample pixel is affected.

Purpose of data	Calculation of project emissions
Calculation method	Ex post version of VM0015 Table 42 in the methodological annex
Comments	

Data / parameter	$\Delta CADLK_t$, ΔCLK_t
Data unit	t CO_2e
Description	Since there are no stock changes associated with leakage prevention measures, total net carbon stock change due to leakage = total decrease in carbon stocks due to displaced deforestation at year *t*
Source of data	Areas of ex-post estimated actual deforestation within the leakage belt for each initial forest class, the leakage belt emissions factors from VM0015 Table 33, and baseline leakage emissions from VM0015 Table 37.
Description of measurement methods and procedures to be applied	The procedure for monitoring deforestation ex-post will follow VMD0055 and is described in section 7.2.1 of the methodological annex. Deforestation in the project area and leakage belt area both measured in this way.
Frequency of monitoring/recording	Annually
Value monitored	See VM0015 Ex-Post Table 62
Monitoring equipment	Remote sensing done in QGIS using Planet.com basemaps for monitoring changes in sample points.
QA/QC procedures to be applied	Sample size must be sufficient to achieve a total deforestation estimate for the project area and leakage belt which has below 20% error at the 90% confidence interval. Where there appears to be a shift in the Planet.com imagery near the edge of deforestation, Sentinel-2 imagery is used to determine whether the sample pixel is affected.

Purpose of data	Calculation of leakage emissions
Calculation method	The estimated area for the leakage belts is combined with the emissions factors for the leakage belt from VM0015 Table 33 to create an ex-post version of VM0015 Table 37. The ex-post results are compared to the baseline results using VM0015 Table 63 to calculate $\Delta CADLK_t$. If there is a cumulative net increase in stocks in year t, then $\Delta CADLK_t$ is set to zero for the purpose of estimating leakage.
Comments	

Data / parameter	$EADLK_t$, ELK_t
Data unit	t CO_2e
Description	Since there are no GHG emissions from leakage prevention activities, total net increase in emissions due to leakage = total ex post increase in GHG emissions due to displaced forest fires at year *t*
Source of data	Areas of ex-post estimated actual deforestation within the leakage belt for each initial forest class and non-CO_2 emissions factors from VM0015 Table 41
Description of measurement methods and procedures to be applied	The procedure for monitoring deforestation ex-post will follow VMD0055 and is described in section 7.2.1 of the methodological annex. Deforestation in the project area and leakage belt area both measured in this way,
Frequency of monitoring/recording	Annually
Value monitored	See VM0015 Ex-Post Table 62
Monitoring equipment	Remote sensing done in QGIS using Planet.com basemaps for monitoring changes in sample points.
procedures to be applied	Sample size must be sufficient to achieve a total deforestation estimate for the project area and leakage belt which has below

	20% error at the 90% confidence interval. Where there appears to be a shift in the Planet.com imagery near the edge of deforestation, Sentinel-2 imagery is used to determine whether the sample pixel is affected.
Purpose of data	Calculation of leakage emissions
Calculation method	Ex-post areas of deforestation in the leakage belt are used to create and ex-post version of VM0015 Table 42 for the leakage belt. $EADLK_t$ is the difference between the baseline and ex-post Versions.
Comments	

Data / parameter	$\Delta REDD_t$
Data unit	t CO_2e
Description	Ex post estimated net anthropogenic GHG emission reduction attributable to the AUD project activity at year *t* (t CO_2e)
Source of data	VM0015 Ex-Post Table 64
Description of measurement methods and procedures to be applied	Just a calculation from other monitored values.
Frequency of monitoring/recording	Annually
Value monitored	See VM0015 Ex-Post Table 64
Monitoring equipment	
QA/QC procedures to be applied	QA/QC procedures already applied to input data

Purpose of data	Calculation of emissions reductions
Calculation method	VM0015 Equation 19 using the values from VM0015 Ex-Post Table 64
Comments	

Data / parameter	ΔVCU_t
Data unit	t CO_2e
Description	Number of Verified Carbon Units at year *t* (t CO2e)
Source of data	VM0015 Ex-Post Table 64
Description of measurement methods and procedures to be applied	Just a calculation from other monitored values.
Frequency of monitoring/recording	Annually
Value monitored	See VM0015 Ex-Post Table 64
Monitoring equipment	
QA/QC procedures to be applied	QA/QC procedures already applied to input data
Purpose of data	Calculation of emissions reductions
Calculation method	VM0015 Equation 20 using the values from VM0015 Ex-Post Table 64
Comments	

Data / parameter	ΔVBC_t
Data unit	t CO_2e
Description	Number of buffer credits deposited in the VCS AFOLU non-permanence buffer at year *t* (t CO2e)
Source of data	VM0015 Ex-Post Table 64
Description of measurement methods and procedures to be applied	Just a calculation from other monitored values.
Frequency of monitoring/recording	Annually
Value monitored	See VM0015 Ex-Post Table 64
Monitoring equipment	
QA/QC procedures to be applied	QA/QC procedures already applied to input data
Purpose of data	Calculation of emissions reductions
Calculation method	VM0015 Equation 21 using the values from VM0015 Ex-Post Table 64
Comments	

Data / parameter	ΔRF_t
Data unit	%
Description	Risk factor used to calculate buffer credits in year *t* (%)
Source of data	AFOLU Non-Permanence Risk Tool on the Project Hub

Description of measurement methods and procedures to be applied	All sources of data from the VCS Non-Permanence Risk Report will be used to measure the various risk factors. If the risk profiles are different for different portions of the project, the risk will be calculated separately for each portion of the project. Then the deductions will be applied based on the portion of VCUs generated from that part of the project. The proportion of credits generated from each part of the project will be based on the proportion of the summed risk density map values in each project area.
Frequency of monitoring/recording	Annually
Value monitored	17% for gazetted forest reserves in project and 18% for all other project areas. Average stock change weighted value was 17.455269%%.
Monitoring equipment	
QA/QC procedures to be applied	QA/QC procedures already applied to input data
Purpose of data	Calculation of emissions reductions
Calculation method	Calculated using the AFOLU Non-Permanence Risk Tool separately for two different project area portions and then using a weighted average. See section 3.2.4.
Comments	

3.1.3 Monitoring Plan (VCS, 3.16, 3.20)

Theron Morgan-Brown, Reterra Limited's director of science oversaw all GHG monitoring activities during this monitoring period. Theron has a PhD in interdisciplinary ecology, is an expert at remote sensing and GIS, and has 14 years of REDD MRV experience. He has authored 3 validated VCS forest carbon project PDs and numerous verified VCS monitoring reports.

Monitoring of carbon stocks

Carbon stocks were assessed during this monitoring period as described in section 6.1 of the methodological annex. Future monitoring of both forest and post-deforestation stocks will occur at the end or beginning of each new baseline validity period, or in response to degradation events effecting more than 1 contiguous ha of the project area as detected by the monitoring of land-cover change described below. Where needed to improve overall accuracy new forest or post-deforestation stratifications will be applied.

Wilson Mugasha, PhD, a director in VCSL and a lecturer at Sokoine University, with 14 years' experience in biomass data collection, oversaw the collection of data from biomass plots during this monitoring period. He was supported in that work by a field team of mostly current and former students whom he trained and directly supervised for many plots with for quality assurance. That data is used in the update project document and was thus 'available at validation' and was used to estimate parameters in section 3.1.1. The collection and analysis of the data is described in section 6.1 of the methodological annex including the sampling approaches, target precision levels, samples sizes, sample site locations, stratification, and QA/QC procedures. The data, combined with other biomass plot data gathered prior to the monitor period was sufficient to achieve less than 10% uncertainty at the 90% confidence interval for above and below ground forest carbon stock estimates (see VM0015 Table 23 in the methodological annex). For post-deforestation biomass estimates, the target of 10% uncertainty at the 90% confidence interval was not achieved so the estimates were adjusted for uncertainty as per VM0015 (see VM0015 Table 26 in the methodological annex). The analysis of biomass data was conducted by Theron Morgan-Brown with some technical advice provided by Mugasha.

The project does not have a formal internal audit system. The built in QA/QC systems within the biomass plot survey form help prevent large errors and all the other monitoring work is performed by a single person. However, Theron did make efforts to confirm two extreme biomass values through reviewing high resolution imagery for plots and asking Mugasha to confirm with the field teams that plots were measured correctly. No non-conformities were identified.

As described in section 7.1.1 of the methodological annex, stock changes from planned timber and charcoal harvesting are expected to be insignificant and temporary. The potential effects of timber and charcoal harvesting on project area carbon stocks are assessed annually using data from the VCSL CCB annual community survey. The survey captures timber volumes harvested and charcoal production income from harvesting licenses issued by project villages. Survey data are available for July 2023 – June 2024; no equivalent survey was conducted for the period April 2022 – June 2023. However, given that Project Instance 2 — which comprises the majority of the project area — did not commence until February 2023, the July 2023 – June 2024 survey period is considered representative of harvesting activity across the full 2022–2024 monitoring period. There is no reason to expect that harvesting intensity during the earlier period was materially higher.

The methodology for converting survey data to AGB carbon stock impacts is described in the methodological annex in section 7.1.1 of the methodological annex using Equation 18 for timber volumes and Equation 19 for charcoal biomass. The conservative assumption that

villages are reporting round log volumes rather than whole tree volumes was applied to all of the reported timber harvesting in the CCB survey. The reported harvest among all villages was 2041 m^2 which converts to 2,916 m^2 using the conservative volume inflation assumption. For charcoal, the total revenue was reported as 230,798,000 TSH, which translates to 923.2 tons of charcoal. The resulting AGB impacts are calculated in Table 4 and Table 5, and summed and expressed as a percentage of total project AGB at the end of the monitoring period (Table 6), confirming that harvesting effects on reported carbon stocks (-0.028%) are insignificant and well below the agreed maximum harvesting rate of 1% of project area biomass specified in the project contracts with forest owners.

Table 4 Timber Harvesting — AGB Impact (July 2023 – June 2024)

Step	Value	Unit
Volume harvested (CCB survey)	2,041	m^3
Adjusted volume (30% uplift for whole-tree conversion)	2,916	m^3
AGB carbon stock impact	3,300	tCO_2e

Table 5 Charcoal Production — AGB Impact (July 2023 – June 2024)

Step	Value	Unit
Total charcoal income (CCB survey)	230,798,000	TSh
Price per kg (GN 59, 2022 regulations)	250	TSh/kg
Charcoal mass produced	923.19	tons
Kiln efficiency (wood-to-charcoal conversion)	19.25%	—
Equivalent AGB consumed	8,616	tCO_2e

Table 6 Total Harvesting Impact on Project AGB

Item	Value	Unit
AGB impact — timber harvesting	3,300	tCO_2e
AGB impact — charcoal production	8,616	tCO_2e
Total AGB harvested	11,917	tCO_2e
Total project AGB at end of monitoring period	42,854,685	tCO_2e
Harvested as % of total project AGB	0.028%	—

Monitoring of land-cover change

Land-cover change monitoring is the primary ongoing monitoring activity which must be conducted at the end of each monitoring period, which under the current plan means annual monitoring. It is the basis for estimating ex-post emissions in the project area and leakage belt. Theron Morgan-Brown of Reterra is responsible for this activity. The process is summarized in section 7.2.1 of the methodological annex. In this section, the project provides details on the process and results for this monitoring period.

Land-use and land-cover change monitoring was conducted using point interpretation of high-resolution imagery meeting the requirements VM0015, and VMD0055, which the project expects to transition to once VM0048 activity data is available for Tanzania. As per VM0015, the minimum target precision was an estimate of deforestation with less than 20% error at the 90% confidence interval to be accepted while applying a correction for uncertainty, or less than 10% error at the 90% confidence interval to be used without any correction for uncertainty.

Ideally, the project would use the same deforestation change detection mapping approach used to map deforestation during the historical reference period since any areas detected as deforested by that approach would have a very high likelihood of being deforested. Unfortunately, JAXA annual PALSAR mosaics are not released until April or May of the following year, meaning that the project wouldn't be able to map land cover change for part of 2024 until 2025. This would create an unsuitably long delay for project monitoring and reporting. However, there is no stated requirement in VM0015 that wall to wall remote sensing must be used for ongoing land-cover change monitoring. The methodology only requires the ex-post tables of land-cover change activity data be created.

Therefore, the project used the risk density map described in section 4.2.3 of the methodological annex as the basis for the stratification of land-cover monitoring reports. The risk density map has 30 risk densities. Dinamica Ego was used to calculate the number of pixels in each of the 30 risk densities falling in the project area and leakage belt. Then by multiplying the densities by the number of pixels in each density, it was possible to calculate the projected amount of baseline deforestation in the project area and leakage belt in risk density. This analysis showed that 36.4% of deforestation was projected to occur within the highest risk density. Then the projected deforestation for the next 3 highest risk densities was 34.6% while the remaining densities would have 29% of deforestation. This seemed to offer an ideal split to create the minimum 3 strata based on relative risk of deforestation required under VMD0055. However, after some interpretation, it was realized that the 3rd strata contained too broad a range of risk densities. Therefore, it was decided to split the 3rd risk strata into 2 strata with essentially equal areas.

The ideal sample size could not be calculated in advance though it was assumed that a large sample size would be required since the proportion of forest change in each risk class would be low. Thus, the project settled on 1000 sample points for each risk class for 3000 sample points.

This did not result in a deforestation uncertainty below 20% at the 90% confidence interval, so the sample sizes were expanded by 300 points, but the uncertainty was still just above 20%. At that point it was realized that splitting the last risk class into 2 strata with roughly equal areas would reduce uncertainty because the lowest risk class would have almost zero deforestation in it. Additional points were then added to the 3rd and 4th risk class to increase their sample sizes to 1000 and 900 respectively bring the total sample size to 4500 points. However, changes to the project area and leakage belt during the monitoring report revision resulted in some points falling outside the monitoring area and being excluded. Finally, as noted in the methodological deviations, one random sample point was added into a section of 316 ha of forest which was missing from the leakage belt because the risk map didn't cover the area. The final sample size was 4305 points. The point locations and details are shown in Figure 7 and Figure 8.

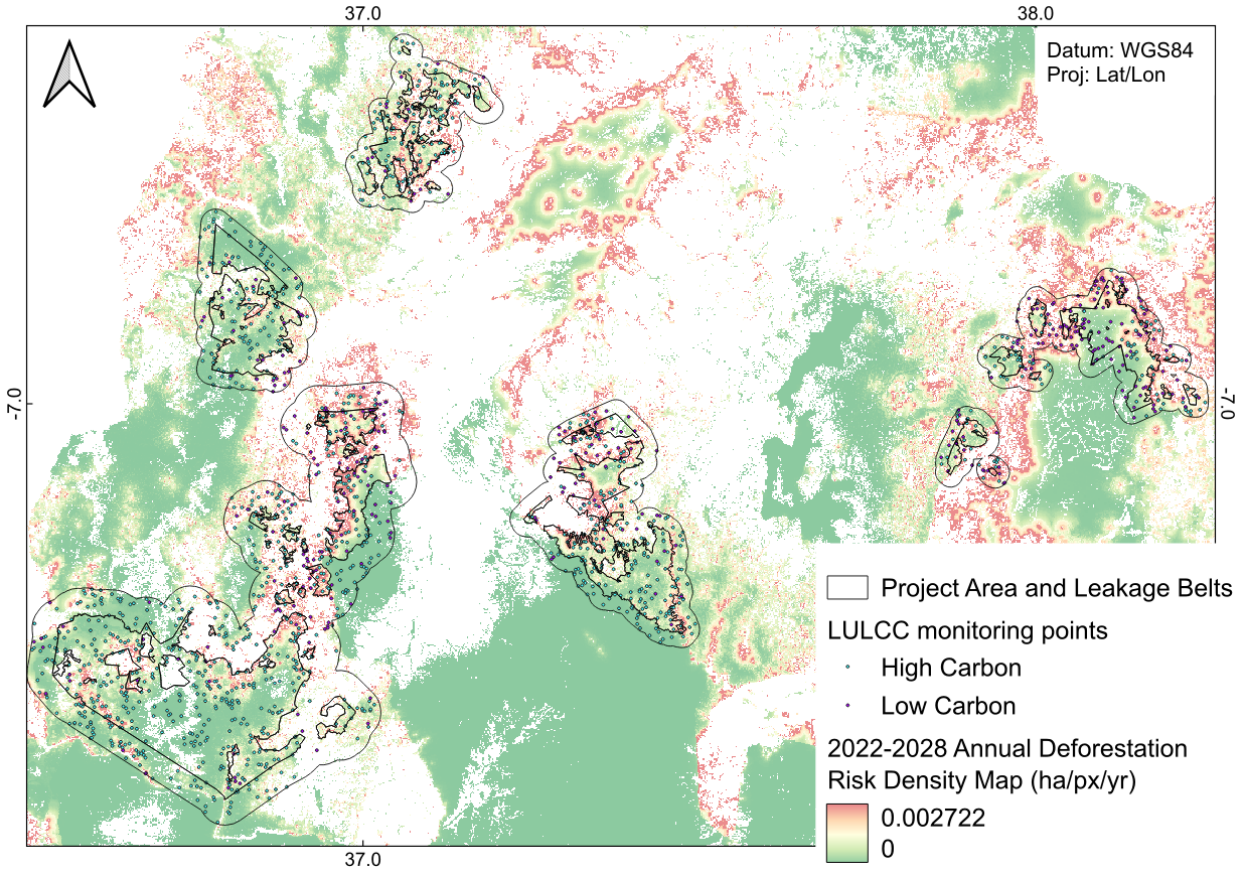


Figure 7 Location of land-cover change monitoring points in Morogoro Region

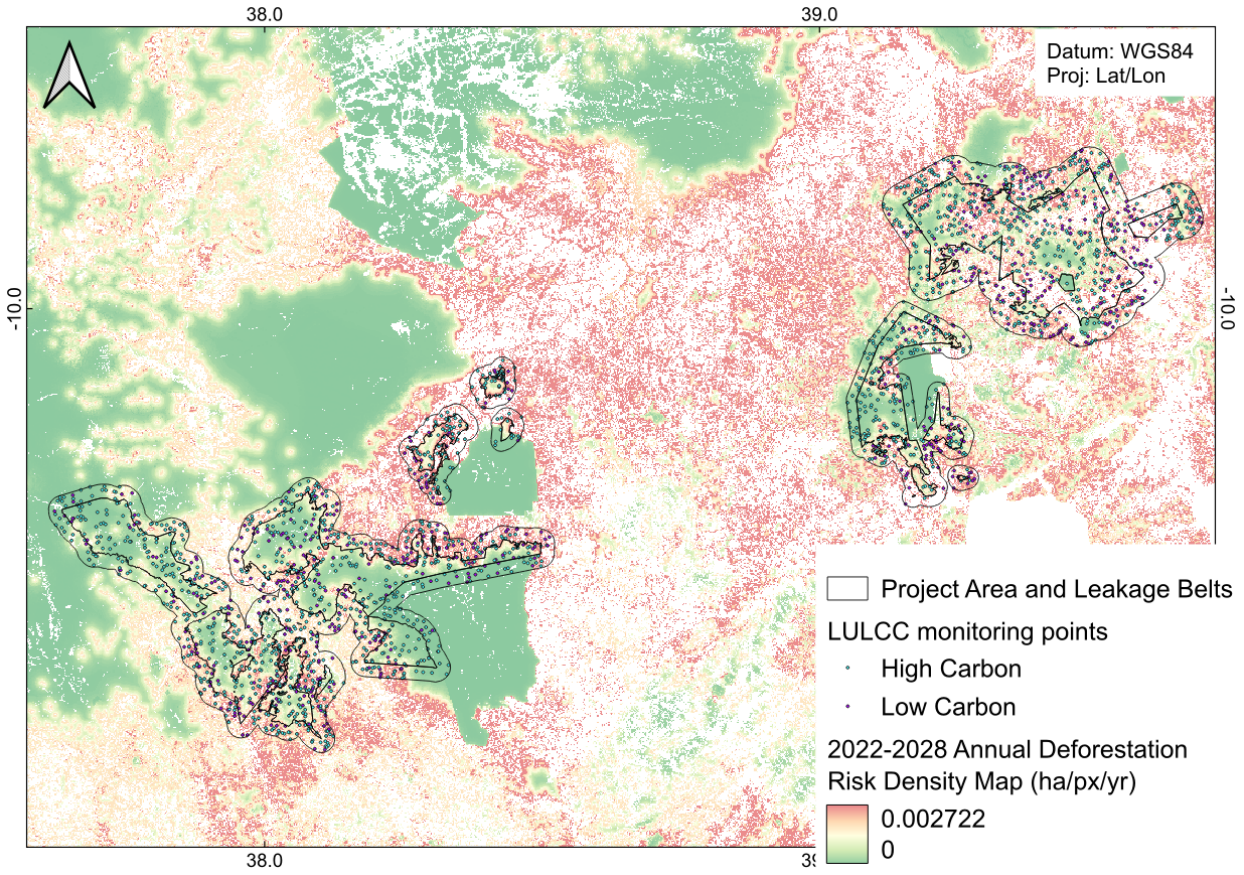


Figure 8 Location of land-cover change monitoring points in Lindi Region

The weights of each stratum used to calculate the proportion of each stratum in the project area and leakage belt and the standard errors of each change class in each strata were calculated in a python script. The script uses the risk density map, forest class map, and a masks for the project area and leakage belts to calculate a stratum map and then to count the number of pixels in each stratum. The project area mask was split into gazetted and non-gazetted project areas to facilitate the division of the stock change estimates for two different non-permanence risk reports. The results are shown in Table 7. The first two letters of the stratum code indicate whether the area is part of the leakage belt – 'LB' or part of the project area 'PA'. 'G-PA' indicates gazetted project areas where as 'PA' without the G are ungazetted project areas. The second letter represents whether the strata is part of the initial high or low carbon forest class. The final number indicates the risk density class of the stratum.

Table 7 Land-Cover Monitoring Strata Weights

Stratum	Pixel Count	Area (ha)	Weight
'LB-A-1'	669537	41,846	0.0624

'LB-A-2'	930406	58,150	0.0867
'LB-A-3'	1196517	74,782	0.1115
'LB-A-4'	1256844	78,553	0.1172
'LB-B-1'	424873	26,555	0.0396
'LB-B-2'	446263	27,891	0.0416
'LB-B-3'	319487	19,968	0.0298
'LB-B-4'	248339	15,521	0.0231
'PA-A-1'	237191	14,824	0.0221
'PA-A-2'	454248	28,391	0.0423
'PA-A-3'	1090697	68,169	0.1017
'PA-A-4'	783311	48,957	0.0730
'PA-B-1'	82688	5,168	0.0077
'PA-B-2'	128918	8,057	0.0120
'PA-B-3'	245397	15,337	0.0229
PA-B-4'	125220	7,826	0.0117
'G-PA-A-1'	161486	10,093	0.0151
'G-PA-A-2'	300709	18,794	0.0280
'G-PA-A-3'	794205	49,638	0.0740
'G-PA-A-4'	571887	35,743	0.0533
'G-PA-B-1'	43470	2,717	0.0041
G-PA-B-2'	60712	3,795	0.0057
'G-PA-B-3'	96058	6,004	0.0090
'G-PA-B-4'	59548	3,722	0.0056
Total	10,728,011	670,501	

Generation of random sampling points within the project area and leakage belt was done in QGIS using the random points within polygon tool. An initial potential sampling frame of 100,000

points was generated. Then, 12.5-meter square buffers were generated around each point and the generate pixel centroid within polygons tool in QGIS was used to get the corresponding pixel centroids for each pixel in the risk density map overlapped by a buffer. This step was required so that square buffers could then be created around each centroid to aid in point interpretation. Then the point sampling tool in QGIS was used to determine the risk density and forest class of each centroid. Finally, the select by location tool was used to identify whether a point was within a leakage belt or project area and whether the point was with in project instance 1 and associated leakage belt, or in project instance 2 and associated leakage belts. Centroids with zero risk (indicating non-forest) were deleted. Then the sampling frame was filtered to the desired risk density for a particular strata and the random selection tool in QGIS was used to randomly select the desired number of centroids from that strata. The selected centroids were then saved in a separate file for interpretation. Then to aid in point interpretation, a separate polygon file was created using 12.5-meter square buffers around each centroid giving square polygons corresponding to the size and location of the 25-meter pixels from the risk density map.

Interpretation of each point was based on land-cover within each pixel using the same criteria used to define forest and non-forest in the forest cover benchmark maps as described in section 3.2 of the methodological annex. However, in preparation for VMD0055, the categories of degradation and regeneration were also added. Degradation was any initially forested pixel with a decrease in canopy cover during the monitoring period while regeneration was pixel which was deforested prior to the start of the monitoring (thus representing error in the 2022 FCBM), but which appeared to be reforested by the end of the monitoring period.

Since the baseline projections for each project instance were adjusted to reflect the fact that instance 2 started on February 9th, 2023 instead of at the beginning of the monitoring period (see section 5.1 of the methodological annex), the land-use and land-cover change time period considered for points in project instance 2 was from February 2023 to June 2023 instead of from April 2022 to June 2023. Any point in project instance 2 which was deforested between April 2022 and February 2023 was interpreted as non-forest persistence rather than deforestation.

Interpretation of monitoring points was carried out in QGIS by loading planet.com monthly basemaps, Sentinel-2 cloud free mosaics, and Google Earth high resolution imagery into QGIS as x,y,z layers and overlaying the pixel boundaries of each sample point (see Table 8 for interpretation layer details). This allowed the interpreter to flip between imagery of different dates and record the land-cover change as either non-forest persistence, forest persistence, deforestation, degradation, or regeneration. Dates of deforestation were determined based on planet.com monthly basemaps, with the June 2024 basemap representing the end of the monitoring period. Due to the inconsistent georeferencing of Planet.com basemaps, for quality assurance, when a pixel fell on or near a forest edge, a 2024 sentinel-2 mosaic of March – June data and/or high-resolution imagery from Google Earth imagery was used to assess whether than June planet.com basemap contained a georeferencing shift or not and the interpretation of the change up until June 2024 was adjusted accordingly. For quality assurance, since correct interpretation of areas of change is more difficult than areas of no change, after all points were

reviewed, all points marked as deforestation and degradation were reviewed a second time to ensure consistent interpretation.

Table 8 Data layers used for interpretation of LULCC in monitoring pixels

Vector	Sensor	Resolution (m)	Type	Project / Leakage Belt Coverage	Mosaic Acquisition Pixel dates		
					Min Date	Median	Max
Satellite	Sentinel-2	10	Multi-spectral	100%	~1-Mar-22	~30-Apr-22	~30-Jun-22
Satellite	Sentinel-2	10	Multi-spectral	100%	~1-Mar-23	~30-Apr-23	~30-Jun-23
Satellite	Sentinel-2	10	Multi-spectral	100%	~1-Mar-24	~30-Apr-24	~30-Jun-24
Satellite	Planetscope	4.77	Visible light	100%	~1-Mar-22	~15-Mar-22	~31-Mar-22
Satellite	Planetscope	4.77	Visible light	100%	~1-Apr-22	~15-Apr-22	~31-Apr-22
Satellite	Planetscope	4.77	Visible light	100%	~1-May-22	~15-May-22	~31-May-22
Satellite	Planetscope	4.77	Visible light	100%	~1-Jan-23	~15-Jan-23	~31-Jan-23
Satellite	Planetscope	4.77	Visible light	100%	~1-Feb-23	~14-Feb-23	~28-Feb-23
Satellite	Planetscope	4.77	Visible light	100%	~1-May-24	~15-May-24	~31-May-24
Satellite	Planetscope	4.77	Visible light	100%	~1-Jun-24	~15-Jun-24	~30-Jun-24
Satellite	Various sensors from Google Earth	0.3	Visible light	100%	2022		2024

Once the dataset was complete, a pivot table was created with the strata as rows and the land-cover change categories counts as columns (Table 9).

Table 9 Land-Cover Change Monitoring Point Counts per Stratum

SS/CHC	NFP	FP	DEF	DEG	REG	Total
LB-A-1	74	374	19	41		508
LB-A-2	46	400	25	34	2	507
LB-A-3	18	296	11	9	2	336
LB-A-4	1	368	2	1		372
LB-B-1	90	220	15	15	2	342
LB-B-2	44	172	11	6	5	238
LB-B-3	9	68	1	2	3	83
LB-B-4		58				58
PA-A-1	13	148	7	8	1	177
PA-A-2	4	218	6	7		235
PA-A-3	1	277	2	5		285
PA-A-4	1	220		1		222
PA-B-1	15	35	2	2		54
PA-B-2	7	56	1	1		65
PA-B-3		45	1			46
PA-B-4		32				32
G-PA-A-1	6	121	3	7		137
G-PA-A-2	2	161	2	6	1	172
G-PA-A-3	1	192		3		196
G-PA-A-4		151		2		153
G-PA-B-1	3	18		2		23
G-PA-B-2	3	15		4		22
G-PA-B-3		20		1		21
G-PA-B-4		21				21

Total	338	3686	108	157	16	4305

Then the points counts were converted to proportions by dividing by the total number of points in the change category and multiplying by the appropriate strata weight (Table 10).

Table 10 Land-Cover Change Categories Proportions per Stratum

SS/CHC	NFP	FP	DEF	DEG	REG	Total
LB-A-1	0.00909	0.04595	0.00233	0.00504	0.00000	0.06241
LB-A-2	0.00787	0.06842	0.00428	0.00582	0.00034	0.08673
LB-A-3	0.00597	0.09825	0.00365	0.00299	0.00066	0.11153
LB-A-4	0.00031	0.11590	0.00063	0.00031	0.00000	0.11716
LB-B-1	0.01042	0.02548	0.00174	0.00174	0.00023	0.03960
LB-B-2	0.00769	0.03006	0.00192	0.00105	0.00087	0.04160
LB-B-3	0.00323	0.02440	0.00036	0.00072	0.00108	0.02978
LB-B-4	0.00000	0.02315	0.00000	0.00000	0.00000	0.02315
PA-A-1	0.00162	0.01849	0.00087	0.00100	0.00012	0.02211
PA-A-2	0.00072	0.03928	0.00108	0.00126	0.00000	0.04234
PA-A-3	0.00036	0.09881	0.00071	0.00178	0.00000	0.10167
PA-A-4	0.00033	0.07236	0.00000	0.00033	0.00000	0.07302
PA-B-1	0.00214	0.00500	0.00029	0.00029	0.00000	0.00771
PA-B-2	0.00129	0.01035	0.00018	0.00018	0.00000	0.01202
PA-B-3	0.00000	0.02238	0.00050	0.00000	0.00000	0.02287
PA-B-4	0.00000	0.01167	0.00000	0.00000	0.00000	0.01167
G-PA-A-1	0.00066	0.01329	0.00033	0.00077	0.00000	0.01505
G-PA-A-2	0.00033	0.02624	0.00033	0.00098	0.00016	0.02803
G-PA-A-3	0.00038	0.07252	0.00000	0.00113	0.00000	0.07403
G-PA-A-4	0.00000	0.05261	0.00000	0.00070	0.00000	0.05331
G-PA-B-1	0.00053	0.00317	0.00000	0.00035	0.00000	0.00405

G-PA-B-2	0.00077	0.00386	0.00000	0.00103	0.00000	0.00566
G-PA-B-3	0.00000	0.00853	0.00000	0.00043	0.00000	0.00895
G-PA-B-4	0.00000	0.00555	0.00000	0.00000	0.00000	0.00555
Total	0.05372	0.89571	0.01920	0.02789	0.00348	

Then, the standard error of each proportion (Table 11) was calculated using equation 26 from VMD0055 and the standard error of each change category was calculated by summing the standard errors of the proportions within that change category and multiplying by the total forest area (670,501 ha) in the project area and leakage belts.

Table 11 Land-Cover Change Category proportion standard errors per Stratum

SS/CHC	NFP	FP	DEF	DEG	REG
LB-A-1	9.56E-07	1.49E-06	2.77E-07	5.70E-07	0.00E+00
LB-A-2	1.23E-06	2.48E-06	6.97E-07	9.30E-07	5.84E-08
LB-A-3	1.88E-06	3.89E-06	1.18E-06	9.68E-07	2.20E-07
LB-A-4	9.92E-08	3.94E-07	1.98E-07	9.92E-08	0.00E+00
LB-B-1	8.92E-07	1.06E-06	1.93E-07	1.93E-07	2.67E-08
LB-B-2	1.10E-06	1.46E-06	3.22E-07	1.79E-07	1.50E-07
LB-B-3	1.05E-06	1.60E-06	1.29E-07	2.54E-07	3.77E-07
LB-B-4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PA-A-1	1.89E-07	3.81E-07	1.05E-07	1.20E-07	1.56E-08
PA-A-2	1.28E-07	5.14E-07	1.91E-07	2.21E-07	0.00E+00
PA-A-3	1.27E-07	9.93E-07	2.54E-07	6.27E-07	0.00E+00
PA-A-4	1.08E-07	2.15E-07	0.00E+00	1.08E-07	0.00E+00
PA-B-1	2.25E-07	2.56E-07	4.00E-08	4.00E-08	0.00E+00
PA-B-2	2.17E-07	2.69E-07	3.42E-08	3.42E-08	0.00E+00
PA-B-3	0.00E+00	2.47E-07	2.47E-07	0.00E+00	0.00E+00
PA-B-4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
G-PA-A-1	6.98E-08	1.72E-07	3.57E-08	8.08E-08	0.00E+00

G-PA-A-2	5.28E-08	2.75E-07	5.28E-08	1.55E-07	2.66E-08
G-PA-A-3	1.43E-07	5.62E-07	0.00E+00	4.24E-07	0.00E+00
G-PA-A-4	0.00E+00	2.41E-07	0.00E+00	2.41E-07	0.00E+00
G-PA-B-1	8.46E-08	1.27E-07	0.00E+00	5.93E-08	0.00E+00
G-PA-B-2	1.80E-07	3.31E-07	0.00E+00	2.27E-07	0.00E+00
G-PA-B-3	0.00E+00	1.82E-07	0.00E+00	1.82E-07	0.00E+00
G-PA-B-4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SE Proportion	0.002954	0.004140	0.001988	0.002390	0.000935
SE Area	1980.63	2775.87	1332.64	1602.61	626.83

Then the area of each change category (Table 12) within each forest type within the project area and leakage belt was calculated by multiplying the sum of the proportions of a change category within the forest type within either the leakage belt or project area. This is the same as equations 24 and 25 in VMD0055.

Table 12 Land-Cover Change Category Areas (ha) per Stratum and Percent Uncertainty

SS/CC	NFP	FP	DEF	DEG	REG
LB-A	15589	220274	7303	9491	675
LB-B	14310	69119	2694	2349	1463
PA-A	2032	153503	1790	2932	84
PA-B	2303	33122	649	315	0
G-PA-A	914	110407	440	2398	109
G-PA-B	872	14153	0	1212	0
Total	36019	600578	12875	18698	2331
U%	9.04%	0.76%	17.03%	14.10%	44.24%

Finally, the overall percent uncertainty of each change category (Table 12) was calculated using equation 28 from VMD0055. The equation calculates the percent uncertainty based on the half-width of a two-sided 90% confidence interval. The percent uncertainty for the deforestation change category was 17.03%, which is below the 20% maximum allowable uncertainty for

activity data under VM0015, but more than 10% maximum allowed to avoid applying an uncertainty inflation factor.

Therefore, the uncertainty inflation factor was calculated using VMD0055 equation 29, which yielded 0.045. Then the uncertainty inflated deforestation figures for deforestation in each forest class in the leakage belt and project area were calculated by multiplying the deforestation estimates by 1 + the inflation factor. These uncertainty adjusted deforestation figures are reported in VM0015 Ex-Post Table 14, VM0015 Ex-Post Table 14 gazetted, and VM0015 Ex-Post Table 15 for the project area, gazetted portion of the project area, and leakage belt respectively.

3.1.4 Dissemination of Monitoring Plan and Results (VCS, 3.18; CCB, CL4.2)

The monitoring plan is publicized online as part of the project document, shared with the Designated National Focal Point and uploaded to the VERRA registry. The monitoring report was also submitted to the Designated National Focal Point and uploaded to the VERRA registry for public review prior to verification. A summary of the MR was emailed to the executive directors and project focal points of the participating Local Authorities. Additionally, the summary was translated into Swahili, printed, and distributed to the Managing Authorities. The MR summarized, and translated into Swahili, was presented at decision-making meetings of the Managing Authorities in February and March 2025. This is a contractual obligation under Clause 14.3 of the carbon trade agreement, requiring the Project Proponent to attend annual meetings of each Managing Authorities and Managers to discuss project outcomes, present performance metrics, and report on the verified emission reductions, ensuring financial transparency.

3.2 Quantification of GHG Emission Reductions and Removals

3.2.1 Baseline Emissions (VCS, 3.15)

The procedure for the quantification of baseline emissions and/or carbon stock changes in accordance with VM0015 is detailed in sections 1 and 3 through 6 of the methodological annex.

Methodological annex sections for calculation of Baseline Emissions:

Section 1: Spatial Boundaries

Section 3: Analysis of Historical Land Use and Land Cover Change

Section 4:

Projection of Future Deforestation

Section 5: Definition of Land Use and Land Cover Change Component of the Baseline

Section 6: Estimation of Baseline Carbon Stock Changes and Non-CO2 Emissions

Beyond the static baseline described in the methodological annex — which projects future deforestation using historical average annual deforestation rates weighted by a spatial risk map — the project will voluntarily employ a dynamic baseline when cumulative observed deforestation in the reference region falls below the projected cumulative baseline quantity within a given monitoring period (per VM0015 Table 9). Deforestation mapping for each monitoring period will be conducted using the PALSAR-based detection model detailed in Section 3 of the methodological annex, or alternatively using any method demonstrated to produce deforestation estimates within ±10% of the PALSAR-derived values.

When a dynamic baseline is triggered, class-specific deforestation rates for both the project area and leakage belt will be estimated from stratified random samples drawn from the reference region, excluding the project area and leakage belt. These samples capture forest persistence and loss during the monitoring period and must contain a minimum of 100,000 pixels per forest class. Stratification ensures that the sample distribution of deforestation density values (see Figure 49, Section 4 of the methodological annex) mirrors that of either the project area or leakage belt for each respective forest class. With two forest classes currently defined, this procedure yields four independent stratified samples in total — one per forest class for each of the two spatial units (project area and leakage belt).

Once the stratified samples are drawn, the dynamic baseline for each forest class and spatial unit is calculated by computing the proportion of sampled pixels classified as forest loss versus forest persistence during the monitoring period. This loss proportion is then applied to the total forest area of the corresponding forest class within the respective spatial unit — either the project area or leakage belt — to yield a dynamic estimate of expected deforestation for that monitoring period. Where this dynamic estimate is lower than the static projected deforestation for a given forest class and spatial unit, the dynamic value supersedes the static one and is substituted into the corresponding cell in VM0015 Table 14 or VM0015 Table 15, as appropriate. All subsequent calculations follow the same procedure as for the static baseline.

The dynamic baseline is a methodological deviation which is justified since it will only result in conservatively reducing the baseline relative to the baseline produced by the applied methodologies.

For this monitoring period, the reference region deforestation mapping was conducted using the PALSAR deforestation detection model used for the HRP. The median imagery dates for the 2022 and 2024 PALSAR mosaics covering the reference region were August 23rd and August 16th respectively. While these dates don't exactly match the dates of the monitoring period, they sufficiently overlap with the monitoring period to estimate the reference region deforestation for the monitoring period. The baseline forest loss in the reference region for the period covered by the PALSAR data was determined by simply multiplying the baseline rate for an entire year from VM0015 Table 9 by 2 years (Table 13).

Table 13 Comparison of reference region baseline and mapped deforestation for 2022-2024

RR Forest Loss Baseline 2022-2024 (ha)	Mapped Forest Loss 2022-2024 (ha)	Difference (ha)
269,374	326,520	57,146

The mapped deforestation exceeded the cumulative baseline deforestation for the monitoring period, so a dynamic baseline was not required.

Since the monitoring period covered in this monitoring report does not end at the end of a calendar year, it was necessary to recalculate the baseline emissions for the January 2024 through June 2024 period. This was done by scaling the projected 2024 baseline deforestation for both the project area and leakage belt by the proportion of year covered in this monitoring report (50%) and then recalculating the baseline emission tables for that year using the same procedures described in the methodological annex. Additionally, since the project area is divided into gazetted and non-gazettted areas for calculating non-permanence risk scores, it was necessary to calculate the baseline for the gazetted areas specifically was well. See the updated versions of VM0015 Table 14, VM0015 Table 14 gazetted, VM0015 Table 15, VM0015 Table 36, VM0015 Table 36 gazetted, and

VM0015 Table 37on the following pages.

As described in section 5.1 of the methodological annex, the 931 already credited under the 2012-2022 baseline validity period (Figure 9) were not considered for recrediting. This was accomplished by subtracting the annual projected baseline deforestation in those areas from the annual 2002-2028 project baseline, which is equivalent to masking those areas from the project area polygon used to calculate the baseline from a VT0007 style deforestation risk density map.

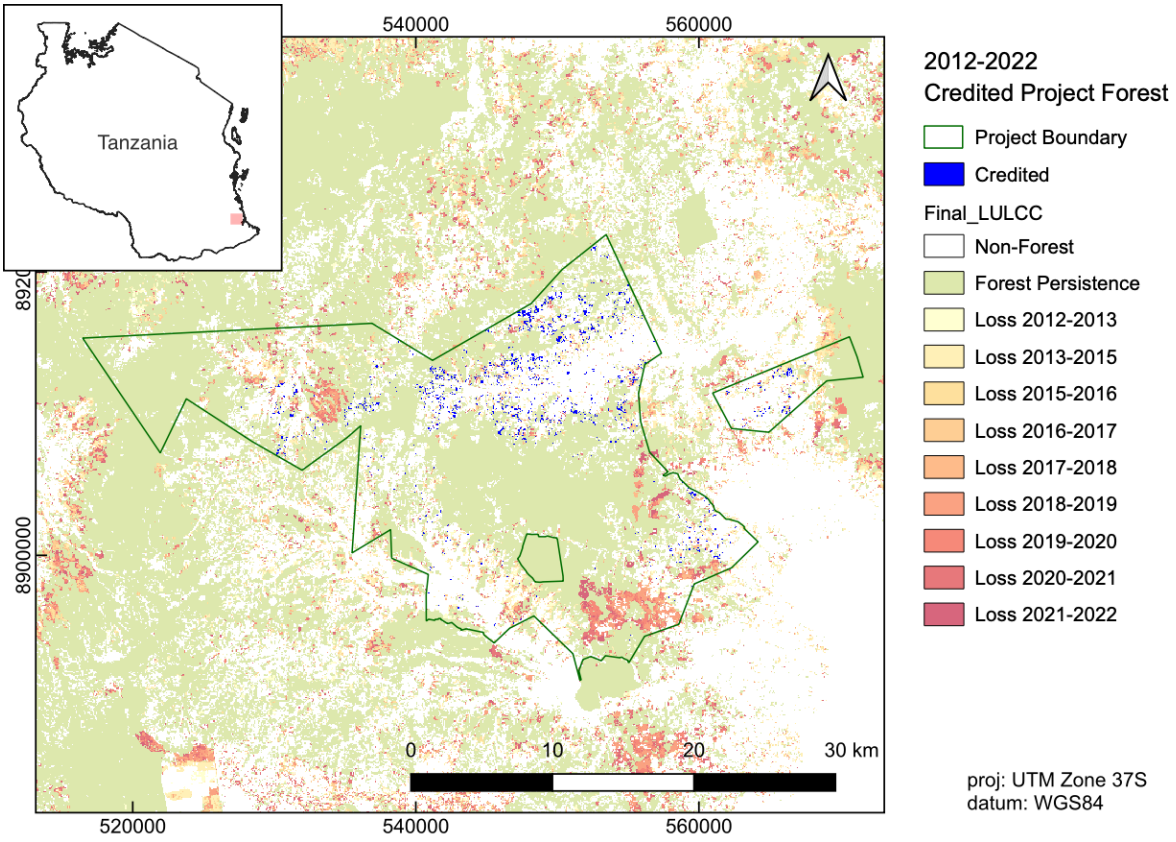


Figure 9 Cumulative Deforestation and Credited Avoided Deforestation 2012-2022 from the verified 2013-2022 monitoring report.

Then, it should also be noted that one consequence of adopting the more accurate VT0007 risk mapping approach is that the project cannot update the map of cumulatively credited pixels, since no specific pixels are identified as projected for deforestation within the 2022-2028 baseline validity period. In lieu of this, the project applies the equivalent safeguard under VMD0055 section 5.3.2.6 — the methodology to which the project will transition during the current baseline validity period — ensuring that the cumulative allocated baseline to each stratum does not exceed the total area of that stratum. As shown in the Table 14, both strata have exhaustion timelines (65 years and 52 years respectively) well in excess of the 42 years of crediting remaining after 2022, confirming no risk of overallocation.

Table 14 Forest Strata Areas as of 2022 and 2022-2028 Annual Allocations

Forest Strata	Area (ha) as of 2022 less 931 ha credited during first baseline validity period.	Annual allocation (ha) during 2022-2028 baseline validity period excluding previously credited areas	Years to stratum exhaustion at 2022–2028 allocation rate
1 – High Carbon	274,055	4,222	64.91

2 – Low Carbon	52,444	1,009	51.98

VM0015 Table 14 Annual Areas Deforested Per forest Class icl Within the Project Area in the Baseline Case (Baseline Activity Data Per Forest Class)

Area deforested per forest class *icl* within the project area			Total baseline deforestation in the project area	
ID_{icl}>	1	2		
Name >	High Carbon	Low Carbon	*ABSLPAt*	*ABSLPA*
			annual	cumulative
Project year *t*	ha	ha	ha/yr	ha
2022	544	185	728	728
2023	3,854	930	4,783	5,512
Jan 2024 - Jun 2024	2,099	502	2,601	8,113

VM0015 Table 14 Annual Areas Deforested Per forest Class icl Within the Gazetted Project Area in the Baseline Case (Baseline Activity Data Per Forest Class)

Area deforested per forest class *icl* within the project area			Total baseline deforestation in the project area	
ID_{icl}>	1	2		
Name >	High Carbon	Low Carbon	*ABSLPAt*	*ABSLPA*
			annual	cumulative
Project year *t*	ha	ha	ha/yr	ha
2022	244	34	278	278
2023	1,582	293	1,875	2,153
Jan 2024 - Jun 2024	860	160	1,020	3,173

VM0015 Table 15 Annual Areas Deforested Per forest Class icl Within the Leakage Belt in the Baseline Case (Baseline Activity Data Per Forest Class)

Area deforested per forest class *icl* within the leakage belt			Total baseline deforestation in the leakage belt	
ID_{icl}>	1	2		
Name >	High Carbon	Low Carbon	*ABSLLKt*	*ABSLLK*
			annual	cumulative
Project year *t*	ha	ha	ha/yr	ha
2022	703	307	1,010	1,010
2023	4,333	2,115	6,448	7,458
Jan 2024 - Jun 2024	2,365	1,158	3,523	10,981

VM0015 Table 36 Baseline Carbon Stock Change for AGB in the Project Area (Method 1)

Carbon Stock Changes in the Aboveground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Aboveground Biomass of Initial Forest Classes in the Project Area		Carbon Stock Changes in Aboveground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Aboveground Biomass of Post- deforestation Zones in the Project Area		Total Net Carbon Stock Change in Aboveground Biomass of Post-deforestation Zones in the Project Area	
ID_{icl}>	1	2	$\Delta Cab\ BSLPA_{icl,t}$ Annual	$\Delta Cab\ BSLPA_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cab\ BSLPA_{z,t}$ Annual	$\Delta Cab\ BSLPA_{z}$ Cumulative	$\Delta Cab\ BSLPA_{t}$ Annual	$\Delta Cab\ BSLPA$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-77,718	-13,993	-91,712	-91,712	2022	1,024	1,024	1,024	-90,688	-90,688
2023	-551,047	-70,439	-621,486	-713,198	2023	7,749	7,749	8,773	-613,737	-704,425
Jan 2024 - Jun 2024	-300,181	-38,026	-338,207	-1,051,405	2024	11,407	11,407	20,180	-326,801	-1,031,225

VM0015 Table 36 Baseline Carbon Stock Change for BGB in the Project Area (Method 1)

Carbon Stock Changes in the Belowground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Belowground Biomass of Initial Forest Classes in the Project Area		Carbon Stock Changes in Belowground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Belowground Biomass of Post- deforestation Zones in the Project Area		Total Net Carbon Stock Change in Belowground Biomass of Post-deforestation Zones in the Project Area	
ID_{icl}>	1	2	$\Delta Cbb\ BSLPA_{icl,t}$ Annual	$\Delta Cbb\ BSLPA_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cbb\ BSLPA_{z,t}$ Annual	$\Delta Cbb\ BSLPA_{z}$ Cumulative	$\Delta Cbb\ BSLPA_{t}$ Annual	$\Delta Cbb\ BSLPA$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-2,967	-632	-3,599	-3,599	2022	259	259	259	-3,340	-3,340
2023	-24,000	-3,813	-27,814	-31,412	2023	1,957	1,957	2,215	-25,857	-29,197
Jan 2024 - Jun 2024	-35,458	-5,531	-40,989	-72,401	2024	2,880	2,880	5,095	-38,109	-67,306

VM0015 Table 36 Baseline Carbon Stock Change for AGB in the Gazetted Project Area (Method 1)

Carbon Stock Changes in the Aboveground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Aboveground Biomass of Initial Forest Classes in the Project Area		Carbon Stock Changes in Aboveground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Aboveground Biomass of Post- deforestation Zones in the Project Area		Total Net Carbon Stock Change in Aboveground Biomass of Post-deforestation Zones in the Project Area	
ID_{icl}>	1	2	$\Delta Cab\ BSLPA_{icl,t}$ Annual	$\Delta Cab\ BSLPA_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cab\ BSLPA_{z,t}$ Annual	$\Delta Cab\ BSLPA_{z}$ Cumulative	$\Delta Cab\ BSLPA_{t}$ Annual	$\Delta Cab\ BSLPA$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-34,915	-2,577	-37,492	-37,492	2022	391	391	391	-37,101	-37,101
2023	-226,168	-22,192	-248,360	-285,852	2023	3,027	3,027	3,418	-245,333	-282,434
Jan 2024 - Jun 2024	-122,948	-12,136	-135,084	-420,936	2024	4,461	4,461	7,879	-130,623	-413,057

VM0015 Table 36 Baseline Carbon Stock Change for BGB in the Gazetted Project Area (Method 1)

Carbon Stock Changes in the Belowground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Belowground Biomass of Initial Forest Classes in the Project Area		Carbon Stock Changes in Belowground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Belowground Biomass of Post- deforestation Zones in the Project Area		Total Net Carbon Stock Change in Belowground Biomass of Post-deforestation Zones in the Project Area	
ID_{icl}>	1	2	$\Delta Cbb\ BSLPA_{icl,t}$ Annual	$\Delta Cbb\ BSLPA_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cbb\ BSLPA_{z,t}$ Annual	$\Delta Cbb\ BSLPA_{z}$ Cumulative	$\Delta Cbb\ BSLPA_{t}$ Annual	$\Delta Cbb\ BSLPA$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-1,333	-116	-1,449	-1,449	2022	99	99	99	-1,350	-1,350
2023	-9,966	-1,119	-11,084	-12,533	2023	764	764	863	-10,320	-11,670
Jan 2024 - Jun 2024	-14,659	-1,667	-16,325	-28,859	2024	1,126	1,126	1,989	-15,199	-26,869

VM0015 Table 37 Baseline Carbon Stock Change for AGB in the Leakage Belt (Method 1)

Carbon Stock Changes in the Aboveground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Aboveground Biomass of Initial Forest Classes in the Leakage Belt		Carbon Stock Changes in Aboveground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Aboveground Biomass of Post- deforestation Zones in the Leakage Belt		Total Net Carbon Stock Change in Aboveground Biomass of Post-deforestation Zones in the Leakage Belt	
ID_{icl}>	1	2	$\Delta Cab\ BSLLK_{icl,t}$ Annual	$\Delta Cab\ BSLLK_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cab\ BSLLK_{z,t}$ Annual	$\Delta Cab\ BSLLK_{z}$ Cumulative	$\Delta Cab\ BSLLK_{t}$ Annual	$\Delta Cab\ BSLLK$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-100,572	-23,243	-123,814	-123,814	2022	737	737	737	-123,077	-123,077
2023	-619,568	-160,251	-779,819	-903,634	2023	5,444	5,444	6,182	-774,375	-897,452
Jan 2024 - Jun 2024	-338,233	-87,721	-425,954	-1,329,588	2024	8,016	8,016	14,198	-417,938	-1,315,390

VM0015 Table 37 Baseline Carbon Stock Change for BGB in the Leakage Belt (Method 1)

Carbon Stock Changes in the Belowground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Belowground Biomass of Initial Forest Classes in the Leakage Belt		Carbon Stock Changes in Belowground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Belowground Biomass of Post- deforestation Zones in the Leakage Belt		Total Net Carbon Stock Change in Belowground Biomass of Post-deforestation Zones in the Leakage Belt	
ID_{icl}>	1	2	$\Delta Cbb\ BSLLK_{icl,t}$ Annual	$\Delta Cbb\ BSLLK_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cbb\ BSLLK_{z,t}$ Annual	$\Delta Cbb\ BSLLK_{z}$ Cumulative	$\Delta Cbb\ BSLLK_{t}$ Annual	$\Delta Cbb\ BSLLK$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-3,839	-1,050	-4,889	-4,889	2022	187	187	187	-4,702	-4,702
2023	-27,488	-8,287	-35,775	-40,664	2023	1,380	1,380	1,567	-34,395	-39,097
Jan 2024 - Jun 2024	-40,399	-12,249	-52,648	-93,311	2024	2,032	2,032	3,598	-50,616	-89,713

VM0015 Table 42 Baseline Non-CO2 Emissions from Forest Fires in the Project Area

Project year t	Emissions of Non-CO2 Gases from Baseline Forest Fires				Total Baseline Non-CO_2 Emissions from Forest Fires in the Project Area	
	ID_{icl}	= 1	ID_{icl}	= 2		
	$ABSLPA_{icl,t}$	$EBBBSLtot_{icl}$	$ABSLPA_{icl,t}$	$EBBBSLtot_{icl}$	Annual	Cumulative
					$EBBBSLPA_t$	*EBBBSLPA*
	ha	t CO_2e/ha	ha	t CO_2e/ha	t CO_2e	t CO_2e
2,022	544	4,375	185	748	5,123	5,123
2,023	3,854	31,020	930	3,764	34,783	39,906
Jan 2024 - Jun 2024	2,099	16,898	502	2,032	18,930	58,836

VM0015 Table 42 Baseline Non-CO2 Emissions from Forest Fires in the Leakage Belt

Project year t	Emissions of Non-CO2 Gases from Baseline Forest Fires				Total Baseline Non-CO_2 Emissions from Forest Fires in the Leakage Belt	
	ID_{icl}	= 1	ID_{icl}	= 2		
	$ABSLLK_{icl,t}$	$EBBBSLtot_{icl}$	$ABSLLK_{icl,t}$	$EBBBSLtot_{icl}$	Annual	Cumulative
					$EBBBSLLK_t$	*EBBBSLLK*
	ha	t CO_2e/ha	ha	t CO_2e/ha	t CO_2e	t CO_2e
2,022	703	5,661	307	1,242	6,903	6,903
2,023	4,333	34,877	2,115	8,563	43,440	50,343
Jan 2024 - Jun 2024	2,365	19,040	1,158	4,687	23,727	74,070

3.2.2 Project Emissions (VCS, 3.15)

Monitoring of unavoided deforestation was conducted as described in section 3.1.3 of this monitoring report. The ex-post uncertainty adjusted unavoided project area deforestation for the

entire monitoring period was distributed to the monitored year sub-periods based on the relative proportion of baseline deforestation projected to occur in each year after adjusting for the fact that only half of 2024 was monitored. The result is VM0015 Ex-Post Table 14 shown below. A version was also created for just the gazetted portions of the project area.

The difference between the projected baseline ha of deforestation during this period shown in VM0015 Table 14 and the estimated ex-post deforestation shown in VM0015 Ex-Post Table 14 during this period is 5107 ha.

As documented in the PD, there are no emissions or stock changes associated with the project's leakage avoidance activities. Planned degradation associated with project area boundary clearing is projected to be insignificant (see section 9.1.1 of the methodological annex) and the actual hectares of boundary clearing during this monitoring period did not exceed what was projected in the methodological annex. Finally, there were no catastrophic events or destructive fires detected in the deforestation monitoring points during this monitoring period. Therefore, the only significant project emissions come from carbon stock changes associated with unavoided unplanned deforestation and non-CO2 GHG emissions from biomass burning as part of the unavoided unplanned deforestation.

VM0015 Ex-Post Table 14 Annual Areas Deforested Per forest Class icl Within the Project Area (Ex-post Data Per Forest Class)

Area deforested per forest class *icl* within the project area			Total ex-post deforestation in the project area	
ID_{icl}>	1	2		
Name >	High Carbon	Low Carbon	*ABSLPAt*	*ABSLPA*
			annual	cumulative
Project year *t*	ha	ha	ha/yr	ha
2022	213	52	266	266
2023	1,511	264	1,775	2,041
Jan 2024 - Jun 2024	823	143	966	3,006

VM0015 Ex-Post Table 14 Annual Areas Deforested Per forest Class icl Within the Gazetted Project Area (Ex-post Data Per Forest Class)

Area deforested per forest class *icl* within the project area			Total ex-post deforestation in the project area	
ID_{icl}>	1	2		
Name >	High Carbon	Low Carbon	*ABSLPAt*	*ABSLPA*
			annual	cumulative
Project year *t*	ha	ha	ha/yr	ha
2022	38	0	38	38
2023	272	0	272	311
Jan 2024 - Jun 2024	148	0	148	459

Then, the project calculated VM0015 Ex-Post Table 36 using the same procedures used to calculate VM0015 Table 36 as described in section 6.1 of the methodological annex but substituting ex-post deforestation in each forest class in place of projected baseline deforestation. A version was also created for the gazetted portions of the project area.

VM0015 Ex-Post Table 36 Ex-Post Carbon Stock Change for AGB in the Project Area (Method 1)

Carbon Stock Changes in the Aboveground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Aboveground Biomass of Initial Forest Classes in the Project Area		Carbon Stock Changes in Aboveground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Aboveground Biomass of Post- deforestation Zones in the Project Area		Total Net Carbon Stock Change in Aboveground Biomass of Post-deforestation Zones in the Project Area	
ID_{icl}>	1	2	$\Delta Cab\ BSLPA_{icl,t}$ Annual	$\Delta Cab\ BSLPA_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cab\ BSLPA_{z,t}$ Annual	$\Delta Cab\ BSLPA_{z}$ Cumulative	$\Delta Cab\ BSLPA_{t}$ Annual	$\Delta Cab\ BSLPA$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-30,470	-3,975	-34,445	-34,445	2022	373	373	373	-34,072	-34,072
2023	-216,039	-20,011	-236,050	-270,495	2023	2,869	2,869	3,242	-233,181	-267,253
Jan 2024 - Jun 2024	-117,687	-10,803	-128,490	-398,985	2024	4,227	4,227	7,469	-124,263	-391,516

VM0015 Ex-Post Table 36 Ex-Post Carbon Stock Change for BGB in the Project Area (Method 1)

Carbon Stock Changes in the Belowground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Belowground Biomass of Initial Forest Classes in the Project Area		Carbon Stock Changes in Belowground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Belowground Biomass of Post- deforestation Zones in the Project Area		Total Net Carbon Stock Change in Belowground Biomass of Post-deforestation Zones in the Project Area	
ID_{icl}>	1	2	$\Delta Cbb\ BSLPA_{icl,t}$ Annual	$\Delta Cbb\ BSLPA_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cbb\ BSLPA_{z,t}$ Annual	$\Delta Cbb\ BSLPA_{z}$ Cumulative	$\Delta Cbb\ BSLPA_{t}$ Annual	$\Delta Cbb\ BSLPA$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-1,163	-180	-1,343	-1,343	2022	94	94	94	-1,248	-1,248
2023	-9,409	-1,083	-10,493	-11,835	2023	724	724	819	-9,768	-11,017
Jan 2024 - Jun 2024	-13,902	-1,571	-15,473	-27,308	2024	1,067	1,067	1,886	-14,406	-25,422

VM0015 Ex-Post Table 36 Ex-Post Carbon Stock Change for AGB in the Gazetted Project Area (Method 1)

Carbon Stock Changes in the Aboveground Biomass per Initial Forest Class icl	Total Carbon Stock Change in Aboveground Biomass of Initial Forest Classes in the Project Area	Carbon Stock Changes in Aboveground Biomass Per Post deforestation Zone z	Total Carbon Stock Change in Aboveground Biomass of Post- deforestation Zones in the Project Area	Total Net Carbon Stock Change in Aboveground Biomass of Post-

									deforestation Zones in the Project Area	
ID_{icl}>	1	2	$\Delta Cab\ BSLPA_{icl,t}$ Annual	$\Delta Cab\ BSLPA_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cab\ BSLPA_{z,t}$ Annual	$\Delta Cab\ BSLPA_{z}$ Cumulative	$\Delta Cab\ BSLPA_{t}$ Annual	$\Delta Cab\ BSLPA$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-5,493	0	-5,493	-5,493	2022	54	54	54	-5,439	-5,439
2023	-38,945	0	-38,945	-44,438	2023	437	437	491	-38,508	-43,947
Jan 2024 - Jun 2024	-21,215	0	-21,215	-65,653	2024	646	646	1,137	-20,570	-64,517

VM0015 Ex-Post Table 36 Ex-Post Carbon Stock Change for BGB in the Gazetted Project Area (Method 1)

Carbon Stock Changes in the Belowground Biomass per Initial Forest Class icl	Total Carbon Stock Change in Belowground Biomass of Initial Forest Classes in the Project Area	Carbon Stock Changes in Belowground Biomass Per Post deforestation Zone z	Total Carbon Stock Change in Belowground Biomass of Post- deforestation Zones in the Project Area	Total Net Carbon Stock Change in Belowground Biomass of Post-deforestation Zones in the Project Area

ID_{icl}>	1	2	ΔC_{bb} $BSLPA_{icl,t}$ Annual	ΔC_{bb} $BSLPA_{icl}$ Cumulative	ID_{iz}	3	ΔC_{bb} $BSLPA_{z,t}$ Annual	ΔC_{bb} $BSLPA_{z}$ Cumulative	ΔC_{bb} $BSLPA_{t}$ Annual	ΔC_{bb} $BSLPA$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-210	0	-210	-210	2022	14	14	14	-196	-196
2023	-1,696	0	-1,696	-1,906	2023	110	110	124	-1,586	-1,782
Jan 2024 - Jun 2024	-2,506	0	-2,506	-4,412	2024	163	163	287	-2,343	-4,125

Then VM0015 Ex-Post Table 42 was calculated using the same procedures as described in section 6.2 of the methodological annex but substituting ex-post deforestation per forest class for baseline deforestation.

VM0015 Ex-Post Table 42 Non-CO2 Emissions from Forest Fires in the Project Area

Project year t	Emissions of Non-CO2 Gases from Ex-Post Forest Fires				Total Ex-Post Non-CO_2 Emissions from Forest Fires in the Project Area	
	ID_{icl}	= 1	ID_{icl}	= 2		
	$ABSLPA_{icl,t}$	$EBBPStot_{icl}$	$ABSLPA_{icl,t}$	$EBBPStot_{icl}$	Annual	Cumulative
					$EBBPSPA_t$	$EBBPSPA$
	ha	t CO_2e/ha	ha	t CO_2e/ha	t CO_2e	t CO_2e
2022	213	1,715	52	212	1,928	1,928
2023	1,511	12,161	264	1,069	13,231	15,158
Jan 2024 - Jun 2024	823	6,625	143	577	7,202	22,360

Then VM0015 Ex-Post Table 47 just summarizes the project area total carbon stock changes by combining the above and below ground biomass changes from VM0015 Ex-Post Table 36. As noted above, emissions from planned activities were insignificant in this monitoring period and are thus set to zero.

VM0015 Ex-Post Table 47 Estimated Net Carbon Stock Change in the Project Area

Project year t	Total Carbon Stock Decrease due to Planned Activities		Total Carbon Stock Decrease due to Unavoided Unplanned Deforestation		Total Carbon Stock Change in the Project Case	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	$\Delta CPAdPA_t$	$\Delta CPAdPA$	$\Delta CUDdPA_t$	$\Delta CUDdPA$	$\Delta CPSPA_t$	$\Delta CPSPA$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022	0	0	-35,320	-35,320	-35,320	-35,320

2023	0	0	-242,950	-278,270	-242,950	-278,270
Jan 2024 - Jun 2024	0	0	-138,669	-416,938	-138,669	-416,938

Finally, VM0015 Ex-Post Table 49 summarizes the results from VM0015 Ex-Post Table 42 and VM0015 Ex-Post Table 47.

VM0015 Ex-Post Table 49 Total Ex Post Estimated Actual Net Carbon Stock Changes and Emissions of Non-CO2 Gases in the Project Area

Project year t	Total Ex Ante Carbon Stock Decrease due to Planned Activities		Total Ex Post Carbon Stock Decrease due to Unavoided Unplanned Deforestation		Total Ex Post Net Carbon Stock Change		Total Ex Post Estimated Actual Non-CO_2 Emissions from Forest Fires in the Project Area	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	$\Delta CPAdPA_t$	$\Delta CPAdPA$	$\Delta CUDdPA_t$	$\Delta CUDdPA$	$\Delta CPSPA_t$	$\Delta CPSPA$	$EBBPSPA_t$	$EBBPSPA_t$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022	0	0	-35,320	-35,320	-35,320	-35,320	1,928	1,928
2023	0	0	-242,950	-278,270	-242,950	-278,270	13,231	15,158
Jan 2024 - Jun 2024	0	0	-138,669	-416,938	-138,669	-416,938	7,202	22,360

3.2.3 Leakage Emissions (VCS, 2.5, 3.2, 3.6, 3.15, 4.3)

The procedure for the quantification of leakage emissions (ex-ante and ex post) and carbon stock changes in accordance with VM0015 is detailed in section 8 of the methodological annex. The definition of the leakage belt and leakage management areas are described, respectively, in section 1.1.3 and section 1.1.4 of the methodological annex.

As documented in section 8.1 of the methodological annex, the only expected source of significant leakage emissions from the project is activity shifting as the project is not promoting any activities that lead to increases in emissions in the leakage management areas. Leakage from activity shifting is calculated by comparing projected baseline emissions in the leakage belt to ex-post actual emissions from the leakage belt. Activity shifting into the leakage belt can cause increased CO_2 emissions from reductions in forest carbon stocks and increases in non-CO_2 emissions from biomass burning during the forest clearing process. Projected baseline emissions

from carbon stock changes and biomass burning in the leakage belt for this monitoring period are documented in section 3.2.1 of this monitoring report.

As in the project area, monitoring of unavoided deforestation in the leakage belt was conducted as described in section 3.1.3 of this monitoring report. The ex-post uncertainty adjusted unavoided leakage belt deforestation for the entire monitoring period was distributed to the monitored year sub-periods based on the relative proportion of baseline deforestation projected to occur in each year after adjusting for the fact that only half of 2024 was monitored. The result is VM0015 Ex-Post Table 15 shown below.

VM0015 Ex-Post Table 15 Annual Areas Deforested Per forest Class icl Within the Leakage Belt (Ex-post Data Per Forest Class)

Area deforested per forest class *icl* within the leakage belt			Total baseline deforestation in the leakage belt	
ID_{icl}>	1	2		
Name >	High Carbon	Low Carbon	*ABSLLKt*	*ALK*
			annual	cumulative
Project year *t*	ha	ha	ha/yr	ha
2022	725	241	966	966
2023	4,466	1,663	6,129	7,095
Jan 2024 - Jun 2024	2,438	910	3,348	10,443

Then, the project calculated VM0015 Ex-Post Table 37 using the same procedures used to calculate

VM0015 Table 37 as described in section 6.1 of the methodological annex but substituting ex-post deforestation in each forest class in place of projected baseline deforestation.

VM0015 Ex-Post Table 37 Carbon Stock Change for AGB in the Leakage Belt (Method 1)

Carbon Stock Changes in the Aboveground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Aboveground Biomass of Initial Forest Classes in the Leakage Belt		Carbon Stock Changes in Aboveground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Aboveground Biomass of Post- deforestation Zones in the Leakage Belt		Total Net Carbon Stock Change in Aboveground Biomass of Post-deforestation Zones in the Leakage Belt	
ID_{icl}>	1	2	$\Delta Cab\ BSLLK_{icl,t}$ Annual	$\Delta Cab\ BSLLK_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cab\ BSLLK_{z,t}$ Annual	$\Delta Cab\ BSLLK_{z}$ Cumulative	$\Delta Cab\ BSLLK_{t}$ Annual	$\Delta Cab\ BSLLK$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-103,654	-18,275	-121,930	-121,930	2022	705	705	705	-121,224	-121,224
2023	-638,559	-126,003	-764,562	-886,492	2023	5,179	5,179	5,884	-759,383	-880,607
Jan 2024 - Jun 2024	-348,601	-68,974	-417,574	-1,304,066	2024	7,623	7,623	13,508	-409,951	-1,290,558

VM0015 Ex-Post Table 37 Carbon Stock Change for BGB in the Leakage Belt (Method 1)

Carbon Stock Changes in the Belowground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Belowground Biomass of Initial Forest Classes in the Leakage Belt		Carbon Stock Changes in Belowground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Belowground Biomass of Post- deforestation Zones in the Leakage Belt		Total Net Carbon Stock Change in Belowground Biomass of Post-deforestation Zones in the Leakage Belt	
ID_{icl}>	1	2	$\Delta Cbb\ BSLLK_{icl,t}$ Annual	$\Delta Cbb\ BSLLK_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cbb\ BSLLK_{z,t}$ Annual	$\Delta Cbb\ BSLLK_{z}$ Cumulative	$\Delta Cbb\ BSLLK_{t}$ Annual	$\Delta Cbb\ BSLLK$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-3,957	-825	-4,782	-4,782	2022	179	179	179	-4,603	-4,603
2023	-28,331	-6,516	-34,847	-39,629	2023	1,313	1,313	1,491	-33,534	-38,137
Jan 2024 - Jun 2024	-41,637	-9,631	-51,268	-90,897	2024	1,932	1,932	3,423	-49,336	-87,473

Then VM0015 Ex-Post Table 42 for the leakage belt was calculated using the same procedures as described in section 6.2 of the methodological annex but substituting ex-post deforestation per forest class for baseline deforestation.

VM0015 Ex-Post Table 42 Non-CO2 Emissions from Forest Fires in the Leakage Belt

Project year t	Emissions of Non-CO2 Gases from Ex-Post Forest Fires				Total Ex-Post Non-CO_2 Emissions from Forest Fires in the Leakage Belt	
	ID_{icl}	= 1	ID_{icl}	= 2		
	$ABSLLK_{icl,t}$	$EBBBSLtot_{icl}$	$ABSLLK_{icl,t}$	$EBBBSLtot_{icl}$	Annual	Cumulative
					$EBBBSLLK_t$	$EBBBSLLK$
	ha	t CO_2e/ha	ha	t CO_2e/ha	t CO_2e	t CO_2e
2022	725	5,835	241	977	6,811	6,811
2023	4,466	35,946	1,663	6,733	42,679	49,490
Jan 2024 - Jun 2024	2,438	19,623	910	3,686	23,309	72,799

Then, as per the methodology, the difference between projected carbon stock changes and actual carbon stock changes during the monitoring period in the leakage belt is calculated using VM0015 Ex-Post Table 63. Note that the $\Delta CBSLLK_t$ for the baseline and actual carbon stock changes are calculated by summing $\Delta Cab\ BSLLK_t$ and $\Delta Cbb\ BSLLK_t$ from the baseline and ex-post versions of VM0015 Table 37 respectively.

VM0015 Ex-Post Table 63 Total Net Baseline Carbon Stock Change in the Leakage Belt (Method 1)

Project year *t*	Total Ex Ante Net Baseline Carbon Stock Change		Total Ex Post Net Actual Carbon Stock Change		Total Ex Post Leakage	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	$\Delta CBSLLK_t$	$\Delta CBSLLK$	$\Delta CBSLLK_t$	$\Delta CBSLLK$	$\Delta CBSLLK_t$	$\Delta CBSLLK$

	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-127,779	-127,779	-125,828	-125,828	1,951	1,951
2023	-808,770	-936,549	-792,917	-918,744	15,854	17,805
Jan 2024 - Jun 2024	-468,554	-1,405,103	-459,287	-1,378,031	9,267	27,072

The methodology does not provide a table to calculate the difference between projected baseline non-CO_2 GHG emissions in the leakage belt and actual, but difference is calculated by comparing $EBBBSLLK_t$ from baseline and ex-post versions of VM0015 Table 42 for the leakage belt. The difference is summarized in VM0015 Ex-Post Table 61.

VM0015 Ex-Post Table 61 Estimated Leakage due to Activity Displacement

Project year t	Total Ex Ante Estimated Decrease in Carbon Stocks due to Displaced Deforestation		Total Ex Ante Estimated Increase in GHG Emissions due to Displaced Forest Fires	
	Annual	Cumulative	Annual	Cumulative
	$\Delta CADLK_t$	$\Delta CADLK$	$\Delta EADLK_t$	$\Delta EADLK$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022	1,951	1,951	-92	-92
2023	15,854	17,805	-761	-853
Jan 2024 - Jun 2024	9,267	27,072	-418	-1,271

Finally, all leakage emissions are summarized in VM0015 Ex-Post Table 62. Note that the positive sign for ΔCLK and negative sign for ΔELK indicates that no leakage occurred during this monitoring period.

VM0015 Ex-Post Table 62 Estimated Total Leakage

Project year *t*	Total Ex Post GHG Emissions from Increased Grazing Activities		Total Ex Post Increase in GHG Emissions due to Displaced Forest Fires		Total Ex Post Decrease in Carbon Stocks due to Displaced Deforestation		Carbon Stock Decrease due to Leakage Prevention Measures		Total Net Carbon Stock Change due to Leakage		Total Net Increase in Emissions due to Leakage	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	$\Delta EgLK_t$	$\Delta EgLK$	$\Delta EADLK_t$	$\Delta EADLK$	$\Delta CADLK_t$	$\Delta CADLK$	$\Delta CLPMLK_t$	$\Delta CLPMLK$	ΔCLK_t	ΔCLK	ΔELK_t	ΔELK
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022	0	0	-92	-92	1,951	1,951	0	0	1,951	1,951	-92	-92
2023	0	0	-761	-853	15,854	17,805	0	0	15,854	17,805	-761	-853
Jan 2024 - Jun 2024	0	0	-418	-1,271	9,267	27,072	0	0	9,267	27,072	-418	-1,271

3.2.4 GHG Emission Reductions and Carbon Dioxide Removals (VCS, 3.15, 4.1)

The procedures and equations for the quantification of estimated GHG emission reductions are the same as those for ex-ante estimates detailed in section 9 of the methodological annex except that ex-post estimates are used instead of ex-ante. The required values for the calculations and results are shown in VM0015 Ex-Post Table 64. Note that the positive sign for ΔCLK and negative sign for ΔELK from VM0015 Ex-Post Table 62 indicates that no leakage occurred during this monitoring period and thus for VM0015 Ex-Post Table 64 and the calculation of GHG emission reductions, these values are set to 0.

The non-permanence risk factor, ΔRF_t, was calculated using the AFOLU non-permanence risk tool. The tool was implemented separately for two different areas of the project area with different risk profiles as per section 3.6.19 2) of the VCS Standard v4.7. The basis for the split was gazetted status since gazetted village and local authority forest reserves are recognized as national protected areas and can only be de-reserved legally by the Minister under the Forest Act, 2002, which is extremely rare. Thus, the gazetted portions of the project area have indefinite longevity. Continued protection of the other portions of the project area after the end of the project contract in 2064 will be up to the managing authorities to decide, meaning that the longevity for those areas is limited to the project crediting period. The net-change in the carbon stocks in gazetted protected areas was calculated by subtracting the cumulative ex—post AGB and BGB stock changes shown in VM0015 Ex-Post Table 36 for the gazetted project area from the baseline AGB and BGB stock changes shown in VM0015 Table 36 for the gazetted project area. This yielded a change of 371,285 tCO_2e. The stock changes in the ungazetted portions in the project area were calculated by subtracting 371,285 from the difference between the total project area baseline stock changes and the total ex-post changes. This yielded 310,308 tCO_2e.

The non-permanence risk score calculated in AFOLU non-permanence risk tool in the project hub for the non-gazetted project area was 18% and for the gazetted project area it was 17%. Rather than producing separate versions of VM0015 Ex-Post Table 64 and the monitoring report template tables for reporting GHG reductions and vintages for the gazetted and non-gazetted portions of the project area, relative weighting was applied. Table 15 shows the calculation of the weighted risk score, which when applied to the whole project area changes results in the same number of buffer credits as the sum of the buffer credits required from the gazetted and non-gazetted portions of the project area.

Table 15 Weighted average non-permanence risk score

Project Area Legal Status	Net stock change for monitoring period	Non-permanence risk score	Buffer Credits

Ungazetted	310,308	18%	55855.440
Gazetted	371,285	17%	63118.450
Weighted Average		17.455269%	

VM0015 Ex-Post Table 64 Estimated Net GHG Emission Reductions: ($\Delta REDD_t$) and Verified Carbon Units (VCU_t)

Project year *t*	Baseline Carbon Stock Changes		Baseline GHG Emissions		Ex Post Project Carbon Stock Changes		Ex Post Project GHG Emissions		Ex Post Leakage Carbon Stock Changes		Ex Post Leakage GHG Emissions		Ex Post Net Anthropogenic GHG Emission Reductions		Ex Post VCUs Tradable		Ex Post Buffer Credits	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	$\Delta CBSLPA_t$	$\Delta CBSLPA$	$EBBBSLPA_t$	$EBBBSLPA$	$\Delta CPSPA_t$	$\Delta CPSPA$	$EBBPSPA_t$	$EBBPSPA$	ΔCLK_t	ΔCLK	ELK_t	ELK	$\Delta REDD_t$	$\Delta REDD$	VCU_t	VCU	VBC_t	VBC
	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-94,028	-94,028	5,123	5,123	-35,320	-35,320	1,928	1,928	0	0	0	0	61,903	61,903	51,655	51,655	10,248	10,248
2023	-639,594	-733,621	34,783	39,906	-242,950	-278,270	13,231	15,158	0	0	0	0	418,197	480,100	348,962	400,617	69,235	79,483
Jan 2024 - Jun 2024	-364,910	-1,098,531	18,930	58,836	-138,669	-416,938	7,202	22,360	0	0	0	0	237,969	718,068	198,478	599,094	39,491	118,974

State the non-permanence risk rating (%)	18% on 310,308 tCO2e in stock changes in Ungazetted project areas and 17% on 371,285 tCO2e in stock changes in gazetted project areas
Has the non-permanence risk report been attached as either an appendix or a separate document?	☒ Yes ☐ No Two non-permanence risk reports have been completed in the project hub for gazetted and ungazetted portions of the project area
For ARR and IFM projects with harvesting, state, in tCO2e, the Long-term Average (LTA).	This is not an ARR or IFM project
Has the LTA been updated based on monitored data, if applicable?	☐ Yes ☐ No This is not an ARR or IFM project
State, in tCO2e, the expected total GHG benefit to date.	817,776
If a loss occurred (including a loss event or reversal), state the amount of tCO2e lost:	No loss occurred

Note that the VCS monitoring report template v4.4 states to complete the following table for the "crediting period", so the table includes a rows for prior monitoring periods. However, for consistency with the verification template, the project has also included a version of the table that only covers the current monitoring period.

Vintage period	Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Leakage emissions (tCO_2e)	Buffer pool allocation (tCO_2e)	Reductions VCUs (tCO_2e)	Removals VCUs (tCO_2e)	Total VCU issuance (tCO_2e)
21-Apr-2012 to 20-Apr-2013	135,552	95,656	0	3,725	36,171		36,171
21-Apr-2013 to	85,451	76,760	1182	1,665	1,113		1,113

31-Dec-2013							
01-Jan-2014 to 31-Dec-2014	121,090	108,879	1786	2,340	1,517		1,517
01-Jan-2015 to 31-Dec-2015	120,975	92,825	548	5,393	4,820		4,820
01-Jan-2016 to 31-Dec-2016	117,208	63,571	0	10,275	9,571		9,571
01-Jan-2017 to 31-Dec-2017	112,769	63,487	0	9,445	8,789		8,789
01-Jan-2018 to 31-Dec-2018	107,756	112,855	0	2,530	2,353		2,353
01-Jan-2019 to 31-Dec-2019	107,168	139,246	0	0	0		0
01-Jan-2020 to 31-Dec-2020	105,271	127,364	0	0	0		0
01-Jan-2021 to 31-Dec-2021	102,787	124,761	92	0	0		0
01-Jan-2022 to 20-Apr-2022	30,646	37,913	39	0	0		0

21-Apr-2022 to 31-Dec-2022	99,150	37,248	0	10,248	51,655		51,655
01-Jan-2023 to 31-Dec-2023	674,377	256,180	0	69,235	348,962		348,962
01-Jan-2024 to 30-Jun-2024	383,839	145,871	0	39,491	198,478		198,478
Total	2,304,040	1,482,615	3,648	154,347	663,428		663,428

Vintage period	Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Leakage emissions (tCO_2e)	Buffer pool allocation (tCO_2e)	Reductions VCUs (tCO_2e)	Removals VCUs (tCO_2e)	Total VCU issuance (tCO_2e)
21-Apr-2022 to 31-Dec-2022	99,150	37,248	0	10,248	51,655		51,655
01-Jan-2023 to 31-Dec-2023	674,377	256,180	0	69,235	348,962		348,962
01-Jan-2024 to 30-Jun-2024	383,839	145,871	0	39,491	198,478		198,478
Total	1,157,367	439,299	0	118,974	599,094		599,094

Vintage period	Ex-ante estimated reductions/ removals	Achieved reductions/ removals	Percent difference	Explanation for the difference
21-Apr-2022 to 31-Dec-2022	29,497	61,903	110%	Ex-ante estimates assumed project activities would

				only reduce deforestation by 35% during this period. Performance was higher likely because this portion of the monitoring period only covered the instance 1 villages, which were historically effective at stopping deforestation apart from the land lost to municipalization. Losses associated with the municipalization stopped in early 2022. Additionally, the ex-ante estimates assumed some leakage, but no leakage occurred.
01-Jan-2023 to 31-Dec-2023	194,215	418,197	115%	Ex-ante estimates of credits assumed that project activities would only reduce deforestation by 35%. This ignored that instance 1 activities were already effective and was overly pessimistic regarding the project's effectiveness in instance 2.

				Additionally, some leakage was expected in the ex-ante estimates, but none was observed. This is likely due to the project's no-eviction policy which allowed farmers to continue to farm in existing clearings.
01-Jan-2024 to 30-Jun-2024	155,513	237,969	53%	Ex-ante estimates of credits assumed that project activities would only reduce deforestation by 50%. This ignored that instance 1 activities were already effective and was overly pessimistic regarding the project's effectiveness in instance 2. Additionally, some leakage was expected in the ex-ante estimates, but none was observed. This is likely due to the project's no-eviction policy which allowed farmers to continue to farm in existing clearings.

Total	379,226	718,068	89%	Overall, the ex-ante estimates of the project's effectiveness at reducing deforestation were too pessimistic and leakage did not occur due to the project's no eviction policy.

3.3 Optional Criterion: Climate Change Adaptation Benefits

3.3.1 Activities and/or processes implemented for Adaptation (CCB, GL1.3)

For this monitoring period, due to funding constraints, the project focused on activities required to improve protection of the project areas and reduce GHG emissions. This means that the climate adaptation benefits during this monitoring period are limited to those associated with improved forest protection compared to baseline. These include reduced local temperatures and protection of water sources in village forest reserves which many project communities depend upon for drinking water and irrigation.

It is widely established that tropical forest cover reduces local surface temperatures due to increased evapotranspiration and surface roughness compared to non-forest land-covers[15]. Studies suggest that 50% reduction in tropical forest cover can be result in as much as a 1.7 C increase in temperatures within a 5x5 km cell[16] and that forests can reduce temperatures over 800 meters from the forest edge[17]. Thus, simply by maintaining more forest cover compared to baseline, the project will help communities adapt to climate change by mitigating local temperature increase compared to baseline.

[15] Lawrence, D., Coe, M., Walker, W., Verchot, L., & Vandecar, K. (2022). The unseen effects of deforestation: biophysical effects on climate. Frontiers in Forests and Global Change, 5, 756115.

[16] Prevedello, J. A., Winck, G. R., Weber, M. M., Nichols, E., & Sinervo, B. (2019). Impacts of forestation and deforestation on local temperature across the globe. PloS one, 14(3), e0213368.

[17] Yin, S., Peng, L. L., Feng, N., Wen, H., Ling, Z., Yang, X., & Dong, L. (2022). Spatial-temporal pattern in the cooling effect of a large urban forest and the factors driving it. Building and Environment, 209, 108676.

It is also established that increased forest cover helps to reduce wet season runoff and increase dry season runoff[18]. Increasing temperatures due to climate change will likely cause greater evaporation of water ways during the dry season. Maintaining more forest cover compared to baseline will help communities adapt to climate change by maintaining water flow in streams and rivers longer during the dry season than would occur if the forest cover were removed.

During the monitoring period, the project also provided alternative income sources to community members involved in forest patrols and boundary clearing work as documented in section 4.4.1. While limited, the income for those community members at least represented an alternative source of income which is unaffected by climate.

Once sales occur from VCUs generated during this monitoring period, the project will have sufficient resources to start to implement the other climate adaptation activities listed in the PD. The project has already begun some of planned agricultural extension support after the monitoring period concluded even before credit sales.

4 COMMUNITY

4.1 Net Positive Community Impacts

4.1.1 Community Impacts (CCB, CM2.1)

The table below outlines the impacts of project activities on each community group under the with-project scenario. This includes all anticipated impacts identified in the project description and realized during the current monitoring period, with no unforeseen outcomes observed during implementation.

Community group	60 rural communities comprising of 5 CBOs and 283 sub-villages with more than 145,609 people , 69,377 men and 76,232 women19
Impact	Carbon credit income worth $2.2 million
Type of benefit/cost/risk	This impact is predicted, as communities are expecting to receive carbon payments following successful CCB validation and overall project verification.

[18] Ogden, F. L., Crouch, T. D., Stallard, R. F., & Hall, J. S. (2013). Effect of land cover and use on dry season river runoff, runoff efficiency, and peak storm runoff in the seasonal tropics of Central Panama. Water Resources Research, 49(12), 8443-8462.

[19] Population data comes from data provided by village leaders during initial focus group meetings with VCSL to discuss joining the project.

	It is a direct impact of the project, as the anticipated income stems from project-supported actions that have demonstrably reduced deforestation. These reductions, compared to the without-project scenario, have generated verified emission reductions, which form the basis for issuing carbon credits and generating revenue. This is a benefit because it represents a new, performance-based income stream for communities. The funds will reward their efforts in forest protection.
Change in well-being	This is a financial impact resulting from VCUs achieved through project-supported forest conservation activities. It falls under the category of economic benefits, specifically performance-based payments for reduced deforestation. The magnitude is high, based on its relative importance to the communities involved. The income represents a significant inflow of resources for rural communities, which have limited income sources. This funding has the potential to support: Local social services (e.g. schools, water, health) Forest patrols and governance systems, Improving agriculture, Improving land tenure security, Community infrastructure, and Direct dividends to the families. Given the scale of benefit, this impact has the potential to transform local economies, strengthen conservation outcomes, and reduce reliance on unsustainable forest use.

Community group	Population living within the project area and leakage belt
Impact(s)	An average of 1% increase in yield of their arable land.
Type of benefit/cost/risk	This impact is predicted, as the increase in yield is expected to occur over time due to two key factors: (1) the project's support for agricultural extension services and (2) the community's planned use of carbon revenues to invest in improved agricultural practices. These

	two activities are expected to commence upon approval of this verification report and issuance of the anticipated VCUs, generating approximately $2.2 million in community revenues. The impact is direct because it stems immediately from project-supported actions (agricultural extension services) and community decisions to allocate carbon income toward agriculture. This is a benefit because increased agricultural productivity leads to improved food security, household income, and resilience. Farmers will be able to produce more from the same land area, supporting livelihoods and reducing pressure on forests.
Change in well-being	The impact is socio-economic, as increased agricultural yield contributes to improved household food security, increased income stability, and enhanced resilience to climate and economic shocks among communities within the project area and leakage belt. The magnitude of this impact is considered significant, as even a modest average increase of 1% in agricultural yield can reduce the need for agricultural expansion beyond baseline conditions, thereby offsetting additional forest clearing above the levels predicted under the without-project scenario within the leakage belt and supporting more sustainable and secure livelihoods.

Community group	Village Natural Resource Committee, with a total of 664 members comprising of 208 female and 456 males[20]
Impact	Demonstrated Capacity to operate cloud-based platforms (mergin map), supported by outcome-driven forest patrol funding initiated by the project[21].
Type of benefit/cost/risk	This impact is actual because the participating villages have smartphones, loaded with Mergin maps, that they use to identify new deforestation, navigate to the deforested polygons, record and share patrol data. This impact is direct as it is immediately and measurably from the project's support. The project facilitated the use of Mergin

[20] Villages CCB survey data 2024

[21] Well documented patrol data are available in the project's database to justify this impact

	Maps, which led directly to villages using smartphones to detect deforestation, navigate affected areas, and share real-time data. This is a benefit because it enhances local capacity, efficiency, and responsiveness in forest protection. Villages are now better equipped to detect and respond to deforestation threats—this reduces forest loss, improves forest governance, and increases the effectiveness of conservation efforts.
Change in well-being	Type of Impact: The use of smartphones with Mergin maps has significantly improved the efficiency of forest patrols. By enabling patrol teams to quickly detect and navigate to newly deforested areas, the technology has enhanced real-time communication and coordination. This has allowed for a more proactive and targeted response to deforestation threats, increasing the overall effectiveness of conservation efforts. Magnitude of Impact: The magnitude of this impact is notable in terms of both immediate and long-term effects. In the short term, patrol teams are able to identify and respond to deforestation incidents faster, reducing damage to critical forest areas. Over time, the improved surveillance and deterrence of illegal activities are expected to decrease the frequency of deforestation, thereby reducing the patrol teams' workload and contributing to sustained forest protection. The technology is expected to lead to significant conservation outcomes, fostering more effective management and reducing the strain on resources required for manual monitoring and patrols.

Community group	Forest boundary clearing team; 566 people, comprised of 527 males and 39 females from 14 villages[22]
Impact	Additional jobs for communities during the lean season (September – October 2023) when farm workloads were lighter
Type of benefit/cost/risk	The impact is actual, as the team got an additional income source worth 20.9 million TZS ($8700 USD) during that season.

[22] Details loaded in the project's boundary clearing team and payment spreadsheet.

	This impact is direct because the additional income was a result of specific project actions; that the project organized and paid for forest boundary clearing leading directly to the actual income gain during September–October 2023. This is a benefit because it provided communities with a new income stream during a time of year when earnings are typically low due to reduced farm work.
Change in well-being	Type of Impact: The impact is economic, offering an additional income source for community members during the lean season when farm workloads were lighter. The forest boundary clearing initiative generated temporary jobs for 566 individuals (527 men and 39 women) across 14 villages. Magnitude of Impact: The impact's magnitude is substantial, with participants collectively earning 20.9 million TZS ($8700 USD) during the September–October 2023 lean season. This income provided critical support to local livelihoods, as the majority of interviewed beneficiaries reported using the earnings for essential needs such as family food and personal goods, enhancing community resilience during a period of reduced agricultural income.

Community group	Village Council, comprising of 1,068 members (342 female and 726 male)[23]
Impact	Improved tenure security and protection of forest resources within the village land, resulting from better understanding of community-based forest management, REDD and VCSL Model.
Type of benefit/cost/risk	This is actual as 97,919 additional hectors of community forests were put under formal management with revised Forest Management Plans approved. Communities can now protect and benefit from these forests through sustainable utilization mechanisms even without REDD+. This impact is direct because the expansion of 97,919 hectares under formal management happened as a direct

[23] CCB monitoring data collected in 2024

	result of project facilitation. The project guided the revision of Forest Management Plans and supported the approval process. These activities immediately led to the formal recognition and management of additional community forest areas. This is a benefit because it gives communities formal rights and tools to sustainably manage and utilize their forests. Even without REDD+ payments, they now have the legal basis to protect resources, implement bylaws, and benefit from forest products like timber, firewood, and non-timber goods under sustainable practices.
Change in well-being	Type of Impact: The impact is environmental and economic. Establishing and expanding Village Land Forest Reserves (VLFRs) fosters sustainable forest management and conservation, aligning with REDD objectives. The creation and expansion of VLFRs by Village Councils enable long-term carbon trade benefits, supporting both conservation and income generation. Magnitude of Impact: The magnitude is substantial, with 6 Village Councils creating new VLFRs and 56 expanding existing ones. Through 40-year carbon trade contracts with VCSL, this initiative has the potential to generate consistent income for the communities and provide lasting forest protection. The long-term nature of these contracts indicates a robust commitment to sustainable forest management, which will benefit communities over multiple decades, directly supporting their economic resilience and environmental goals.

Community group	Youth, 12 to 25 years
Impact(s)	Improved completion rate of primary education, lower secondary education, and upper secondary education.
Type of benefit/cost/risk	This impact is predicted, as it reflects an expected future outcome based on two key actions: (1) community sensitization on the importance of education, and (2) the decision by villages to allocate a portion of the expected $2.2 million carbon revenues to support education (e.g., school infrastructure, scholarships, or learning

	materials). These efforts aim to reduce dropout rates and improve educational attainment over time. The impact is direct because it results immediately from the projects and community's own actions; project's sensitization activities which will trigger communities' financial investments using revenues from VCUs, aimed at improving education. These efforts target known barriers to education completion (e.g., cost, motivation, school conditions). This is a benefit because higher education completion rates among youth lead to enhanced skills, future employment opportunities, and long-term social mobility.
Change in well-being	Improved knowledge will enable more youth to pursue stable employment opportunities beyond slash-and-burn agriculture. It supports the development of human capital, contributing to broader community development and resilience.

4.1.2 Negative Community Impact Mitigation (VCS, 3.19; CCB, CM2.2)

There was no negative impact on communities anticipated or observed during this monitoring period. The project focused on Community-Based Forest and Wildlife Management schemes, which were established under Free, Prior, and Informed Consent (FPIC) principles based on procedures stipulated in the Forest Act, CAP 323 of the Laws of Tanzania. Forest management bylaws and national policies explicitly prohibit farming in these reserved areas. Without the project, farmers within these reserves would risk occasional legal evictions attempts, jeopardizing their confidence to venture into long-term future agricultural investments.

However, the project's philosophy allows existing farmers to retain their current plots, which is widely accepted by the Managing Authorities. The cloud-based mobile technology already in use helps swiftly detect and address new clearings, enhancing trust. Additionally, the project started financing the creation of cutlines and other visible boundary marks along forest reserve perimeters adjoining farms and residential areas, ensuring clear delineation of farming limits.

4.1.3 Net Positive Community Well-Being (VCS 3.19; CCB, CM2.3, GL1.4)

The project has provided substantial net benefits for community groups compared to a "without-project" land use scenario. The Village Natural Resource Committees (VNRCs), comprising 708 members, are now equipped to use a cloud-based platform, Mergin Map, which is backed by consistent, outcome-based funding for forest patrols. Without this project, villages would not have access to such technology, and traditional patrol methods, labor-intensive, time-consuming, and less effective at preventing deforestation, would persist. Additionally, patrols would remain severely underfunded, increasing the vulnerability of forest resources.

The project has also enhanced economic resilience through a forest boundary clearing initiative that employed 566 individuals from 14 villages during the lean season in September and October 2023. This initiative generated temporary income totaling 20.9 million TZS, which many community members used to purchase food and other essential goods.

Village Councils, comprising 1,068 members, developed essential skills in implementing community-based forest management and REDD initiatives, generating climate, community, and biodiversity benefits. By establishing new Village Land Forest Reserves (VLFRs) and expanding existing ones by over 97,919 hectares, the councils have effectively transitioned open-access tenure into managed communal forest land. This initiative positions communities to earn long-term carbon trade income through VCSL. Under the carbon trade contract, communities are guaranteed a minimum of 51% of gross revenues, along with the continued preservation of their forest resource base, which holds value for future sustainable use. This provides a more stable and substantial income compared to the unpredictable returns from rain-fed slash-and-burn agriculture, which has become increasingly unreliable due to the impacts of climate change.

4.1.4 Protection of High Conservation Values (CCB, CM2.4)

The project neither introduced nor planned any new restrictions on the use of village land forest reserves or local authority forest reserves, other than those established by the Managing Authorities themselves through bylaws, which uphold the High Conservation Value (HCV) of the project area for the communities. Instead, it promoted the application of existing regulations and communities' administrative structure to support conservation efforts. No new limitations were imposed on the sustainable use of forest resources. This approach ensures that communities continue to benefit from forest resources while adhering to conservation standards

4.2 Other Stakeholder Impacts

4.2.1 Mitigation of Negative Impacts on Other Stakeholders (VCS, 3.18, 3.19; CCB, CM3.2)

Only two groups of stakeholders would have potentially faced negative impacts on their livelihoods due to the project. The first group includes Forest User Groups, particularly those involved in cutting and selling wood for timber and charcoal. These groups would have been adversely affected if new use restrictions had been introduced. However, instead of imposing additional restrictions, the project philosophy allowed users to continue operating under existing regulations as set out in the relevant forest bylaws. To prevent excessive harvesting that could impact carbon credits, the project established a contractual requirement for managing authorities to limit harvesting to a maximum of 1% of the standing biomass annually, in line with the Forest Act, CAP 323, which will be monitored over time.

The second group includes communities residing within or near forest reserves in the project area. Enforcing existing legal restrictions on residing or farming within these reserves could have

led to evictions or attempted evictions, disrupting their livelihoods. Instead, the project embraced a no-eviction approach if residents refrain from causing new deforestation. Patrol teams raised awareness among farmers about their presence within the reserve, emphasizing that they would not face eviction but should avoid cutting trees apart from clearing farm fallows less than 10 years old. Looking ahead, the project will also provide agricultural extension services to help farmers improve yields without clearing additional forested areas. Additionally, the project worked with Managing Authorities to remove heavily encroached, consistently farmed polygons within the pre-existing reserves, covering 7,811 hectares from existing VLFRs and 12,388 from the proposed Ndonda WMA, thereby creating more defensible boundaries for patrol teams and reducing potential conflicts.

4.2.2 Net Impacts on Other Stakeholders (VCS, 3.18, 3.19; CCB, CM3.3)

The Village Climate Solutions Project (VCSP) engaged a diverse range of stakeholders, including Local Government Authorities (LGA), regional administrations, Designated National Authority (DNA), forest user groups, and national conservation agencies. Throughout the monitoring period, no negative impacts were observed on these stakeholders. VCSP collaborated closely with LGAs, regional administrations, and DNA in developing the project, including the idea note, concept note, and project document. Additionally, the project worked with District Forest Officers to introduce and operationalize patrol technology.

For Forest User Groups, such as timber and charcoal producers, the project avoided imposing new use restrictions, instead allowing continued access under existing bylaws. Harvesting was limited to 1% of standing biomass annually, in compliance with legal standards, supporting sustainable resource use without disrupting livelihoods. For communities living within or near the reserves, the project adopted a no-eviction policy, provided they refrained from causing further deforestation. Patrol teams focused on raising awareness, ensuring these communities understood their location within the reserve but would not face eviction. They were also informed of potential future benefits from agricultural extension services aimed at improving crop yields on existing farmland.

By ensuring collaboration in the project design, respecting existing use rights, preventing evictions, and providing awareness on project benefits, VCSP promoted positive outcomes for stakeholder well-being while fostering sustainable forest management.

4.3 Community Impact Monitoring

4.3.1 Community Monitoring Plan (CCB, CM4.1, CM4.2, GL1.4, GL2.2, GL2.3, GL2.5)

This section presents the results of community impact monitoring conducted during the monitoring period in accordance with the project's Community Monitoring Plan and Theory of Change (ToC). Monitoring assessed progress related to implementation of forest governance,

boundary clarification, patrol systems, community participation, employment generation, and other community well-being indicators identified in the monitoring plan and ToC pathways.

Monitoring covered all project communities, community groups, managing authorities, and community well-being values identified in the monitoring framework. Information was collected through structured surveys, focus group discussions, patrol records, village records, training records, financial records, meeting minutes, field observations, and stakeholder interviews conducted during the monitoring period.

Monitoring activities included:

- opportunity cost survey;
- monitoring of forest governance and participation;
- monitoring of education, livelihoods, land tenure, and social services;
- monitoring of patrol, boundary management, and forest protection activities; and
- monitoring of employment and benefit-sharing related activities.

The monitoring process generated both quantitative and qualitative information used to evaluate project implementation progress, assess community impacts, and inform adaptive management. Data collection activities were conducted continuously at key implementation stages depending on the indicator and monitoring approach applied, and at the end of monitoring period.

Monitoring Process and Methods

Interviews with Farmers During the Opportunity Cost Survey: Before the project launch in 2022, the project conducted an opportunity cost survey involving 102 farmers associated with recently deforested areas within the project zone. The survey targeted farmers located at 10 randomly selected deforestation points identified from areas cleared between 2017 and 2020 using PALSAR radar data and GIS analysis. Each sample point was verified using high-resolution Google Earth imagery and Sentinel-2 data before field visits were conducted. Survey teams used GPS-enabled smartphones to navigate to sampled locations, while village representatives assisted in identifying farm owners and nearby cleared farms. Only farmers who confirmed ownership and forest clearance within the previous three years participated in the interviews. Structured questionnaires administered through the ODK tool were used to collect socio-economic and livelihood information to establish baseline community conditions relevant to the project's monitoring framework and Theory of Change.

Focus Group Discussions During Consent Meetings: During consent meetings conducted across 57 participating communities, the project carried out focus group discussions involving Village Councils and Village Natural Resource Committees as part of the community monitoring process. These discussions were conducted during the project establishment phase and

contributed information relevant to governance, socio-economic conditions, education, and forest management practices. A total of 1,610 participants attended the discussions, including 507 women, 1,103 men, and 259 youth representatives. In addition, village assemblies conducted alongside the discussions involved 5,456 participants. The discussions covered topics related to project area management, demographic conditions, education status, governance structures, and community participation in forest management.

Interviews with Farmers During Forest Patrol Activities: Throughout the monitoring period from February 2023 to June 2024, the project conducted continuous monitoring interviews with individuals associated with detected forest disturbances during forest patrol activities. Patrol teams used Mergin Maps integrated with interview questionnaires. Smartphones provided to patrol teams enabled field verification of deforested polygons and recording of information regarding disturbance agents whenever possible. This monitoring approach was purposive, targeting all detected disturbance locations within the project area. By June 2024, patrol teams had recorded 4,853 disturbance entries, which were subsequently filtered into 2,501 unique entries based on names and age profiles. Minor spelling inconsistencies resulted in limited duplication but were not considered likely to introduce systematic bias. The interviews generated monitoring information related to drivers of deforestation, educational background, livelihood conditions, and community dependence on forest resources during the monitoring period.

Interviews with Boundary Clearing Beneficiaries: During implementation of forest boundary clearing activities throughout the monitoring period, the project conducted structured interviews with beneficiaries participating in boundary clearing work. The monitoring targeted community members directly engaged in cutline establishment activities within participating villages. Structured questionnaires were used to collect demographic information, participation data, and information regarding the use of income generated through boundary clearing employment. A total of 566 participants were interviewed, including 527 men and 39 women. The information collected contributed to monitoring project-supported employment, livelihood benefits, and community participation in forest protection activities.

Focus Group Discussions at the End of the First Monitoring Period: At the end of this monitoring period in 2024, the project conducted focus group discussions with representatives from project communities to evaluate changes and community experiences during the monitoring period. Participants included sub-village leaders, village chairpersons, village executive officers, village civil servants, and Village Natural Resource Committee members from participating project villages. The discussions applied purposive sampling to include key governance and community representatives involved in project implementation and local forest management. A total of 660 participants attended, including 117 women, 543 men, 37 youth, 252 individuals with secondary education or higher, 240 sub-village leaders, 107 village chairpersons and executive officers, 169 village civil servants, and 122 Village Natural Resource Committee leaders. Discussions focused on forest management, education, health, water access, land tenure, grievance management, governance, and general community well-being, including

community perceptions regarding project implementation and related changes observed during the monitoring period.

Project Implementation Progress During the Monitoring Period

During the monitoring period, the project implemented activities linked to the Theory of Change, including boundary clarification and cutline establishment, strengthening of Village Natural Resource Committees, deployment of cloud-based forest patrol systems, governance and REDD awareness trainings, consent meetings, patrol implementation, and employment generation through forest protection activities. Monitoring also documented community investments supported through earlier performance-based payments in selected villages, particularly in education, water, and health infrastructure.

Community Context

Project Sites: The project spans 60 communities across Nachingwea, Mtama, Lindi Municipality, Morogoro, Kilosa, Mvomero, and Mikumi Local Authorities. These include 54 Village Councils, 5 Community-Based Organizations managing forests on municipal and township land, 1 Local Authority Forest Reserve, and 1 forest block owned by the University of Dar es Salaam. There are 280 sub-villages, with 176 (63%) of them adjacent to the project area.

Demographics: The project area comprises 36,827 households with 145,609 people (76,232 female, 69,327 male), including 84,545 adults and a working population of 70,058 (48%). Approximately 19,749 households (54%) with 68,251 people (47%) live in the sub-villages which are adjacent to the project area (the village land forest reserves).

Village Council and Natural Resource Committee Members: Data collected from the project sites in July 2024, prior to the local government elections, documented 1,068 Village Council members, comprising 342 females (32%) and 726 males (68%). Natural Resource Committees had 664 members, comprising 208 females (31%) and 456 males (69%). At least 62% of these sites had a female leader on the Natural Resource Committee.

Community livelihoods remain primarily dependent on smallholder agriculture and forest-related ecosystem services. The monitoring results presented in the following sections establish baseline conditions and implementation progress related to governance participation, education, livelihoods, land tenure, social services, and community well-being indicators identified in the monitoring plan and Theory of Change.

Monitoring Results Against Community Indicators and Theory of Change Pathways

Participation in benefit-sharing decision-making meetings, disaggregated by sex and youthhood, measured as percentage (%) of participants: No benefit-sharing meetings were conducted during the monitoring period because the project had not yet generated actual VCU revenues. However, meetings related to consent acquisition and approval of carbon trade contracts, including discussions on the overall benefit-sharing model in accordance with national regulations, were conducted. Village Council meetings were attended by a sum of

1,713 participants, including 31% women, 69% men, and approximately 13% youth. Village General Assemblies and Community-Based Organization meetings were attended by a sum of 5,206 participants, including 39% women, 61% men, and approximately 18% youth.

Smallholder farmers perceiving benefit-sharing decision-making processes as inclusive and responsive, measured as percentage (%) of interviewed smallholder farmers: Assessment of smallholder farmers' perceptions regarding inclusiveness and responsiveness of benefit-sharing decision-making processes was not conducted during the monitoring period because the project had not yet started delivering actual carbon revenue benefits to communities. The assessment will commence during future monitoring periods following implementation of carbon revenue distributions and associated benefit-sharing activities.

Total revenue generated from carbon credits paid to Managing Authorities and communities, measured as USD distributed: No carbon revenue distributions to Managing Authorities and communities occurred during the monitoring period because the project had not yet generated verified VCUs for issuance and sale. Monitoring of USD distributions to Managing Authorities and communities will commence during future monitoring periods following issuance and commercialization of verified carbon credits.

Proportion of carbon revenues allocated to dividends and social development priorities, measured as USD allocations: Assessment of carbon revenue allocations toward household dividends and social development priorities was not conducted during the monitoring period because the project had not yet generated distributable carbon revenues. Monitoring of USD allocations toward household dividends, education, water services, health services, communal farming projects, and other social development priorities will commence during future monitoring periods following carbon revenue distributions.

Participation in project-administered trainings during the monitoring period, disaggregated by sex, measured as percentage (%) of participants: Participation in project-administered trainings during the monitoring period reached 1,732 Village Council and Village Natural Resource Committee members, comprising 32% women and 68% men. Trainings focused on REDD implementation, cloud-based patrol systems, forest monitoring technology, forest governance, and the VCSL implementation model.

Completion rate of primary, lower secondary, and upper secondary education by sex, measured as percentage (%) completion rate by education level and sex: The project had not yet contributed to the observed completion rates during the monitoring period because carbon revenue distributions to communities had not yet commenced. Completion rates assessed against students enrolled at the beginning of each education cycle showed that primary education completion rate reached 85%, with girls at 86% and boys at 84%; lower secondary completion rate reached 58%, with girls at 57% and boys at 59%; while upper secondary completion rate reached 74%, with girls at 89% and boys at 68%. Overall, the project area had approximately 17,794 youths of secondary-school age in 2024, with 5,443 enrolled in secondary schools, representing a 31% attendance rate.

Participation in vocational and tertiary education, disaggregated by sex, measured as percentage (%) increase in number of students: The project did not yet contribute to measurable progress in vocational and tertiary education during the monitoring period. However, participation in vocational and tertiary education included 89 students in Vocational Education and Training (VETA), comprising 29 females (33%) and 60 males (67%); 169 students in lower colleges, comprising 72 females (43%) and 97 males (57%); and 184 students in higher education institutions, comprising 49 females (27%) and 135 males (73%). Of the 13,015 tertiary-age youth, only 442 were participating in tertiary education, representing approximately 3% of the eligible population.

Proportion of smallholder farmers adopting climate-resilient agronomic practices, measured as percentage (%) of farmers: During this monitoring period, the project had not yet begun providing agricultural extension services because of limited funding while the project remained under monitoring and verification. However, 36% of project villages received basic agricultural extension services from Local Government Authority officers. Fertilizers and manure were primarily used by horticultural farmers, with 24% of farmers reporting fertilizer use and 9% reporting manure use.

Proportion of agricultural area under productive and sustainable agriculture, measured as percentage (%) of agricultural land: No measurable progress was recorded against this indicator during the monitoring period because the project was still under monitoring and verification and had not yet generated saleable VCUs to finance implementation of planned agricultural extension and climate-resilient farming interventions.

Average crop yield per unit area for sesame, maize, and pigeon pea, measured as average kg/ha: No measurable progress was recorded regarding average crop yield per unit area for sesame, maize, and pigeon pea during the monitoring period because the project was still under monitoring and verification and had not yet generated saleable VCUs to finance implementation of planned agricultural extension and climate-resilient farming interventions.

Population with access to basic social services, measured as percentage (%) of population: During this monitoring period, the project did not contribute to improvements in health insurance, water services, or electricity access because carbon revenue distributions to communities had not yet commenced. However, information on community well-being and access to social services show that health insurance services reached 1,443 households (4%), benefiting 4,991 people, including 2,782 females and 2,209 males. Piped water services benefited 12,872 households (35%), while 2,298 households (6%) used improved rainwater harvesting systems. National grid electricity served 4,790 households (13%), benefiting approximately 15,240 people, while solar lighting systems were used by 25,971 households (71%), benefiting approximately 89,315 people.

Adult population with secure tenure rights to land, measured as percentage (%): No measurable progress was recorded against this indicator during the monitoring period because the project did not support issuance of Certificates of Customary Rights of Occupancy (CCROs) during this

period. However, assessment results showed that 33% of project villages had begun issuing CCROs, primarily with support from TFCG and MJUMITA. By 2024, a total of 4,973 households (14%) possessed CCROs, including 1,879 female-headed households (38%), 3,094 male-headed households (62%), and 30 households involving people living with disabilities. All surveyed sites perceived their tenure conditions as secure, with 51% describing tenure as "well secured" and 49% as "somehow secured."

Employment generated through project-supported forest protection and governance activities, disaggregated by sex and expressed as Full-Time Equivalents (FTEs): During the monitoring period, the project funded 773 forest patrols, each involving an average of four participants, 31% of whom were women. Each patrol required approximately eight hours of work per participant. The project additionally supported creation of a 502 km cutline, employing local community members, where each worker cleared approximately 1 km over four days, with women representing 7% of the workforce. Together with 10 full-time employees, including two women, the total workforce equated to approximately 33 Full-Time Equivalents during the monitoring period, including seven women and 26 men. Boundary clearing and patrol implementation generated approximately TZS 20.9 million (USD 8,700) in additional income benefiting 527 men and 39 women across 14 villages.

Communities reporting maintained or improved access to forest-related ecosystem services, measured as percentage (%): During this monitoring period, qualitative information was collected through focus group discussions and stakeholder consultations indicated that communities continued recognizing the importance of forest conservation for maintaining rainfall patterns, regulating local temperatures, protecting water sources, and reducing erosion and land degradation. Discussions further suggested increased community awareness regarding forest protection and continued participation in patrol and forest management activities.

For example, during discussions held on 11 July 2024, a Village Council member from Milola-Magharibi village stated:

> "We never stop the patrols; instead, we continued them on a weekly basis. We understand that the forest plays a crucial role in maintaining regular precipitation and regulating temperatures in our area. Fortunately, we didn't encounter significant illegal activities in Noto, as many community members respect it as our own reserve."

Similarly, during discussions conducted on 10 July 2024, the Chairperson of the NONA Community Based Organization in Nandambi associated historical forest clearing with changes in local rainfall patterns and increased community awareness regarding forest protection:

> "In recent years, we've noticed a decline in rainfall here in Nandambi compared to our neighboring upland villages (Mkombamosi and Muungano). In the past, a cloudy sky meant rain for us, but now it falls only in the

> neighboring upland villages. We suspect this change is linked to the large-scale clearing of natural forests between 2018 and 2021. Now, everyone here is committed to protecting the remaining forests."

Stakeholder consultations further highlighted concerns regarding erosion and siltation linked to previous forest clearing activities. During discussions held on 10 July 2024, the Ward Councilor for Tandangongoro explained:

> "The extensive clearing has caused increased erosion, leading to siltation in the lowland Rutamba dams. As the ward councilor, I have been addressing this in council meetings and community gatherings to ensure that the conversion of reserved community forests for farming does not happen again. Both Rutamba and the neighboring villages now understand the issue and are happy to get support to formally protect their own forests."

Overall, the monitoring results demonstrate implementation progress consistent with the project's Theory of Change during the monitoring period. Monitoring confirmed implementation of forest governance strengthening activities, boundary clarification and patrol systems, community participation processes, and employment generation through forest protection activities. Monitoring further documented community perceptions regarding project impacts, maintenance of HCVs related to community well-being, and progress toward longer-term livelihood improvement, expanded benefit-sharing arrangements, agricultural development, education, and social service outcomes that will continue to be assessed during future monitoring periods.

4.3.2 Monitoring Plan Dissemination (CCB, CM4.3)

Monitoring reports was submitted to the Designated National Focal Point and uploaded to the Verra registry for public review before each verification. A summary of the annual monitoring report has been emailed to Executive Directors and Project Focal Points of the participating Local Authorities. Additionally, each monitoring report has been summarized, translated into Swahili, printed, and distributed to all Managing Authorities. This summary was also presented at decision-making meetings (village council and village general meetings) of the Managing Authorities. Clause 14.3 of the carbon trade agreement requires the Project Proponent to attend annual meetings with each Managing Authority and Manager to discuss project outcomes, present performance metrics, and report on monitoring results.

4.4 Optional Criterion: Exceptional Community Benefits

4.4.1 Short-term and Long-term Community Benefits (CCB, GL2.2)

The Village Climate Solutions Project (VCSP) is strategically designed to provide both immediate and long-term benefits that enhance the well-being of smallholders and community members. In the short term, the project has already started delivering additional, consistent income

streams for smallholders involved in forest patrols and boundary clearing. During this monitoring period, boundary clearing generated TZS 20.9 million ($8,700), benefiting 527 men and 39 women (7%) across 14 villages, during the lean season in September and October 2023. Additionally, 664 members of the Village Natural Resource Committees (31% female) received a total of TZS 50,640,000 (≈ $21,082) for patrols, utilizing Mergin Maps technology introduced by the project. These payments for boundary clearing and patrols summed up to TZS 71,534,119 (≈ $29,781) to communities. According to Tanzania's minimum wage regulations under Government Notice (GN) No. 605A, the minimum wage in forestry is TZS 185,000 per month[24]. Dividing the total payments by the annual minimum wage per employee (TZS 185,000 × 12 months = TZS 2,220,000) corresponds to 32.2 full-time equivalent (FTE) employees annually, including 7.5 FTE contributed by women.

The project also introduces a new income source through REDD revenues, anticipated to yield communities more than ten times their previous income from sustainable timber operations, with an expected annual average of $2.65 million over the project's lifetime. According to this monitoring report, the project will generate $2.2 million payable to participating communities between July and December 2025. This additional income stream, valued at an average of $4.1 per hectare of avoided deforestation, exceeds the opportunity cost, providing greater financial stability than the increasingly climate-vulnerable earnings from slash-and-burn agriculture.

In addition, because the project model does not impose restrictions on sustainable timber and charcoal harvesting (limited to 1% of standing biomass annually), participating villages were able to generate $227,000 from sustainable wood products alongside anticipated carbon revenue during this monitoring period.

From January to June 2025, the project will be assisting communities in developing benefit-sharing guidelines, empowering them to invest the anticipated revenues in essential social services, particularly education for boys and girls. By equipping the next generation with skills and motivation for sustainable livelihoods, the project aims to break the cycle of poverty and low educational attainment, as over 96% of individuals involved in deforestation within the project area currently lack secondary education.

The project also targets a 1% net increase in agricultural yield through targeted extension services, further boosting community economic resilience. Data collected by the patrol team show that 100% (N=2,501) of farmers who cleared forests during this monitoring period are willing to participate in the agricultural extension services planned under the project. Moreover, by contributing to increased forest cover, the project will help regulate the local climate, leading to lower temperatures and improved rainfall patterns, thereby mitigating the adverse effects of climate change on livelihoods of smallholder farmers in long run.

[24] https://media.tanzlii.org/media/legislation/381234/source_file/7026c43665908c9c/tz-act-gn-2025-605a-publication-document.pdf

These combined outcomes demonstrate that the VCSP is already delivering substantial short- and long-term benefits, significantly enhancing the well-being of smallholders and community members.

4.4.2 Marginalized and/or Vulnerable Community Groups (CCB, GL2.4)

The table below identifies the marginalized and vulnerable community groups the project engages with and outlines how these groups have or are on track to gain net positive benefits

Community Group	Young boys and girls in Primary and Secondary schools within the project villages
Net positive impacts	Villages are expected to start investing the revenues to be generated during this monitoring period in improving Primary and Secondary Education. Between January and June 2025, the project will support the participating villages to develop benefit sharing regulations which will emphasize the generated carbon revenues to be prioritized in improving education facilities, particularly secondary education
Benefit access	No barriers or risks are foreseen that might prevent benefits going to secondary school girls and boys.
Negative impacts	No negative impacts are anticipated to these beneficiaries.

Community Group	Elderly group, and people farming within the reserve and leakage belt, .
Net positive impacts	The opportunity cost survey conducted by the project in Lindi revealed that forest clearing for agriculture is primarily carried out by older individuals. While village forest bylaws and national forest laws prohibit farming within reserved forest areas, the project's policy allows existing farmers to continue cultivating their current plots without further clearing. During this monitoring period, patrol teams prioritized raising awareness among farmers that clearing the reserves was illegal and legally punishable. However, they primarily encouraged farmers to avoid cutting trees older than 10 years, while permitting them to farm in already deforested areas. This approach has provided greater security compared to scenarios without the project, where legal displacement attempts would have been likely. Additionally, an analysis of 2,444 patrol team entries in the project's Mergin maps identified 10% of the deforestation agents were female

	and 90% male. All these agents expressed interest in participating in the project's agricultural extension services, which aim to improve arable land yield by at least 1%. Between January and June 2025, the project will institutionalize a village benefit-sharing guideline that will encourage villagers to invest part of the revenues to be generated during this monitoring period in agricultural improvements. Concurrently, the project will develop a strategy for delivering agricultural extension services, with Extension Agents beginning to engage at least 30 farmers per village to promote improved agronomic practices and increase productivity. By fostering sustainable farming practices and enhancing productivity, the project aims to achieve net positive impacts on economic stability and overall well-being for these groups. This approach not only preserves forest resources but also empowers community members, particularly the elderly, to sustain their livelihoods and improve their quality of life within the framework of forest conservation regulations.
Benefit access	The project recognizes the risk of elite capture in identifying beneficiaries of agricultural extension services and the potential for revenues to disproportionately fund social services in village centers, potentially neglecting older individuals living inside or near the forest. To address these challenges, the project emphasizes the registration and monitoring of specific areas within the leakage belt, utilizing a cloud-based platform to be designed for this purpose. A comprehensive benefit-sharing guideline which treats all villagers as equal owners of the forest, has been drafted to promote equitable distribution of dividends. This guideline will be customized and institutionalized in each village between January and June 2025. Beneficiaries are registered and approved at the sub-village level to ensure fair inclusion of marginalized groups, particularly older residents reliant on forest resources. To enhance transparency, the beneficiary lists will be printed and displayed publicly at sub-village centers. This approach mitigates barriers to participation, ensuring that all identified vulnerable community members receive project benefits and services. By proactively addressing these risks, the project seeks to enhance the well-being of marginalized smallholders and community members while promoting inclusive development and sustainable resource management.

Negative impacts	There is no foreseen negative impact to the communities and other stakeholders

4.4.3 Net Impacts on Women (CCB, GL2.5)

During this monitoring period, the project employed 4 extension agents, including 2 women who are recent university graduates. As the project expands, it aims to recruit more agents, with a strategic emphasis on increasing the representation of women. During this monitoring period, at least 30% (N=483) of patrol team members trained in patrol technology were women. Furthermore, 31% of community leaders participating in Village Council meetings and 41% of attendees at village general meetings to discuss and endorse the project were women.

The project also facilitated the establishment of three new Village Natural Resource Committees (VNRCs), with women comprising 13 of the members (33%). Notably, 67% of VNRCs in the project area have at least one female leader, 91% of whom hold the role of treasurer. This initial engagement of women in key roles and decision-making positions highlights their growing influence and meaningful contribution to the project's success.

The project is committed to advocating for women's participation in decision-making activities, emphasizing the one-third requirement stipulated in the National Community Based Forest Management (CBFM) Guideline (2007) and section 33 (2) (b) of the National Forest Act CAP 323 of the laws of Tanzania. Social monitoring tools have been designed to track the participation of women in project activities and decision-making processes, ensuring that women's voices are heard and considered.

To ensure that the project generates net positive impacts on the well-being of women, benefit-sharing guidelines have been drafted to be customized by each participating village from January to June 2025. These guidelines are based on experiences from the previous MJUMITA Community Forest Project (Lindi), which emphasized dividends to households. To mitigate men's control over household revenues, women were directly paid for themselves and on behalf of all dependents in the household. This approach ensures that women have direct access to financial benefits, enhancing their economic independence and well-being.

Furthermore, the anticipated social service facilities to be funded by communities through project-generated revenues will have a significant impact on women. Improved water infrastructure will reduce the walking distance and time women spend fetching water, as this is typically a woman's role in rural Tanzania. Health infrastructure will serve women and household dependents, facilitating access to health services. Education support, particularly for girls, is also a priority. Some villages are expected to use funds to construct hostels and provide related facilities to save students, especially girls, from long walks to secondary schools. These improvements in social services will directly benefit women and contribute to their overall well-being.

4.4.4 Benefit Sharing Mechanisms (CCB, GL2.6)

Benefit sharing is already described in Section 2.5.6 above. Further details are as provided in section 4.5.6 of the Project Description.

4.4.5 Governance and Implementation Structures (CCB, GL2.8)

During this monitoring period, the project's governance structure has enhanced forest management in the project area through forest patrols, boundary clearing, and revision and approval of forest management plans. Moving forward, the project will also support the supervision of performance-based payments and coordinate agricultural extension services at the community level within the leakage belt.

Forest management structures: The project uses governance structures specified in Sections 33 and 30 of the National Forest Act, CAP 323, for managing Village Land Forest Reserves (VLFRs) and Local Authority Forest Reserves (LAFRs). VLFRs are managed by Village Natural Resource Committees (VNRCs), which are accountable to the Village Council and General Assembly. Most villages already had VNRC members when the project began, and the project established three new committees, elected democratically to ensure representation from all sub-villages with at least one-third female participation. Each VNRC is led by a Chairperson, Secretary, and Treasurer, elected annually by committee members.

The VNRCs formed patrol teams led by a Patrol Commander responsible for regular forest patrols and reporting to VNRC meetings. VNRC activities are guided by a Forest Management Plan and village bylaws, approved by the Local Authority Council following Village General Assembly endorsement. In LAFRs, the bylaws are approved by the Minister responsible for Local Government. VNRCs report regularly to the Village Executive Officer, monthly to the Village Council, and quarterly to the Village General Assembly.

For full compliance, VNRCs receive technical guidance from the District Forest Officer and report quarterly to the District Executive Director (DED) via the Village Council. LAFRs are managed by the District Forest Officer, who reports to the DED, the Council's economic and environmental committee, and the Full Council. National authorities, particularly the Forest and Beekeeping Division under the Ministry of Natural Resources and Tourism, conduct regular monitoring to ensure adherence to national policies and regulations.

Project extension services: The project employs four Extension Agents stationed in Kilosa, Morogoro, Lindi, and Nachingwea, providing technical backstopping to patrol teams monthly. In the future, project extension officers will collaborate with government extension officers to ensure farmers implement best practices, monitor progress, and report performance regularly.

Governance of the performance-based payments and cost-benefit sharing: Between January and June 2025, the project will establish a performance-based payment system involving Local Authorities, VNRCs, Village Councils, the Village Cost-Benefit Sharing Committee, and the General Assembly. This process begins with drafting village cost-benefit sharing guidelines, reviewed by

the District Planning Officer and Village Council, and approved by the Village General Assembly. Each village will form a cost-benefit sharing committee with representatives from all sub-villages and various community groups, subject to General Assembly approval.

Participatory planning will guide the payment system, with the District Planning Officer facilitating annual Opportunities and Obstacles to Development (O&OD) assessments through sub-village meetings. These assessments inform the village's annual implementation plan and budget, reviewed by the Village Council and General Assembly before approval. The Cost-Benefit Sharing Committee will prioritize development projects funded by REDD revenues from this budget, integrating forest management plans and budgets proposed by the VNRCs.

Decision-making and oversight: Each village will hold an annual general meeting focused on the REDD project, attended by the project proponent, Local Authority representatives, and village members. In these meetings, the proponent will present monitoring reports covering successes and challenges in reducing deforestation, verified carbon credits, and revenues based on stock-flow accounting. VNRCs will present progress reports, plans, and budgets, while the Village Council will update the assembly on projects funded by REDD revenues. The Cost-Benefit Sharing Committee will present proposed priority projects for the upcoming year, subject to General Assembly discussion and approval. National authorities will oversee compliance with national policies throughout the process.

Proponent and project governance: The proponent oversees project monitoring, verification, issuance, and community payments. The highest decision-making body within the proponent organization is its Board of Directors, responsible for approving policies, plans, and budgets. Daily project operations are managed by the Operations Director, who supervises extension agents. The Finance Director manages accounting, administration, and community payments. Finally, the proponent submits monitoring reports to the Designated National Authority per national regulations.

4.4.6 Smallholders/Community Members Capacity Development (CCB, GL2.9)

The project has strengthened Village Councils and Natural Committees by training 1,732 members (550 women and 1,182 men) in essential skills for community-based forest management and REDD initiatives. The trainings were provided along with obtaining community consent for the project. This training, combined with the establishment of three new Village Land Forest Reserves (VLFRs) and an expansion of existing reserves by over 97,919 hectares, has enabled these councils to transition forests from state-controlled, open-access tenure to communal tenure, with management formally vested in the communities. This shift establishes a foundation for long-term income generation through carbon trading under the Village Climate Solutions Limited (VCSL) model, alongside other forest-based enterprises for smallholders, that would not have been possible without the project.

The project has also equipped 454 village patrol team members (136 women and 318 men) with skills to use VCSL's cloud-based platforms, enabling them to identify newly deforested areas and

take responsive actions. Comprising elected members of Village Natural Resource Committees, these patrol teams were funded to implement this technology and trained to communicate the project's REDD and VCSL model to local deforestation agents, primarily smallholders. Extension agents provided regular technical support to the patrol teams. The deforestation agents, who had illegally cleared parts of the VLFR, were sensitized about the project and informed they would not face eviction provided they refrained from further deforestation. They were also briefed on plans for future agricultural extension services, which nearly 100% of farmers (N=2,501) interviewed by patrol teams expressed interest in accessing.

5 BIODIVERSITY

5.1 Net Positive Biodiversity Impacts

5.1.1 Biodiversity Changes (VCS, 3.19; CCB, B2.1)

Change in Biodiversity	Deforestation in high conservation value forests important for biodiversity conservation in the project area (see HCV forests in Figure 4, Figure 5, and Figure 6) was reduced compared to the without project scenario.
Monitored Change	The monitored biodiversity change during this monitoring period is a reduction in deforestation in forests important for biodiversity conservation compared to baseline. This was a predicted and positive change for biodiversity. The change is directly a result of project activities but is an indirect measure of biodiversity benefits since other quantitative measures of biodiversity changes were not implemented. The change in HCV forests during this monitoring period was monitored and compared to baseline predictions for these forests. The breakdown for each HCV forest is presented in Table 16. Overall, deforestation in these forests was reduced by 920 ha or 80.7% compared to baseline. Only 1 HCV forest (Ilole) experienced more deforestation than baseline with 1.78 ha of deforestation above baseline. Ilole is very remote and unfortunately the small-scale deforestation was missed by the deforestation mapping until recent months and thus the area was not visited by a forest patrol team during this monitoring

	period. This will be rectified in the next monitoring period and hopefully deforestation in that forest will be halted. The project will also hope to potentially increase some populations of threatened species compared to starting conditions by reducing poaching of these species (e.g. Abbott's Duiker). However, anti-poaching efforts had not yet started during this monitoring period, nor has the project started direct population monitoring of such species to quantify the impact.
Justification of Change	The project activities during this monitoring period that contributed to reductions in deforestation and therefore improved biodiversity outcomes compared to baseline were: 1. Improved forest monitoring and patrols – established and trained forest patrol teams to patrol every project area forest using Mergin Maps and frequently updated maps of disturbances in project forests. Paying for patrols. 2. Establishing forest management plans for new village forest reserves and updating forest management plans for existing village forest reserves. 3. Halting the sale of forested land in the former Nandambi and Mkanga 1 village forest reserves and developing and agreement with the Lindi Municipality to protect these forests and establish CBOs from surrounding communities to partner with the Municipality and start forest patrols. The methods used to quantify the change are described in section 5.3.1. The underlying assumption of the analysis is that the biodiversity values are dependent on forest cover and will be damaged by farming and can be maintained simply by reducing deforestation. This is a well justified assumption because many of the rare and threatened species in the project area (see section 5.4.1) are forest dependent and are not targets of hunting. Thus, simply by protecting forest, biodiversity can be maintained. For other species like Abbott's Duiker, which are subject to hunting, additional activities will need to be undertaken to maintain the species in addition to protecting forest. These

[redacted]	activities and the monitoring required to assess them had not yet started during this monitoring period.

5.1.2 Mitigation Actions (VCS, 3.19; CCB, B2.3)

Mitigation of project activity related impacts

Boundary cutline clearing impacts were limited by ensuring that communities stick to the boundary cutline clearing guidelines. All boundary clearing during this monitoring period was supervised by project extension officers who were responsible for tracking and paying for boundary clearing activities.

Impacts from sustainable timber harvesting, which is not a project activity, but carried out in many project forests, were mitigated by ensuring that harvesting quota setting, and actual harvesting activities follow the timber harvesting manual developed by MJUMITA[25]. All harvesting plans used by project villages during this monitoring period were developed by either the Tanzania Forest Conservation Group, the Mpingo Conservation and Development Initiative, or district forest officers to ensure that the quota setting was appropriate. All project villages during this monitoring period had functioning village natural resource committees responsible for ensuring that cutters adhere to harvesting rules.

Maintenance and enhancement of HCVs

The most important activity for the maintenance of biodiversity in the project area is to prevent the loss of forest to agriculture. The project activities carried out during this monitoring period focused on reducing deforestation through updating and approving forest management plans, creating new village forest reserves, and establishing a system to monitor deforestation on a regular basis and community the location of any new deforestation to trained forest patrol teams through the Mergin Maps app allowing them to rapidly respond to and stop deforestation. These activities were effective at reducing deforestation in the project area by 5,107 ha compared to projected baseline deforestation in this monitoring period. That represents a significant savings in habitat for rare species, which is always good for conservation.

5.1.3 Net Positive Biodiversity Impacts (VCS, 3.19; CCB, B2.2, GL1.4)

According to the current deforestation risk map (Figure 35), in the without project scenario, the project area forests would contract by 219,699 ha over the next 42 years, a 67% reduction. The critical coastal forests on the Noto and Chitoa Plateaus would decrease by 12,000 ha, a loss of nearly 75%. The projected risk to Ilole forest is less significant, but conversion to agriculture is a growing threat there with the first farms ever being detected in 2024. Fire on the other hand is

[25] https://www.tfcg.org/wp-content/uploads/2020/08/Sustainable-Timber-Harvesting-Manual-2020-08-24.pdf

already a significant threat to Ilole, which the project will work to mitigate through forest patrols during the dry season. Since most of the project area biodiversity is forest dependent, by maintaining forests in the project area, the project will have significant net positive impacts on biodiversity compared to the without-project land use scenario.

Maintaining forest cover is also important to help biodiversity adapt to climate change. The most certain projected climate impact for the project area is increasing temperatures. Given that the project area is already in a tropical climate, temperature increases will likely put greater physiological stress on project area's biodiversity. A simultaneous decrease in habitat caused by deforestation in without project-scenario will only increase the chance of local extinction of many of the project area species.

However, protecting forests will also help mitigate the local effects of climate change even within the remaining project forest patches in the baseline scenario by reducing local temperature extremes. Deforestation in the tropics leads to both local and regional temperature increases beyond the impact of increasing atmospheric CO_2[26]. Local temperature increases from deforestation can be far more than the long-term projected temperature increases in the worse climate change scenarios[27]. Thus, the without project scenario would greatly exacerbate the effects of climate change and by protecting forest habitat, the project will keep local temperatures more stable and increase the resilience of the project area biodiversity. During this monitoring period, the project reduced deforestation in high conservation value areas by 81% (see Table 16)

Species and habitat	The project does not promote any activities which are expected to negatively impact rare, threatened or endangered species. Endemic, endangered and threatened Species found in the Coastal Forests of Eastern Africa and Eastern Arc biodiversity hotspots are mostly forest dependent and will benefit from the project's protection of existing native forests. Additionally, elephants use many of project area forests on a seasonal basis. The project areas provide buffer areas to large, protected areas such as Mikumi National Park, Ukwiva Forest Reserve, and Msanjesi Game Reserve. During this monitoring period, deforestation in these high conservation value forests was reduced by 81% compared to baseline (see Table 16).

[26] Lawrence, D., Coe, M., Walker, W., Verchot, L., & Vandecar, K. (2022). The unseen effects of deforestation: biophysical effects on climate. *Frontiers in Forests and Global Change*, *5*, 756115.
[27] Zeppetello, L. R. V., Parsons, L. A., Spector, J. T., Naylor, R. L., Battisti, D. S., Masuda, Y. J., & Wolff, N. H. (2020). Large scale tropical deforestation drives extreme warming. *Environmental Research Letters*, *15*(8), 084012.

Areas needed for habitat connectivity	As a REDD project protecting natural forests, the project will enhance rather than harm habitat connectivity. Part of the project area in Nachingwea is the only remaining corridor of natural vegetation linking Msanjesi Game reserve to wilderness in Liwale district, which in turn links to the Nyerere National Park and the Selous Game Reserve. Deforestation in this wildlife corridor was reduced by 37% during this monitoring period (see Table 16), indicating substantial room for improvement in enforcement, but also net positive benefits.

5.1.4 High Conservation Values Protected (CCB, B2.4)

The project does not promote any activity expected to negatively impact HCV areas. Instead, the project activities have increase habitat in HCV areas compared to the without project scenario (Table 16).

5.1.5 Species Used (VCS, 3.19; CCB, B2.5, 2.6)

The project did not engage in any activities resulting in the introduction of new species to the project area during this monitoring period.

Species introduced	Classification	Justification for use	Adverse effects and mitigation
None	N/A	N/A	N/A

5.1.6 Invasive Species (VCS, 3.19; CCB, B2.5)

Existing invasive species	Mitigation measures to prevent the spread or continued existence of invasive species
None	None

5.1.7 GMO Exclusion (CCB, B2.7)

The project is a REDD project involving the protection of native forests. No GMOs are used to generate GHG emissions reductions or removals.

5.1.8 Inputs Justification (VCS, 3.19; CCB, B2.8)

No fertilizers, chemical pesticides, biological control agents and other inputs have been used or promoted by the project during this monitoring period.

5.2 Offsite Biodiversity Impacts

5.2.1 Negative Offsite Biodiversity Impacts (CCB, B3.1) and Mitigation Actions (CCB, B3.2)

The project does not promote any activities which have negative impacts on biodiversity offsite.

Negative Offsite Impact	Mitigation Measure(s)
None	N/A

5.2.2 Net Offsite Biodiversity Benefits (VCS, 3.19; CCB, B3.3)

There are no anticipated offsite negative biodiversity impacts as the project activities do no impact native ecosystems outside of the project area.

5.3 Biodiversity Impact Monitoring

5.3.1 Biodiversity Monitoring Plan (CCB, B4.1, B4.2, GL1.4, GL3.4)

During this monitoring period, the project was only able to measure two of the 6 biodiversity monitoring variables listed in the PD. This included monitoring deforestation in high conservation value areas compared to baseline and a persistence survey for the Rondo Dwarf Galago on Noto Plateau. African Savanah elephants were recorded in the project area during this monitoring period, but not using a systematic approach. The project will add systematic monitoring for African Savanah Elephants, Abbott's Duiker, Wild Dogs, and poaching levels in the next monitoring period.

While the monitoring plan was only partially executed for this monitoring period, the results confirm the presence of the Rondo Dwarf Galago and African Savanah Elephant, two IUCN Red-List endangered species, in the project area during this monitoring period and thus satisfying the Gold Level Biodiversity requirements. The deforestation analysis also shows that the project was particularly effective at reducing deforestation in High Conservation value areas relative to baseline, which by extension indicates likely positive outcomes for other IUCN endangered and vulnerable species in the project area relative to baseline.

Biodiversity Variable	Location	Dates	Monitoring Method	Result

Habitat Persistence in High Conservation Value Areas	Polygons for Noto Plateau, Ilole Forest, protected area buffer forests and the Msanjesi wildlife corridor depicted in the project zone maps in the PD.	Entire monitoring period	Hand digitizing disturbance based on changes in Planet.com basemaps and Sentinel-1 imagery during the monitoring period. Note that monitoring period dates vary depending on the start date of the activity instance. Converting the hand digitization to pixels of disturbance using the rasterize tool in QGIS. Then calculate baseline deforestation for HCV forests using zonal statistics from the deforestation risk density map (see Figure 35) scaled by the length of the monitoring period in the project instance where the HCV forest occurs. Finally, calculate the difference between baseline deforestation and observed deforestation in HCV forests during this monitoring	Deforestation in High Conservation value areas was reduced by 920 ha (80.7%) compared to baseline for this monitoring period (see Table 16). There was a reduction in deforestation in all forests except for Ilole where deforestation exceeded baseline by 1.78 ha. Ilole is a very remote forest and has not yet been reached by a patrol team. It is possible that Malolo A's success in reducing deforestation elsewhere in their village forest reserve has driven some deforestation to shift to Ilole.

			period (see Table 16).	
Rondo Dwarf Galago Persistence	270 ha portion of Noto Plateau (assuming each audiomoth could pick up Rondo Galago calls up to 250 meters away	May 8th, 2024 – May 12th 2024	Passive Nocturnal Acoustic Monitoring using a grid of 10 audiomoth devices mounted 500 meters apart and 7:00 to 23:00 and 5:00 to 6:00 walking surveys. The survey was led by Andrew Perkin, the world's leading expert on the Tanzanian Galagoes.	No Rondo Dwarf Galago calls were detected on the audiomoths. Their calls may be too quiet and infrequent to be monitored using audiomoths and machine learning in a forest with other larger, noisier Galagoes. However, three Rondo Dwarf Galagoes were recorded calling on handheld devices during the 4 night walks confirming that they persist on Noto Plateau and setting a baseline of 0.75 detections per survey night.
African Savanah Elephant Persistence	Noto Plateau, Nachingwea Forests	Various Dates	No systematic survey system was established during this period, but Elephant observations (e.g. fresh dung) were noted by forest patrol teams and the biomass plot monitoring team during this monitoring period.	Elephants made use of the project areas during this monitoring period, though the project has not yet established a systematic monitoring system which will allow for tracking long term population dynamics.
Abbott's Duiker Persistence	Ilole Forest	No survey conducted during this monitoring period	Forest patrol dung records	No result for this monitoring period
Wild Dog Persistence	Mikumi National	No survey conducted	Forest patrol sighting and dung	No result for this monitoring period

	Park and Msanjesi buffer forests and the Msanjesi wildlife corridor	during this monitoring period	records and community interviews	
Poaching reduction	All HCV area polygons shown in the project zone maps in the PD	No survey conducted during this monitoring period	Forest patrol records for snares gathered/destroyed and hunters encountered	No result for this monitoring period

Table 16 Avoided Deforestation in Project HCV Areas during this monitoring period

District / Municipality	HCV Area Name	Dominate Forest Types	Monitoring Period Baseline Deforestation (ha)	Monitoring Period Observed Deforestation (ha)	Difference (ha)
Lindi Municipality	Chitoa FR buffer	Coastal Forest	129.8	21.7	108.1
Kilosa	Ilole Forest	Montane Forest	0.9	2.7	(1.8)
Nachingwea	Lionja FR buffer	Miombo	56.1	11.6	44.6
Lindi Municipality	Litipo FR buffer	Miombo and Coastal Forest	41.0	8.8	32.2
Lindi Municipality	Matapwa FR buffer	Miombo	38.2	18.4	19.7
Kilosa and Mvomero	Mikumi NP buffer	Miombo	245.2	29.9	215.4

Morogoro	Mkulazi FR buffer	Miombo	64.0	29.7	34.3
Nachingwea	Msanjesi Corridor	Miombo	110.1	69.5	40.6
Nachingwea	Msanjesi GM buffer	Miombo	148.8	8.9	139.9
Lindi Municipality	Noto Plateau Forest	Coastal Forest	147.1	0.4	146.8
Mtama	Rondo NR buffer	Coastal Forest	124.3	14.4	109.9
Kilosa	Udzungwa NP buffer	Miombo	7.2	-	7.2
Kilosa	Ukwiva FR buffer	Montane Forest	26.8	3.8	23.1
Total			1,139.6	219.6	919.9

5.3.2 Biodiversity Monitoring Plan Dissemination (CCB, B4.3)

This monitoring reports will be submitted to the Designated National Focal Point and uploaded to the VERRA registry for public review prior verification. Additionally, a summary of this monitoring report will be translated into Swahili, printed, and distributed to the Managing Authorities in January 2025 for presentation in village assembly meetings. Later in 2025, the project will present the monitoring report summaries at decision-making meetings of the Managing Authorities. This is a contractual obligation under Clause 14.3 of the carbon trade agreement, requiring the Project Proponent to attend annual meetings of each Managing Authorities and Managers to discuss project outcomes, present performance metrics, and report on the verified emission reductions, ensuring financial transparency. The project will perform these meetings just prior to the completion of verification to inform communities of the amount of money they will receive from this monitoring period so they can plan for how they will use the funds before receiving them.

5.4 Optional Criterion: Exceptional Biodiversity Benefits

5.4.1 Trigger Species Population Trends (CCB, GL3.2, GL3.3)

Trigger Species	Paragalago rondoensis (Rondo Dwarf Galago)
With-project Scenario	This endangered primate species is primarily under threat from habitat loss as it not a target of hunting, but only occurs in a limited number of coastal forests in Tanzania. Within the project area, this species is limited to the portion of the Noto Plateau covered by the Muungano Village Forest Reserve. It is also known to occur within Chitoa Forest Reserve, which is surrounded on 4 sides by project area forests. The project actions to protect this species during this monitoring period include re-establishing forest patrol teams in villages with village forest reserves covering these forests, training forest patrol teams to use Mergin Maps, mapping areas of deforestation just prior to and during this monitoring period, funding patrol teams to visit these areas of deforestation to enforce the forest management plans and stop any ongoing deforestation and supporting the updating of village forest management plans. There were 11 distinct patrol dates covering these forests where 93 points of recent and historical disturbance were patrolled and where the culprits were identified an actions taken to prevent further deforestation. Deforestation during this monitoring period was 92% less than baseline for the Noto Plateau and Chitoa Forest reserve buffer forests. Additionally, a survey of Noto plateau in May-2024 found that the species is still present on Noto plateau. Based on the May 2024 acoustic and walking survey, the population trend of Rondo Dwarf Galago on Noto Plateau cannot yet be determined with high confidence from a single monitoring period baseline. However, the presence of the species was confirmed and deforestation in the project forest where they occur was almost completely halted. Since this species is not hunted and completely forest dependent, the available evidence suggests the population trend was likely stable during this monitoring period, which is an improvement over the baseline condition in which the population would be decreasing due to habitat loss.

Trigger Species	*Cephalophus spadix* (Abbott's Duiker)
With-project Scenario	This endangered antelope species is primarily under threat from habitat loss and hunting and only occurs in a limited number of montane forests in Tanzania. Within the project area, this species is limited to Ilole Forest, which is part of Msimba, Kisanga, and Malolo A's village forest reserves. The project actions to protect this species during this monitoring period include re-establishing forest patrol teams, training forest patrol teams to use Mergin Maps, mapping areas of deforestation just prior to and during this monitoring period, and funding patrol teams to visit these areas of deforestation to enforce the forest management plans and stop any ongoing deforestation. Unfortunately, the limited amount of deforestation that occurred in Ilole during this monitoring period was not identified until after the monitoring period, so it was not reached by forest patrol teams. Ilole is a very remote area, and it is possible that the successful patrol work elsewhere in Malolo A drove some limited deforestation to Ilole (2.69 ha). Hopefully, the Malolo A forest patrol teams will be able to stop further deforestation in Ilole now that they are aware of it. Given that the species is a target of hunting habitat persistence alone is not enough to confirm its persistence. It is even possible it has gone locally extinct since the last survey of Ilole was in 2007. No direct monitoring of Abbott's Duiker was conducted during this monitoring period. Population trend is therefore unknown. Presence will be confirmed by a camera trap or dung survey of Ilole Forest in 2026, which will establish a baseline for trend assessment in subsequent monitoring periods.

Trigger Species	*Loxodonta africana* (African Savanah Elephant)
With-project Scenario	This species is endangered. Habitat clearing in the project area in the with-out project scenario increases conflict between humans and elephants, which in turn can lead to elephant killing and or cause elephants to move elsewhere. Current population levels everywhere in the country are lower than natural due to poaching, so habitat availability itself is probably not a population limiting factor. Elephants are also subject to

	increased poaching in the with-out project scenario, due to greater levels of support from communities when there are more conflicts. Almost the entire project area has some potential as habitat for Elephants, but the most important forests are the HCV forests shown in the project zone maps in Figure 4, Figure 5, and Figure 6. The project actions to protect this species during this monitoring period include re-establishing / establishing forest patrol teams, training forest patrol teams to use Mergin Maps, mapping areas of deforestation just prior to and during this monitoring period, and funding patrol teams to visit areas of deforestation to enforce the forest management plans and stop any ongoing deforestation. Deforestation in HCV forests was reduced by 81% compared to baseline representing a significant reduction in potential elephant conflict as well. Elephants were observed in the Muungano Village Forest Reserve and in village forest reserves providing buffer forests to Msanjesi Game Reserve during this monitoring period. Elephant presence in the project area was confirmed by opportunistic observations during this monitoring period. No systematic monitoring was conducted, and population trend cannot yet be assessed. A systematic monitoring protocol will be implemented in 2025 to establish a baseline for trend assessment.

Trigger Species	*Lycaon pictus* (African Wild Dog)
With-project Scenario	This species is endangered. In the without-project scenario, wild dog populations would decrease due to reductions in their prey caused by reductions in suitable habitat for their prey when natural areas in the project area are converted to agriculture or their prey are hunted by humans. Conflict with humans encroaching into the project area would also increase in the without-project scenario potentially leading to Wild Dogs being shot, snared, or poisoned. The most important project areas for Wild Dogs are the buffer and corridor forests for Msanjesi Game Reserve and Mikumi National Park shown in the project zone maps in Figure 5, and Figure 6. The project actions to protect this species during this monitoring period include re-establishing / establishing forest patrol teams, training forest patrol teams to use Mergin Maps, mapping

	areas of deforestation just prior to and during this monitoring period, and funding patrol teams to visit areas of deforestation to enforce the forest management plans and stop any ongoing deforestation. Deforestation in HCV forests potentially used by Wild Dogs was reduced by 78.5% compared to baseline representing a significant reduction in potential conflict with humans as well. Wild Dogs were not observed in any project area forest during this monitoring period, though there was also no survey effort to find them. No direct monitoring of Wild Dogs was conducted during this monitoring period, and no sightings were recorded incidentally. Population trend is therefore unknown for this monitoring period. A systematic monitoring protocol will be developed and implemented in 2025.

APPENDIX 1: PROJECT RISKS TABLE

	Identified risk(s)	Potential impact of risk on stakeholders, ecosystem health, and biodiversity	Mitigation or preventative measure(s) taken
Natural and human induced risks to stakeholders' wellbeing	Corruptions in the use of money from carbon trade and forest reserve management	Mismanagement of funds intended for community development projects, may lead to non-preforming project and disincentivize communities to protect the forests	The project team has revised the template for the benefit-sharing guidelines developed during the first phase. These guidelines promote a dividend model to ensure transparency and accountability in the benefit-sharing process. With active community participation in decision-making, the model minimizes the risk of corruption, as individuals directly control the income. Between January and December, the project team plans to customize the benefit-sharing regulations for each participating village.
Risks to stakeholder participation	Low attendance of communities in the decision-making meetings	Undermines representation, legitimacy, and trust, leading to ineffective policies in addressing deforestation and fostering community development	The dividend model in benefit-sharing is designed to incentivize participation in meetings and encourage sub-village-level gatherings, making it easier for the majority to engage in decision-making regarding the revenues generated from Verified Emission Reductions during this monitoring period.
Working conditions	Injuries during patrols (e.g., from dangerous animals).	VNRCs may hesitate to participate in patrols, potentially leading to increased deforestation	The project team has provided each participating village and Mtaa with mobile phones equipped with Mergin Maps, allowing them to identify and plan patrol areas in advance and determine the safest routes, minimizing exposure to dangerous wildlife. During this monitoring period, the project has encouraged patrol teams to consist of at least

			four members, promoting greater collective vigilance, enhancing the ability to respond effectively to potential threats, and reducing the risk of individual exposure to wildlife encounters.
Capacity Loss	VNRC turn over	VNRC turn over can erode the collective skills and knowledge provided. The loss of the knowledge base for implementing the project's philosophy may undermine the consistency of forest patrols, jeopardizing efforts to protect the forests from degradation and deforestation risks.	The project has introduced patrol technology that is easily transferable, ensuring continuity in patrol operations, even as committee membership changes. In addition, the project has encouraged youth participation in the Village Natural Resource Committees (VNRC) and patrol teams, with progress to be monitored in the upcoming period. Furthermore, the project has been encouraging mechanisms for VNRC elections to ensure that at least half of the existing members are re-elected to the new committee, and these practices have been incorporated into the revised Forest Management Plans.
Safety of women and girls	Potential gender-based violence especially where patrols are conducted far from village center.	Demotivates the participation of women and girls in forest patrols, undermining inclusivity in forestry and related project activities.	The introduced patrol technology enables the team to predetermine the patrol areas and predict potential risks. Where the identified patrol areas are too far from the village center and much difficult for women, the project encouraged the patrol teams to look for possibility of hiring motorcycles funded by the project.
Safety of minority and marginalized groups, including children	Elderly individuals living within or near the forest may face humiliation from patrol teams or be excluded from	Undermine community trust, disrupt local knowledge sharing, and lead to ineffective forest management, ultimately	The project has been promoting educational and community-based patrol actions over police-based approaches, while avoiding evictions and humiliation of those living in or near the forest. Besides, during the monitoring period, the project worked with communities to remove 7,811 hectares of heavily encroached areas in

	decision-making processes.	harming ecosystem health and biodiversity.	VLFRs and 12,388 ha from the proposed Ndonda WMA before adding it to new VLFRs, creating more defensible boundaries for patrol teams and thereby eliminating potential disputes with elderly individuals living within or near the forest
Pollutants (air, noise, discharges to water, generation of waste, and release of hazardous materials and chemical pesticides and fertilizers)	Pollution from misuse of chemical pesticides and fertilizer potentially promoted by the project through farm extension services.	Potential poisoning of wildlife, farmers, and their families.	No project activities during this monitoring period cause pollution or potential pollution. Farm extension services which will be provided in future monitoring periods will include training to farms to properly store, handle, and apply pesticides and fertilizers in safe an environmentally friendly ways.
Discrimination	Women, youth, and the elderly, might be excluded from decision-making on benefits, or participation in forest patrols and boundary clearing activities.	Inequitable access to resources and participation in forest management, weaken community cohesion, ineffective conservation efforts,	The project has established grievance reporting files and guidelines to document and address issues related to discrimination. The drafted benefit-sharing guidelines, which will be customized by individual villages, encourage communities to allow women to collect dividends for themselves and their dependents. Beginning with the revenues generated from Verified Emission Reductions during this monitoring period, the project will promote youth- and girl-centered educational priorities within the benefit-sharing models.
Sexual harassment	Possibility of women and girls being disproportionately involved in forest	Diminished participation and trust among women girls, ultimately undermining community engagement in	The project has established grievance reporting files and guidelines to document and address issues related to sexual harassment. The introduced patrol technology allows teams to pre-identify patrol areas and predict potential risks. This technology is actively being operated by both

	patrols, leading to unwanted advances, verbal abuse, physical intimidation, and coercion by other participants or individuals in remote areas.	conservation efforts and jeopardizing efforts to reduce deforestation and forest degradation	young boys and girls. The project has ensured that 147 women and 138 youth, out of the 483 trained patrol team members, are included, with at least 30% of the patrol team members in all project-funded patrols being women.
Equal pay for equal work	Potential for elite capture in forest patrol and boundary clearing jobs	Unequal distribution of benefits, undermining community trust and engagement	Workers with the same rank and responsibilities, such as Extension Officers, are paid equally in terms of salaries and field allowances. Boundary clearing teams are compensated equally at a rate of 60,000 TZS per kilometer, while patrol teams receive a daily allowance of 10,000 TZS per person per patrol. The number of patrols per village is determined based on each village's baseline data and forest size, ensuring fairness and equality across all participating villages and mitaa.
Gender equity in labor and work	Shortage of women employed by the project	Shortage of diverse perspectives in decision-making and perpetuate gender inequalities within the community.	The new employees during the monitoring period are Extension Officers, all selected from previous TFCG staff members who were serving as volunteers or working on projects that have now concluded. There are 4 Extension Officers, with a gender ratio of 50:50. The project will continue to implement targeted recruitment strategies for women, create supportive environments to encourage their participation and career advancement.

Forced labor	No risk identified	The project's actions do not trigger forced labor.	The Tanzanian constitution prohibits forced labor, and the project would not ever force labor or contract a third party who would force labor.
Child labor	No risk identified	The project's actions do not trigger child labor.	The project doesn't employ and would not employ any people under the age of 18. Most project activities are carried out by village and district authorities who are employed by the village or district governments and subject to national laws preventing child labor. Project staff communicated to communities specifically that children were not eligible to participate in boundary clearing work. Forest patrol teams all consist of adults.
Human trafficking	No risk identified	The project's actions do not trigger human trafficking	Tanzanian laws prohibit human trafficking, and the project would not ever traffic people or contract with third parties who would traffic people.
Recognition of, respect of, and promotion of the rights to IPs, LCs and customary rights holders	Disputes over village boundaries.	Delay or hinder forest patrols, allowing some farmers to continue clearing land in adjacent villages.	During the monitoring period, the project collaborated with communities to remove 7,811 hectares of heavily encroached areas in existing VLFRs and 12,388 ha in the proposed Ndonda WMA, thereby establishing more defensible boundaries for patrol teams and preventing potential disputes with local communities who had previously encroached on the project area before its commencement.
	Legislative changes that may restrict direct access to REDD revenues for communities.	Demoralize communities from continuing with conservation efforts, hence potentially trigger	The project has obtained all approvals ensuring compliance with national legislation. The project has provided communities with copies of national legislation for them to understand their legal rights and obligations. This monitoring report has been summarized and translated to

		deforestation and forest degradation.	Swahili, disseminated to communities to provide them with clear facts and figures to analyze, understand, and protect their forest rights and responsibilities.
	Municipalization of regions containing Village Land Forest Reserves.	Demoralize communities from continuing with conservation efforts, hence potentially trigger deforestation and forest degradation.	During the monitoring period, the project established five community-based organizations (CBOs) to enable local communities to continue managing forests in the Mitaa, where land has been transferred from village ownership to Municipal or Township Council ownership. Under the project's carbon trade contract, these communities are empowered to benefit from the forests in the same way that the villages would have.
Preserving and protecting cultural heritage	Internal conflicts within communities regarding forest access rights.	Illegal and unsuitable use of forest products may occur among communities that feel their rights have been undermined by project activities, leading to further degradation of forest resources and create tensions between the project and residents.	During the monitoring period, the project developed and signed a carbon trade agreement with the managing authorities, promoting sustainable use by limiting annual biomass harvesting to a maximum of 1%. Additionally, the Forest Management Plans recognize and protect the customary rights of local communities, ensuring access to traditional and cultural resources within the reserves.
Protecting and preserving property rights, customary rights, or protecting legal or customary tenure/access rights to territories, property, and resources, including	Private sectors purchase forested land within project areas for conversion to other land uses.	Continued deforestation and forest degradation leading to habitat destruction, loss of biodiversity, and disruption of ecosystem services, loss of tenure security	To maximize community rights and benefits over natural forests in the project area, the project sensitized communities during the monitoring period about formalizing new forest reserves and incorporating forested areas designated for other land uses that align with conservation efforts into existing reserves. As a result, 97,919 hectares of land previously classified as open access and owned by

collective and/or conflicting rights			the state have been transformed into communally reserved forest land, now owned by the communities.
	Forest clearing by residents of adjacent villages.	Continued deforestation and forest degradation leading to habitat destruction, loss of biodiversity, and disruption of ecosystem services, loss of tenure security	The project developed forest boundary revision maps, which were presented to the village councils, where it was decided to remove 7,811 hectares of heavily encroached VLFRs and 12,388 ha of the proposed Ndonda WMA before adding them to the project area VLFRs, thereby creating more defensible boundaries for patrol teams and addressing potential issues related to customary rights. The establishment of the CBOs, along with provisions in the carbon trade contract allowing them to manage and benefit from the forests in the Mitaa in the same way the village councils would, safeguards the property and customary rights of the participating communities. This arrangement ensures that these communities retain their rights over the resources, despite the land being municipalized.
Impacts on biodiversity and ecosystems	Increased human-wildlife conflict due to expanded forest cover and enhancement efforts.	Threaten community safety and agricultural efforts through crop destruction.	During the monitoring period, the project focused on raising awareness among farmers that they are farming within areas designated as reserves, which have been approved by the participating villages for carbon trading registration. Through patrol teams, the project collected data on farmers' willingness to engage in agricultural extension services, with 100% of them expressing their readiness to participate.
	Boundary clearing	Loss of forest cover	During the monitoring period, the project implemented a no-burning approach during boundary clearing. The cleared grasses were repurposed as mulch to help prevent soil erosion. Additionally, the project ensured that no trees with

			a diameter at breast height (DBH) larger than 15 cm were cut.
Soil degradation and soil erosion	Boundary clearing may trigger soil erosion and soil degradation in the cleared areas.	Increase in edge effects along forest boundaries, lead to spread of invasive species compromising ecosystem stability	During the monitoring period, the project implemented a no-burning approach during boundary clearing. The cleared grasses were repurposed as mulch to help prevent soil erosion. Additionally, the project ensured that no trees with a diameter at breast height (DBH) larger than 15 cm were cut.
Water consumption and stress	No risk identified	The project activities are not directly related to consumption of water	The project's activities are centered around forest conservation and do no modify water consumption. If anything, the project's protection activities will result in lower water stress by maintaining forest cover, which is associated with lower local temperatures, increased precipitation, and slower runoff.
Habitats (and areas needed for habitat connectivity) for rare, threatened, and endangered species	Residents living within or near forests can inadvertently cause fires, or intentionally cause forest clearing	Deforestation and disrupt habitat connectivity, threatening biodiversity, and ecosystem stability	During the monitoring period, the patrol teams focused on sensitizing farmers to avoid clearing trees older than 10 years and refraining from burning, in order to prevent forest fires.
Areas needed for habitat connectivity	Boundary clearing may disconnect ecosystems or habitats.	Fragmentation disrupts wildlife movement, impairs ecological processes, isolates species populations, and weakens	During the monitoring period, the project supported communities in establishing three new Village Land Forest Reserves in Nachingwea, which enhanced the connectivity between the Msanjesi Game Reserve, wilderness areas in Liwale (primarily Selous Game Reserve), and the Niassa Game Reserve in northern Mozambique. Additionally, the

		ecosystem resilience and functionality.	project worked with communities to designated more forested land that buffers the existing Village Land Forest Reserves, further improving connectivity with Mikumi and Nyerere National Parks.
Invasive species	Farm extension services provided by the project result in the introduction of invasive species.	Invasive species displace native species reducing the biodiversity benefits of the project.	The project activities during this period protect native forests and reduce deforestation and degradation which might otherwise enable invasive species. Farm extension services in future monitoring periods will be designed such as to no promote the use of any species identified as invasive.
Ecosystem conversion	Farm extension services provided by the project encourage increased ecosystem conversion	The project's climate and biodiversity benefits are reduced due to increased ecosystem conversion, especially in the leakage belt.	The project activities during this period prevent rather than cause ecosystem change. Farm extension services in future monitoring periods will only be provided to farmers for the purpose of farming in existing farms. Farmers who continue to clear land in future monitoring periods will not be eligible for farm extension services from the project.
Expectations	REDD revenues may fall short of community expectations.	Unmet expectations can reduce motivation to engage in conservation efforts, leading to diminished actions against deforestation and degradation.	Prior to the commencement of the monitoring period, the project conducted an opportunity cost survey, which provided the basis for determining a minimum payment of $4.10 per Verified Emission Reduction, starting from this monitoring period.

APPENDIX 2: STAKEHOLDER ENGAGEMENT MEETINGS

Table 17 Community Level Engagement Meetings

No	District	Village / Mtaa	Village Council Consent Meeting date	Village General Consent Meeting date	Patrol team training date	Village Meeting date to endorse VLFR boundary clearing plan	Village Council and VNRC meetings to endorse updated FMPs and Carbon trade contracts	Village General meetings to endorse updated FMPs and Carbon trade contracts
1	Kilosa	Chabima	1/18/23	1/18/23	4/30/23	12/9/23	2/21/24	2/25/24
2	Kilosa	Dodoma_Isanga	1/19/23	1/19/23	2/9/23	19/09/2023	2/22/24	2/24/23
3	Kilosa	Gongwe	6/15/23	6/15/23	6/15/23		3/2/24	3/5/24
4	Kilosa	Ihombwe	1/21/23	1/21/23	4/28/23		3/19/24	
5	Kilosa	Kisanga	1/26/23	1/21/23	4/30/23	5/9/23	3/8/24	3/8/24
6	Kilosa	Kisongwe	6/8/23	6/8/23	6/8/23		3/1/24	3/1/24
7	Kilosa	Kitunduweta	6/6/23	6/6/23	6/6/23	9/6/23	3/7/24	3/7/24
8	Kilosa	Malolo A	1/24/23	4/26/23	4/26/23	6/9/23	3/11/24	3/12/24
9	Kilosa	Mbamba	6/7/23	6/7/23	6/7/23		3/21/24	3/22/24
10	Kilosa	Mhenda	1/20/23	1/20/23	2/8/23	8/16/23	3/13/24	3/14/24

11	Kilosa	Msimba	1/23/23	1/23/23	4/28/23	8/19/23	3/15/24	3/17/24
12	Kilosa	Nyali	1/19/23	1/19/23	5/1/23	8/12/23	2/29/24	3/4/24
13	Kilosa	Rudewa Gongoni	6/14/23	6/14/23	6/14/23		2/26/24	3/2/24
14	Kilosa	Ulaya Mbuyuni	1/20/23	1/20/23	2/11/23	8/17/23	3/4/24	3/7/24
15	Kilosa	Unone	6/9/23	6/9/23	6/9/23	8/8/23	2/28/24	2/28/24
16	Lindi_Municipality	Kinyope	11/16/22	2/21/23	2/22/23		3/18/24	3/18/24
17	Lindi_Municipality	Kiwawa	11/17/22	2/23/23	2/24/23	8/30/23	3/16/24	3/16/24
18	Lindi_Municipality	Likwaya	11/15/22	3/1/23	3/2/23		3/23/23	3/25/24
19	Lindi_Municipality	Makumba	11/15/22	3/2/23	3/1/23	8/24/23	3/22/24	3/23/24
20	Lindi_Municipality	Milola Magharibi	11/17/22	2/22/23	2/23/23		3/14/24	3/20/23
21	Lindi_Municipality	Mkombamosi	11/14/22	2/27/23	2/25/23		3/21/24	3/22/24
22	Lindi_Municipality	Mputwa	3/28/24	3/1/24			26-28/03/2024	3/28/24
23	Lindi_Municipality	Muungano	11/14/22	2/25/23	2/27/23	8/25/23	3/15/24	3/21/24
24	Lindi_Municipality	Namkongo	11/18/22	2/17/23	2/17/23	8/31/23	3/26/24	3/26/24
25	Lindi_Municipality	Nandambi	12/24/22	3/4/23	3/4/23		3/25/24	3/25/24
26	Lindi_Municipality	Ruhoma	11/16/22	2/20/23	2/21/23		3/19/24	3/19/24
27	Mtama	Chiwerere	11/9/22	4/14/23	4/15/23	8/26/23	3/6/24	3/7/24
28	Mtama	Liganga	11/8/22	4/18/23	4/18/23		3/13/24	3/13/24

29	Mtama	Mihima	7/12/23	4/19/23	4/17/23		3/12/24	3/12/24
30	Mtama	Muungano II	11/9/22	4/15/23	4/17/23	8/29/23	3/9/24	3/10/24
31	Mtama	Nndawa	7/13/23	4/19/23	7/13/23		3/8/24	3/9/24
32	Mtama	Ntene	11/8/22	4/17/23	4/17/23		3/11/24	3/11/24
33	Mvomero	Kihondo	8/1/23	8/1/23	8/1/23		28/02/2024	6/3/24
34	Mvomero	Maharaka	8/2/23	8/2/23	8/2/23		4/2/24	5/3/24
35	Mvomero	Misengele	7/31/23	7/31/23	7/31/23		2/3/24	3/3/24
36	Mvomero	Msongozi	7/30/23	7/30/23	7/30/23		6/3/24	7/3/24
37	Mvomero	Sewe Kipera	7/29/23	7/29/23	7/29/23		1/3/24	4/3/24
38	Morogoro DC	Diguzi	11/15/23	11/17/23	13/12/2023		13/03/2024	13/03/2024
39	Morogoro DC	Lulongwe	11/16/23	11/18/23	14/12/2023		11/3/24	11/3/24
40	Morogoro DC	Matuli	11/17/23	11/18/23	12/12/23		12/11/24	12/3/24
41	Morogoro DC	Mlilingwa	11/14/23	11/14/23	15/12/2023		10/3/24	10/3/24
42	Morogoro DC	Tununguo	11/19/23	11/19/23	17/12/2023		8/3/24	9/3/24
43	Nachingwea	Kiegei A	12/8/22	5/23/23	5/23/23		3/4/24	3/4/24
44	Nachingwea	Kiegei B	12/8/22	5/22/23	5/22/23		2/4/24	2/4/24
45	Nachingwea	Kilimarondo	12/7/22	5/26/23	5/26/23		1/4/24	1/4/24
46	Nachingwea	Lionja-b	12/6/22	5/17/23	5/17/23		29/03/2024	29/03/2024
47	Nachingwea	Lipuyu	12/10/22	5/18/23	5/18/23		28/03/2024	28/03/2024

48	Nachingwea	Majonanga	12/9/22	5/21/23	5/21/23		7/4/23	7/4/23
49	Nachingwea	Mbondo	12/7/22	5/20/23	5/20/23		8/4/24	8/4/24
50	Nachingwea	Namatunu	12/9/22	5/24/23	5/24/23		5/4/24	5/4/24
51	Nachingwea	Ngunichile	12/6/22	5/19/23	5/19/23		27/04/2024	27/4/2024
52	Nachingwea	Matekwe	10/9/23	10/9/23	10/9/23		6/4/23	6/4/23
53	Nachingwea	Nahimba	11/9/23	11/9/23	25/12/2023		20/4/2024	20/4/2024
54	Nachingwea	Mtua	12/9/23	12/9/23	12/9/23		24/04/2024	24/04/2024
55	Nachingwea	Chimbendenga	12/9/23	12/9/23	12/9/23		26/04/2024	26/04/2024
56	Nachingwea	Nanjihi	13/09/2023	13/09/2023	30/9/2023		4/4/24	4/4/24
57	Nachingwea	Nakalonji	15/09/2023		13/10/2023		19/4/2023	19/4/2023
58	Nachingwea	Ndonda WMA	9/9/23					

Table 18 Other stakeholder engagement meetings

No	District	Meeting Place	Main Objective of the meeting	Participants	Date
1	Lindi Municipality	Lindi MC Hall	Introductory Meeting to Council Management Team	Council Management team (CMT) Members	9/5/22
2	Mtama DC	Mtama DC hall	Introductory Meeting to Council Management Team	Council Management team (CMT) Members	9/5/22
3	Nachingwea DC	Nachingwea DC Hall	Introductory Meeting to Council Management Team	Council Management team (CMT) Members	9/7/22

4	Kilwa DC	Kilwa DED Office	Introductory Meeting to Council Management Team	Council Management team (CMT) Members	9/9/22
5	Ruangwa DC	Ruangwa DED Office	Introductory Meeting to Council Management Team	Council Management team (CMT) Members	9/6/22
6	Liwale DC	Liwale DED Office	Introductory Meeting to Council Management Team	Council Management team (CMT) Members	9/8/22
7	Lindi Municipality	Lindi MC Hall	Training District Officials on basics of REDD+ and VCSL Model	Council Management team (CMT) Members & RNRO	10/1/22
8	Kilwa DC	Sulatni Hall	Training District Officials on basics of REDD+ and VCSL Model	CMT members, MCDI Officers and RNRO	10/3/22
9	Mtama DC	Mtama DC hall	Obtaining Consent of DED to start engaging with Villages on VCSP	DED, VEOs, WEOs, Ward Councilors	10/31/22
10	Nachingwea DC	Nachingwea DC Hall	Training District Officials on basics of REDD+ and VCSL Model	CMT members	10/30/22
11	Lindi Municipality	DC Office	Obtaining Consent of DC to start engaging with Villages on VCSP	DC	10/3/22
12	Dodoma	PO-RALG	Obtain an introductory letter to the LGAs	PO-RALG staff	1/31/23
13	Kilosa	Kilosa DC	Introduce VCSL idea to District Officials	DED and District Natural Resource Department	1/17/23
14	Lindi Municipality	Lindi MC Hall	Introductory Meeting to Council's Finance Committee	Finance committee	11/10/22
15	Morogoro	Nashela Hotel	Introduce VCSL model to regional level	RC, RAS, DCs, DED, DFOs,	2/23/23

16	Nachingwea DC	Nachingwea DC Hall	Introductory Meeting to Council's Finance Committee	Finance committee	12/5/22
17	Liwale DC	Liwale DC	Introductory meeting to Full Council	Full Council	12/14/22
18	Ruangwa DC	Ruangwa DC	Introductory Meeting to Council's Finance Committee	Finance committee	12/21/22
19	Nachingwea DC	Nachingwea DC Hall	Obtain resolution about Ndonda Issue	DNRAB	1/17/24
20	Nachingwea DC	Kilimarondo	Obtain resolution about Ndonda Issue	Village leaders and executive committee	9/9/23
21	Lindi Municipality	DC Office	Obtain resolutions for Nandambi Issue	DED, lawyer, DC	9/22/23
22	Lindi Municipality	Nandambi	Introduce CBO idea to Nandambi Communities	Nandambi communities	9/23/23
23	Lindi Municipality	Nandambi	Obtain resolution to establish CBO - Nandambi	all potential CBO members	9/24/23
24	Lindi Municipality	Narunyu	Obtain resolution to establish CBO - Narunyu	all potential CBO members	9/25/23
25	Lindi Municipality	Mkanga 1	Obtain resolution to establish CBO - Nandambi	all potential CBO members	9/25/23
26	Lindi Municipality	Rutamba	Obtain resolution to establish CBO - Rutamba	all potential CBO members	9/25/23
27	Lindi Municipality	Nandambi	Develop CBO constitution	CBO members	9/26/23
28	Lindi Municipality	Narunyu	Develop CBO constitution	CBO members	9/27/23

29	Lindi Municipality	Rutamba	Develop CBO constitution	CBO members	9/25/23
30	Kilosa	Kilosa DC	Obtain resolutions for Ihombwe, Mbamba, Mhenda and Msimba issue	DED and District Natural Resource Department	11/1/23
31	Kilosa	Mhenda	Obtain resolution to establish CBO in Mbamba area to Manage Mhenda VLFR	Village Council, VNRCs and Communities - Mhenda	11/2/23
32	Kilosa	Mbamba	Obtain resolution to establish CBO in Mbamba area to Manage Mhenda VLFR	all potential CBO members	12/1/23
33	Kilosa	Msimba	Obtain resolution to establish CBO in Msimba	all potential CBO members	12/3/23
34	Kilosa	Ihombwe	Obtain resolution to establish CBO in Ihombwe	all potential CBO members	11/30/23
35	Kilosa	Msimba	Develop CBO constitution	all potential CBO members	12/22/23
36	Kilosa	Ihombwe	Develop CBO constitution	all potential CBO members	12/20/23
37	Kilosa	Kilosa DC	Obtain resolution for Ihombwe, Mbamba, Mhenda and Msimba issue	DED, DC and other members of district team	12/18/23
38	Lindi Municipality	Lindi MC Hall	awareness to Council Members on REDD and VCSL model	All full council members	9/12/23
39	Lindi Municipality	OUT Hall	Feedback of REDD+ progress - Lindi region	Regional Commissioner, Lindi Mayor, District Commissioners and Executive Directors, head of	9/11/23

				departments from Nachingwea, Mtama, and Lindi Municipal councils	
40	Kilosa	Ihombwe-Visu	Awareness on CBOs and forest management	all potential CBO members	12/19/23
41	Kilosa	Ihombwe	Awareness on CBOs and forest management	all potential CBO members	12/20/23
42	Kilosa	Iyovi	Awareness on CBOs and forest management	all potential CBO members	12/21/23
43	Kilosa	Ng'apa	Awareness on CBOs and forest management	all potential CBO members	12/21/23
44	Kilosa	Msimba kati	Awareness on CBOs and forest management	all potential CBO members	12/21/23
45	Kilosa	Kikonga	Awareness on CBOs and forest management	all potential CBO members	12/22/23
46	Kilosa	Msimba	Awareness on CBOs and forest management	all potential CBO members	12/23/23
47	Kilosa	Ihombwe	Awareness on CBOs and forest management	all potential CBO members	12/27/23
48	Nachingwea DC	Ngunichile	Obtain resolution to expand VLFR or establish new VLFR	community village_chairperson VEO VC VNRC VLUM village_patrol_team other_village_committee DFO other	22/01/2024
49	Nachingwea DC	Lipuyu	Discuss the progress of REDD and update FMP	village_chairperson VEO VC VNRC DFO	23/01/2024
50	Nachingwea DC	Lionja-b	Training on REDD and updating FMP	village_chairperson VEO VC VNRC DFO other	24/01/2024

51	Nachingwea DC	Nahimba	Training on REDD and updating FMP	village_chairperson VEO VC VNRC other	27/01/2024
52	Nachingwea DC	Mtua village	Introduction of REDD+ project	community	2/2/24
53	Nachingwea DC	Mtua	Recap of the REDD+ project , introducing CBFM process of CBFM and Survey activity plan to the proposed village land forest reserve map	village_chairperson VEO VC VNRC	2/2/24
54	Nachingwea DC	Chindimbilile	Recap about REDD+ project from previous training, introducing CBFM in Mtua village	community village_chairperson VEO VC VNRC DFO	1/2/24
55	Nachingwea DC	Chindimbilile	Introduction of survey activity, cbfm process	village_chairperson VEO VNRC DFO	1/2/24
56	Nachingwea DC	Mbondo	Recap of REDD+ project training, introduction of survey activity and Introduction of CBFM processes and its benefits	village_chairperson VEO VC DFO	31/01/2024
57	Nachingwea DC	Kiegei_A	To let Village leaders and VNRC on the REDD+ project recap, survey activity to the proposed village land forest reserve and types of activities expecting to be done under REDD+ project support	village_chairperson VEO VC DFO	24/01/2024
58	Nachingwea DC	Majonanga	to obtain resolutions to create new VLFRs expand the existing ones and mark the boundaries	village_chairperson community VEO VC DFO	22/01/2024

59	Nachingwea DC	Matekwe	To obtain resolution to create new VLFRs, expand the existing ones and mark the boundaries	village_chairperson VEO VC VNRC other_village_committee DFO district_council_member other	21/01/2024
60	Nachingwea DC	Nanjihi	To obtain resolutions to create new VLFRs, expand the existing ones and mark the boundaries	village_chairperson VEO VC VNRC other_village_committee DFO district_council_member other	19/01/2024
61	Nachingwea DC	Chimbendenga	to obtain resolutions to create new VLFRs, expand the existing ones and mark the boundaries	village_chairperson VEO VC VNRC other_village_committee DFO district_council_member other	1/1/24
62	Nachingwea DC	Kiegei B	Resolution to establish VLFR	village_chairperson VEO VC VNRC other_village_committee DFO district_council_member other	25/01/2024
63	Nachingwea DC	Kilimarondo	Discuss the progress of REDD and update FMP	village_chairperson VEO VC VNRC other_village_committee DFO district_council_member other	23/01/2024
64	Nachingwea DC	Nakalonji	To let Village leaders and VNRC on the REDD+ project recap, survey activity to the proposed village land forest reserve and types of activities expecting to be done under REDD+ project support	village_chairperson VEO VC VNRC other_village_committee DFO district_council_member other	29/02/2024
65	Nachingwea DC	Nakalonji	Establish VNRC	village_chairperson VEO VC VNRC other_village_committee DFO district_council_member other	29/02/2024

66	Nachingwea DC	Namatunu	Approval of VNRC	village_chairperson VEO VC VNRC other_village_committee DFO district_council_member other	25/01/2024
67	Kibaha	Kibaha town	District / Municipal Lawyer workshop to review the carbon agreement	Council lawyers and DFOs	2/6/24
68	Lindi Municipality	Milola Magharibi	Presentation of the Deed of Accession and Deeds of partial release	VEO and Village Chairpersons Kinyope, Mkanga 1, Nandambi, Milola Magharibi and Kiwawa	3/14/24
69	Lindi Municipality	Muungano	Presentation of the Deed of Accession and Deeds of partial release	VEO and Village Chairpersons Mkombamosi, Muungano, makumba, Likwaya	3/15/24
70	Lindi Municipality	Kinyope	Presentation of the Deed of Accession and Deeds of partial release	Village Council and VNRC members	3/18/24
71	Lindi Municipality	Kiwawa	Presentation of the Deed of Accession and Deeds of partial release	Village Council and VNRC members	3/16/24
72	Lindi Municipality	Likwaya	Presentation of the Deed of Accession and Deeds of partial release	Village Council and VNRC members	3/23/23
73	Lindi Municipality	Makumba	Presentation of the Deed of Accession and Deeds of partial release	Village Council and VNRC members	3/22/24

74	Lindi Municipality	Milola_Magharibi	Presentation of the Deed of Accession and Deeds of partial release	Village Council and VNRC members	3/14/24
75	Lindi Municipality	Mkombamosi	Presentation of the Deed of Accession and Deeds of partial release	Village Council and VNRC members	3/21/24
76	Lindi Municipality	Muungano	Presentation of the Deed of Accession and Deeds of partial release	Village Council and VNRC members	3/15/24
77	Lindi Municipality	Nandambi (NONA)	Presentation of the Deed of Accession and Deeds of partial release	Village Council and VNRC members	3/25/24
78	Lindi Municipality	Ruhoma	Presentation of the Deed of Accession and Deeds of partial release	Village Council and VNRC members	3/18/24
79	Lindi Municipality	Rutamba (KUMIRU)	Obtain approval of carbon trade contract	CBO general assembly members	3/20/24
80	Lindi Municipality	Narunyu (MTENA	Obtain approval of carbon trade contract	CBO general assembly members	3/25/24
81	Morogoro DC	Morogoro DC Hall	Obtain approval of carbon trade contract at Full council meeting	CMT members, Ward councilors,	22/04/2024
82	Mvomero DC	Mvomero DC hall	Obtain approval of carbon trade contract at financial committee meeting	CMT members Finance committee members	30/04/2024

83	Mvomero DC	Mvomero DC hall	Obtain approval of carbon trade contract at Full council meeting	CMT members, Ward councilors	8/6/24
84	Morogoro	EDEMA	Review of carbon trade contract with VPO, PO-RALG and NCMC	VPO representatives, PO-RALG Staff, VCSL staffs	22-24/05/2024
85	Kilosa DC	Kilosa DC hall	Obtain Approval of Carbon trade Contract at Finance Committee level	CMT members and finance committee	19/6/2024
86	Kilosa DC	Ilonga teachers' college	Obtain approval of carbon trade contract at Full council meeting	CMT members, Ward councilors,	26/6/2024
87	Nachingwea DC	DED Office	Obtain approval of carbon trade contract at financial committee meeting	CMT members, Ward councilors,	5/16/24
88	Nachingwea DC	Council Meeting Hall	Obtain approval of carbon trade contract at Full council meeting	CMT members, Ward councilors,	5/17/24
89	Lindi Municipality	Council Meeting Hall	Obtain approval of carbon trade contract at Full council meeting	CMT members, Ward councilors,	5/11/24

APPENDIX 3: METHODOLOGICAL ANNEX

This methodological annex provides details for the methodological steps outlined in VM0015 v1.2 published on 18 December 2023. The heading and derived subheading numbering matches the step numbering from the methodology outlined in Figure 2 on page 6 of the methodology. Table numbering also matches the numbering from the methodology unless otherwise specified.

1 PROJECT BOUNDARY

1.1 Spatial Boundaries

1.1.1 Reference Region

The revised reference region for the baseline reassessment consists of 18 districts encompassing most of Southeastern Tanzania (). It is a single contiguous area and includes the project areas and leakage belts. District boundaries were derived by aggregating 2022 Tanzania ward boundaries created by the National Bureau of Statistics. The file was downloaded from: https://www.nbs.go.tz/uploads/statistics/documents/en-1714652282-TANZANIA_2022PHC_WARD_SHAPEFILES.zip

The reference region is 18,578,230 ha, equivalent to approximately 19% of Tanzania's total land area, of which 13,208,455 ha was forested at the start of the historical reference period. These figures do not include 126,684 ha of planned flooding in Lindi and Morogoro Regions as the result of the Julius Nyerere Hydropower Station for which construction started during the historical reference period. That area is excluded from the reference region as planned deforestation.

The project area is 327,234 ha of forest at the start of the baseline validity period. Thus, the reference region, being 56.8 times as large as the project area easily meets the methodology guideline of being 5 to 7 times larger than the project area in the case of projects larger than 100,000 ha.

The boundaries are unbiased consisting entirely of official administrative boundaries. The districts include the 12 districts in the two regions, Lindi and Morogoro, with the largest overlap with the project area, two districts in Mtwara region and Tunduru district which borders the project area in Nachingwea. The project may also expand to these districts in the future. The reference region also includes Kibiti, Rufiji and Kilolo districts, which are all adjacent to Lindi and Morogoro regions and are districts where the project plans to expand in the future.

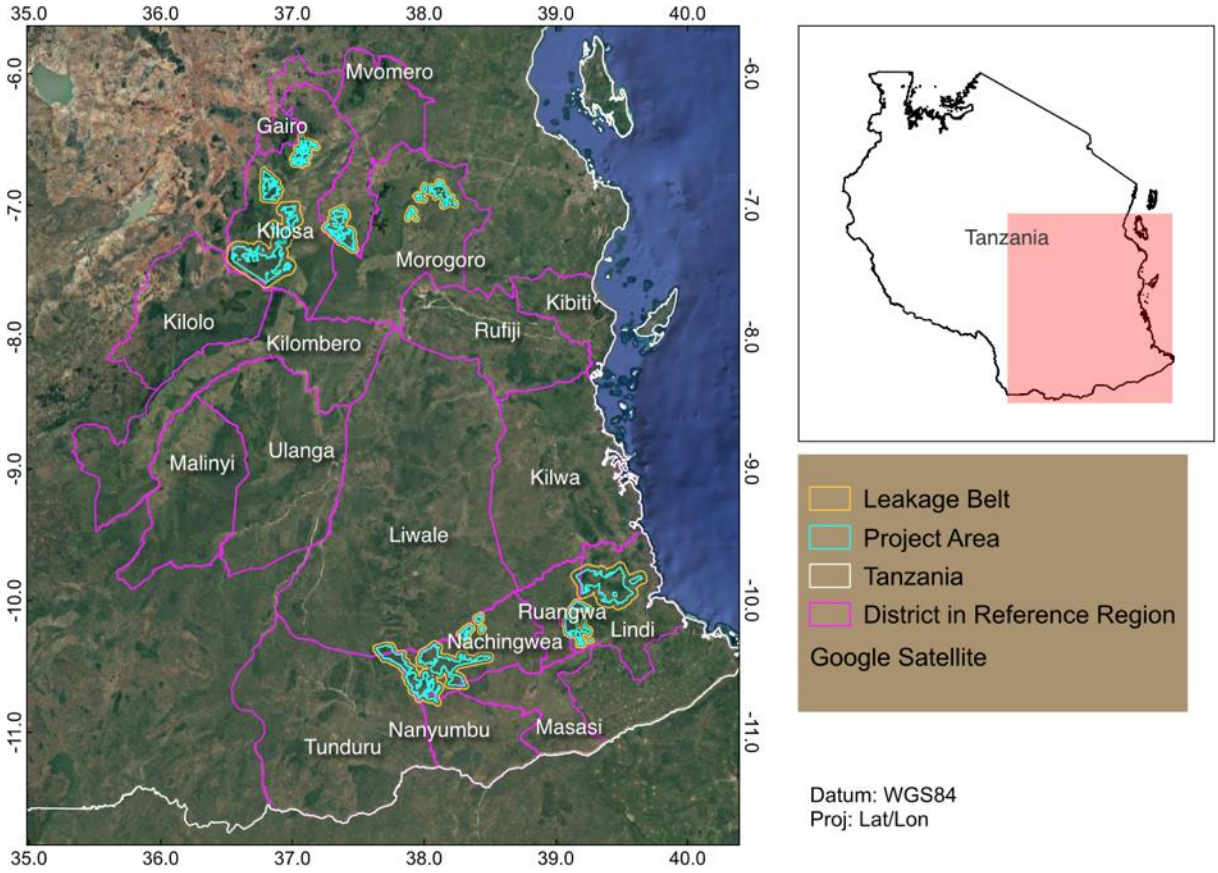


Figure 10 Reference Region Map

The reference region meets the similarity requirements with the project area as follows:

1. The reference region is a good representation of project areas during the baseline validity period. A nationwide study of deforestation in Tanzania showed large consistency in the drivers of deforestation across the country[28]. At least Eighty-nine percent of forest loss in Tanzania is driven by the expansion of agriculture, primarily small-holder agriculture. This is also true in the reference region, though there is a growing threat from larger commercial agriculture as demonstrated by what happened to two villages in Lindi Municipality which were part of the original 10 villages in the project. Thus, the inclusion of some larger scale deforestation driven by commercial agriculture in the reference region is also appropriate.

    a. Expected deforestation agents expected to encroach into the project area in the baseline scenario include small holder farmers, who are ubiquitous in Tanzania, charcoal harvesters, who are often also small holder farmers, and to a lesser extent, larger-scale commercial farmers. Monitoring of encroachment into the project area

[28] Doggart, N., Morgan-Brown, T., Lyimo, E., Mbilinyi, B., Meshack, C. K., Sallu, S. M., & Spracklen, D. V. (2020). Agriculture is the main driver of deforestation in Tanzania. *Environmental Research Letters*, *15*(3), 034028.

from 2023-2024 by village forest patrols teams showed encroachment from all these agents resulting in project area loss. Thus, all these agents exist in the reference region and clearly pose a threat to the project area.

b. Due to the absence of a comprehensive settlement point layer for Tanzania, settlement density was assessed in two ways. The first used the Global built-up surface layer available on Google Earth Engine from the Global Human Settlement Layer (GHSL) project. Processing this data to identify reliable pixels of settlement followed the steps described in section 4.2.1 of this methodological annex. There were 14.08 pixels of settlement per square kilometer of reference region in 2010 compared to 20.71 pixels of settlement per square kilometer of leakage belt in 2020 (see section 1.1.3 for details on the leakage belt). Thus, settlement density in terms of settled pixels in the reference region at the start of the historical reference period is less than the density around the project area at the baseline validity period start date. The builtup pixel density in the reference region in 2020 (20.37) was also slightly lower than the density in the leakage belt.

   To assess road densities only tertiary and above roads from OpenStreetMaps were used. This is because the mapping intensity of lesser roads is highly variable depending on location. Tertiary and above roads include tertiary, secondary, primary, and trunk roads. The roads were clipped to either the reference region or leakage belt and the density calculated. The road density in the reference region was 44 m/sqkm while the density in the leakage belt is 92.5m/sqkm. Thus, the density of major roads in the area surrounding the project area is significantly higher than in the reference region.

   There are no navigable rivers in either the project area or reference region

2. The landscape configuration and ecological conditions of the reference region and project area meat the following similarity requirements:

   a. Forest types were assessed using a 2010 Tanzania Landcover map produced by Space Intelligence and shared with the project as part of a consultancy for the Nature Conservancy. There are three main types of forest in Eastern Tanzania. The largest portion is miombo woodland followed by lowland/coastal forest and montane forest. The project area and reference region both contain all 3 of these forest types. Miombo is the most common forest type in both the project area and reference region. The core area of the original 10 project area villages is coastal forest on the Noto and Chitoa Plateaus and the Ilole forest within the Msimba, Malola A, and Kisanga village forest reserves is montane.

   b. Elevation was assessed using the Copernicus Digital Elevation Model downloaded from Google Earth Engine and reprojected to match the pixel size and spacing of the forest cover benchmark maps. Histogram counts were produced using Dinamica Ego. Project

elevation ranged from 61 to 2067 masl, which overlaps with 95% of the range of the rest of the forested reference region at the beginning of the HRP.

c. Slope was assessed using slope calculated from Copernicus Digital Elevation Model in Google Earth Engine and reprojected to match the pixel size and spacing of the forest cover benchmark maps. Histogram counts were produced using Dinamica Ego. Project slope ranged from 0 to 68 degrees, which overlaps with 99.99% of the range of the rest of the forested reference region at the beginning of the HRP.

d. Precipitation was assessed using OpenLandMap Monthly Precipitation map available on Earth Engine. The dataset was reprojected to match the pixel size and spacing of the forest cover benchmark maps. Histogram counts were produced using Dinamica Ego. Project annual precipitation ranged from 718 mm to 1322 mm, which overlaps with 92.5% of the range of the rest of the forested reference region at the beginning of the HRP.

e. Soil types were assessed using the dominate soil types from the FAO Digital Soil Map of the World. The vector data was rasterized and projected to have the same projection and pixel spacing as the forest cover benchmark maps. Histogram counts were produced using Dinamica Ego. The soil types in the project area exist in 86% of the forested portion of the reference region. However, the largest area of soil type not included in the project area at the time of writing this annex does exist in planned project expansion areas in Rufiji district. Once that expansion is complete, the project area will include soil types found in 91% of forested portions of the reference region.

3. The required project area and reference region socio-economic and cultural similarities are met as follows:

a. In the baseline case, the project area would predominately consist of a mixture of unprotected forests and protected forests on village land. The project area also includes some forest in local authority forest reserves and land which will be included in local authority forest reserves, but which would have been unprotected forest on general land in the absence of the project. The reference region includes all these land status types, but also includes various types of national protected areas. It is important to include national protected areas because they fall in the project leakage belts and thus must be included in the deforestation risk map. The forest in national protected areas is better protected than the project area forests in the baseline scenario, so including these forests in the reference region does not bias the reference region to include more deforestation than if these areas were excluded.

b. In the baseline case, the project area would include forest under village council authority, forest which is converted through clearing from village council to individual household ownership, forest which would have been sold by local authorities to agricultural investors by villages or local authorities, and forest which is under the

control of local authorities. All these land-tenure types are prevalent in the reference region.

c. The current land-use class in the project area is natural forest under protection. That is a common land-use throughout the reference region. The projected land-use in the project areas include conversion to small-holder farming, conversion to commercial agriculture, and conversion to non-forest due to excessive charcoal harvesting. All these use cases are prevalent in the reference region.

d. All land is Tanzania is governed by the 1999 Land Act and subsidiary regulations.

e. There is no spatially explicit data for Tanzania showing the proportion of urban and agriculturally based populations. Within districts, there are municipal and district councils, but there are municipalities which include villages (e.g., the project villages in the Lindi Municipality) and there are towns within district councils (e.g., Mikumi town in Kilosa district, which is adjacent to the project area). Thus, the council types don't clearly distinguish between urban and rural populations. Furthermore, there are agriculturally based peoples in urban areas and non-agriculturally based peoples in rural areas. The 2022 census data only provides summary metrics of urban vs rural populations which works out to approximately 65% rural. It is not clear if this is just based on splitting up populations into district and municipal wards, which would be misleading, or if it is captured by some other metric measured in the census. WorldPopulationReview.com provides what they claim are 2024 estimates of 275 Tanzanian city and towns with populations greater than 2000 people including 38 which overlap the reference region. Dividing the total population from these 38 cities and towns by the total population for the reference region from the 2022 census gives 18 percent urban. Diving the population of Mikumi town, which directly borders a portion of the project area in Kilosa district by the total population of participating project communities and Mikumi town gives 10 percent urban, which is within 10% of the proportion for the reference region.

1.1.2 Project Area

At baseline revision, the project area consists of 327,234 ha of forest persistence since 2010 within the project area polygons (Figure 11). The forest mapping was conducted as part of the reference region historical deforestation analysis as described in section 3.

There are no areas of planned deforestation within the project area and the entire project area is under the control of the project at this baseline revision. The project area includes both areas under immediate and future threat of deforestation according to the risk map created as described in section 0.

Project area polygons in kml format with the details of the ownership of each polygon have been provided to the VVB and uploaded to the project VCS registry account. The complete list of project

participants and their roles is provided in sections 2.1.4, and 2.1.5 of this monitoring report. An interactive web map of the project area is also available at:
https://maps.reterra.ltd/VCSL_Project_Areas/

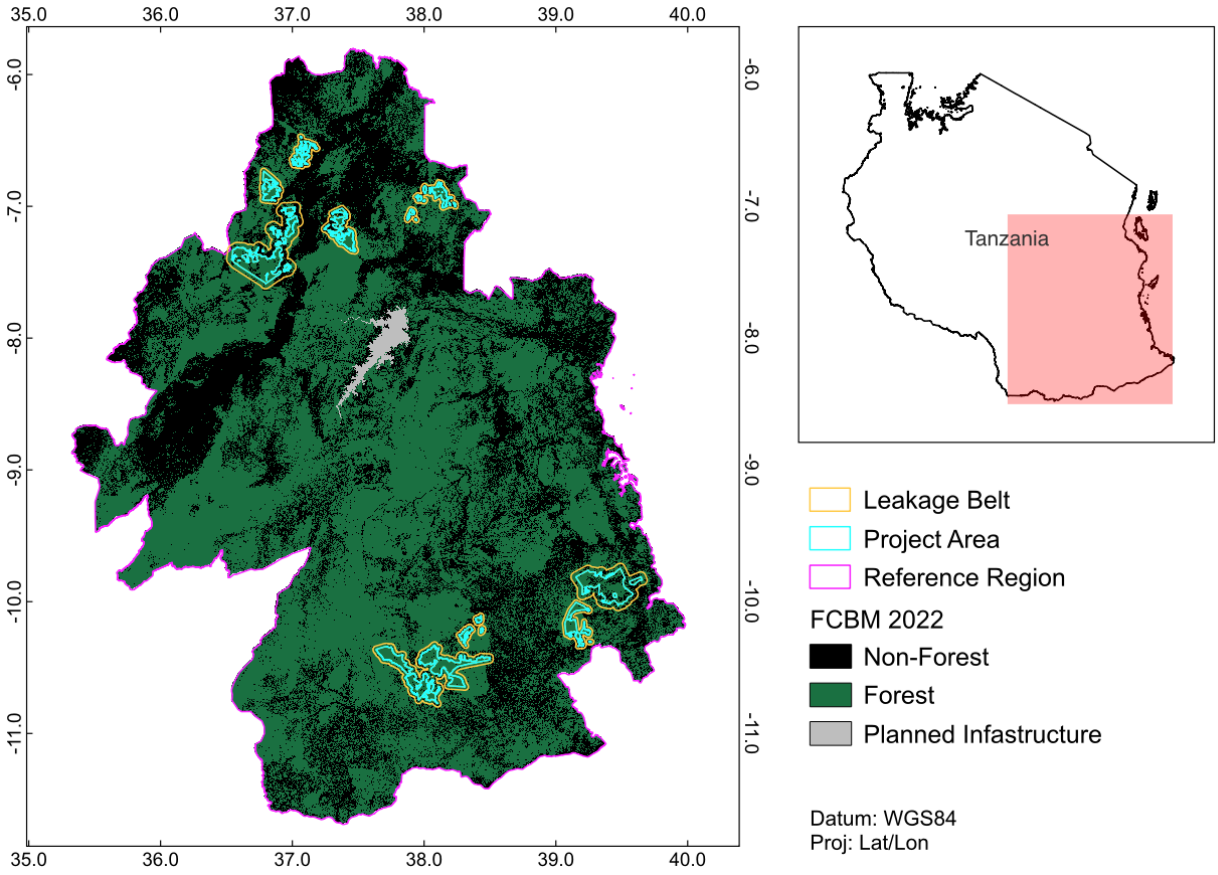


Figure 11 Project Area and Leakage Belt Map

1.1.3 Leakage Belt

The leakage belt is the land surrounding the project area that is monitored for the displacement of deforestation activities from the project area because of project activities. The leakage belt extents were revised due to the baseline revision and expanded project area. The revised leakage belts were established using a combination of requirements from VM0015 mobility analysis and VMD0055 leakage belt requirements to ensure the leakage belts will be valid after the transition to VM0048.

VMD0055 allows for a maximum leakage belt buffer of 10km around the project area, which is then reduced until the forest within the leakage belt is equivalent to the amount of forest within the project area or the leakage belt has reached the minimum buffer of 2km. This calculation is done separately for each discreet project area parcel separated by more than 4km. During the leakage belt calculations, parcels that were separated by more than 4km, but which required leakage belt buffers which would overlap were subsequently combined for the purposes of calculating the leakage belt buffer. The minimum required buffer for each parcel or group of parcels was calculated using numpy functions in

python using a distance from project area parcels group map and the 2022 FCBM as a mask to identify the distance percentile containing the same number of forested pixels as the project parcels in the group. The identified parcel risk buffers ranged from the required minimum of 2000 meters to 4175 meters. The leakage buffer around Malolo A village in Kilosa district ended up extending slightly outside the reference region. The area was mapped as part of the buffer area around the reference region, which indicated that there were 169 ha of forest in the portion of the leakage buffer extending beyond the reference region. Since the area was not part of the reference region, it was not assigned a deforestation density and thus will be conservatively assumed to have zero risk and will be monitored as part of the project leakage belt. The total forest within the identified required buffers was 343,267 ha or approximately 4.9% more than in the project area.

In terms of the requirements of VM0015 mobility analysis, distance from the project area functions as the facilitation criterion, because deforestation agents who were going to deforest in the project area would find it easier to shift their activities into forests that are closer to the project area compared to forests farther away. Then, the risk maps produced in section 0 were used to assess constraints on activity mobility. The risk maps are produced by creating spatial maps of different factors and then training a model based on historical patterns of deforestation and persistence and thus meet the requirements for mobility mapping. See section 4.2.1 for the maps of each factor. The final risk map model included distance to recent deforestation, soil cation exchange capacity, distance to major roads, national protected areas with clear boundaries, slope, and topographic position index. Each one of these variables can be interpreted as a deforestation constraint. For instance, deforestation is much less likely to occur in a national protected area with clear boundaries, which is clearly reflected in the final risk map. Deforestation is also unlikely to occur in very sandy soils with poor cation exchange capacity because the soil is not suitable for rainfed agriculture without fertilizer, which is the main kind of agriculture in Tanzania, the reference region, and around the project areas. By totally up the projected annual density of deforestation in the project area vs leakage belts, it was therefore possible to establish if the leakage belts had forests that were not only accessible from the project area, but also unconstrained for conversion. The total annual deforestation projected in the leakage belts was 7035 ha while the projected deforestation in the project area is 5268 ha. Therefore, during the baseline validity period, the leakage belts hold more than enough forest to accommodate 100% of the deforestation projected in the project area and the average accessibility/conversion suitability of forest in the leakage belt is higher than in the project area.

1.1.4 Leakage Management Zones

The primary leakage management activity for the project is agricultural extension services aimed at improving yields from areas already deforested by communities participating in the project. This will include farms existing within the project area polygons as well as the leakage belt polygons in 2022. According to the 2022 forest cover benchmark map, there are approximately 209,577 ha of non-forest in the leakage belt and 48,781 ha of non-forest in the project area polygon. Most of these non-forest areas are active or fallow farms where leakage management activities can be undertaken.

1.1.5 Forest

For the purposes of this project, the forest definition follows the FAO definition of lands of more than 0.5 hectares, with a tree canopy cover of more than 10 percent, which are not primarily under agricultural or urban land use. Trees should be able to reach a minimum height of 5 meters in situ. The Tanzanian definition is similar except that it includes trees which may grow to reach 3 meters in-situ. The FAO definition is more conservative and much easier to consistently map with remote sensing techniques. A study published in 2023 of long-term land-use trajectories in Tanzania found that most deforestation on village land is permanent[29]. This was also supported by an unpublished 2021 survey of farmers in Lindi region, where shifting cultivation is common[30]. That study found that the average fallow length has declined to just 4 years, which is sufficient time for significant canopy up to 3 meters to develop from coppicing and root suckers, but not enough time for significant biomass recovery.

The forest cover benchmark maps produce in section 3 have pixels which are 0.0625 ha and have 8-pixel orthogonal sieves applied to them so that the minimum landcover parcel is 0.5 ha and thus met the 1 ha minimum mapping unit requirement of the methodology.

1.2 Temporal Boundaries

1.2.1 Start and End Dates of the Historical Reference Period

This methodological annex is for a revised baseline. The start date for the original project historical reference period was 25-May-2001, and the end date 21-April-2012, corresponding with the start date of the project. Version 1.2 of VM0015 states that the start of the HRP should not be more than 10 years prior to the start date of the project but is silent on the length of the HRP to be used for baseline revision. The VCS Methodology Requirements v4.4, which are the most recent at the time of writing this annex, state that historical factors from at least the previous 10 years must be used to project the future location of deforestation, implying that longer timeframes can be used. The revised baseline uses a 12-year historical reference period from 2010 to 2022. A longer historical reference period was necessary because the PALSAR radar backscatter mosaics which are critical for producing accurate land-cover maps in Tanzania do not cover 2012. There isn't an exact start date because the PALSAR imagery used to map the historical reference period is a mosaic of imagery in strips acquired from May 1, 2010, to September 23, 2010, with a pixel-based average of July 7, 2010.

The end dates of the historical reference period correspond to the 2022 PALSAR II radar backscatter mosaics used in the final change step. The dates of the 2022 PALSAR II strips in the mosaic range from July 27, 2022, to Nov 11, 2022, with a pixel-based average of September 4, 2022.

[29] Doggart, N., Mugasha, W. A., Mpiri, A., Morgan-Brown, T., Sallu, S. M., & Spracklen, D. V. (2023). Agricultural fallows are the main driver of natural forest regeneration in Tanzania. *Environmental Research Letters*, *18*(5), 054008.

[30] Morgan-Brown, T. (2021) Lindi Opportunity Cost Study. Unpublished study report shared with VVB.

1.2.2 Start Date of the AUD Project Activity Crediting Period

This a grouped project with two instances. The start date of the first project instance was 21-April-2012 and the start date for the parcels in the second instance is Feb 9th, 2023, which is the date of the first on the ground patrols supported by the project in the new instance. The initial crediting period was to be 30 years, but this has been extended by an additional 20 years in new contracts with the participating forest owners. Version 4.7 of the VCS standard requires a minimum of 20-year crediting periods for AFOLU projects which can be renewed for a maximum of 100 years. The standard also sets a minimum of 40 years for AFOLU project longevity. In the baseline case, the project areas would still have some forests in 40 years, so it was reasonable to extend the crediting to cover the entire longevity period.

1.2.3 Start and End Dates of the Baseline Validity Periods

The initial baseline validity period was from April 21, 2012, to April 20, 2022.

As per version 4.7 of the VCS standard, the new baseline validity period will be for 6 years from April 21, 2022, to April 20, 2028. However, the project expects to transition to VM0048 before that subject to availability of VM0048 baseline data from Verra.

1.2.4 Monitoring Period

As per the methodology and VCS standard, the minimum monitoring period is one year, and the maximum duration is the baseline validity period.

1.3 Carbon Pools

The greenhouse gasses included or excluded from the project boundary area shown in VM0015 Table 2.

VM0015 Table 2 Carbon Pools Included in or Excluded from the Boundary of the Proposed AUD Project Activity

Carbon pools	Included / Excluded	Justification
Above-ground biomass	Tree: Included	The largest carbon pool subject to change
	Non-tree: Excluded	The only perennial crops in the baseline final land-cover are tree crops and are thus captured in the tree pools. The project area is not suitable for sugarcane plantations and pigeon peas are cleared and replanted each season.

Below-ground biomass	Included	This is a significant carbon pool subject to change
Dead wood	Excluded	The carbon stocks in the standing dead tree pool are higher on average in the baseline scenario due to residual unfelled ringbarked trees left in the first 1-2 years after deforestation. However, subsequent burning, cutting, and termite activity remove these residual trees leaving a stock in this pool comparable to the project scenario. The difference between the long-term average post deforestation stock in this pool and average stock in the project forest classes weighted by projected baseline deforestation is 1.98t CO_2e/ha, which is 1.2% of the average emissions factor weighted by projected baseline deforestation. Thus, excluding this pool will not lead to significant overestimate of GHG reductions. Lying dead wood was measured in a subset of forest and post-deforestation biomass plots. The volume of lying dead wood in the forest plots was higher than in the post-deforestation plots, so excluding that pool is conservative.
Harvested wood products	Excluded	Most of the biomass cleared in the baseline scenario is simply burned on site as part of farm preparation. A minority (less than 10%) is turned into charcoal, but that does not translate into a long-lived wood product. An even smaller amount (less than 1%) is turned into timber. The level of timber extraction in both the baseline and project scenario is low because only a minority of tree species are considered suitable for timber and only a minority of those trees are large enough to produce timber. Finally, there isn't likely to be a significantly difference between scenarios as sustainable timber harvesting is allowed in the project scenario. Thus, excluding this pool does not lead to an overestimation of net GHG emissions reductions.
Litter	Excluded	Most of the project area is Miombo woodland, which is subject to periodic burning, so this pool is temporary even in the project case.

Soil Organic Carbon	Excluded	The predominate land-use change in the baseline scenario is conversion from forest to cropland, which results in reductions in soil organic carbon. Excluding SOC is conservative for now, though the project may decide to include SOC when it transitions to VM0048.

1.4 Sources of GHG Emissions

VM0015 Table 3 Sources and GHG to be Included in or Excluded from the Boundary of the Proposed AUD Project Activity

Sources	Gas	Included/Excluded	Justification
Biomass burning	CO_2	Excluded	Counted as carbon stock change
	CH_4	Included	Slash and burn is the method of forest clearance in the baseline scenario
	N_2O	Included	Slash and burn is the method of forest clearance in the baseline scenario
Livestock emissions	CO_2	Excluded	Not a significant source as per the methodology
	CH_4	Excluded	The project activities have no effect on livestock numbers or emissions and therefore they are excluded as insignificant
	N_2O	Excluded	The project activities have no effect on livestock numbers or emissions and therefore they are excluded as insignificant

2 BASELINE SCENARIO

2.1 Determination of the most plausible baseline scenario

As per the methodology and VCS standard, the additionality of the project is assessed using the most recent version (3.0) of VT0001 Tool for the Demonstration and Assessment of Additionality in VCS AFOLU Project Activities. This assessment is updated for the baseline revision and expanded project

area, though largely remains the same because the conditions have not changed much in the 10 years since the project start.

The tool requires four steps to be applied:

a) Step 1. Identification of alternative land use scenarios to the AFOLU project activity

b) Step 2. Investment analysis to determine that the proposed activity is not the most economically or financially attractive of the identified land use scenarios; or

c) Step 3. Barrier analysis; and

d) Step 4. Common practice analysis

Step 1. Identification of alternative land use scenarios to the proposed VCS AFOLU project activity

In this step, alternative land use scenarios to the proposed VCS AFOLU project activities that could be the baseline scenario are identified through the following sub-steps:

Sub-step 1a. Identify credible alternative land use scenarios to the proposed VCS AFOLU project activity.

Four credible alternative land use scenarios have been identified in line with the guidelines presented in the tool.

1. Continued conversion of communally owned village forest land to small-scale agriculture, primarily for annual cash or subsistence crops. This has been observed within the previous 10 years affecting forest areas within the project area polygons and leakage belt polygons. It is the dominate driver of deforestation for the entire country.

2. Changing villages to township or municipal status ceases the village council's role as Managing Authority. Without active efforts to secure effective cooperation between the Local Authority (Municipal Council) and communities, management of the village land forest reserve becomes ineffective, potentially resulting in the conversion of forests to agricultural use. This is a new threat which was not present during the initial historical reference period, but which is demonstrated most clearly through the experience of Nandambi and Mkanga 1 villages, which in the absence of continued support from the REDD project were converted to municipal land by the Lindi Municipality and had portions of what had been their village forest reserves sold to local investors for agriculture between 2018 and 2022.

3. Conservation resulting from an NGO raising the funds necessary to implement all the proposed project activities, including CBFM, from sources not related to carbon markets.

4. Conservation resulting from the conversion of village land to a new national protected area such as a national park, nature reserve, forest reserve, or game reserve.

Scenario 1 and 2 is the continuation of the pre-project (or business as usual) land uses seen within the project area and reference region within the past 10 years. See section 2.2 of this methodological annex for more details of these scenarios. Scenarios 3 and 4 require external sources of funding to

support conservation activities. An example of scenario 3 is the creation of 10 village forest reserves now part of the Village Climate Solutions project in Mvomero and Morogoro rural districts with support from the Transforming Tanzania's Charcoal Sector project. Sustainable charcoal production was the primary motivation for the creation of the forest reserves, not carbon finance. The work was funded by the Swiss Development Corporation[31], but ended in 2023. For scenario 4, while Tanzania has created many new national protected areas in the past 10 years, we could not find examples of where the protected area was created by converting village land to a national protected area.

Outcome of sub-step 1a: Scenarios 1, 2, and 3 are credible scenarios with examples that have occurred within the previous 10 years.

Sub-step 1b. Consistency of credible land use scenarios with enforced mandatory applicable laws and regulations

Scenario 1: Prior to the project, none of the villages in the initial project instance had established village forest reserves or conducted land-use planning. Thus, conversion of forest to small holder agriculture was legal, except in the case of conversion of forest land to agriculture within 30 meters of a stream and farming on extremely steep slopes (hazard lands), which are illegal land-uses under the 2002 Forest Act and 1999 Land Act respectively. However, there is not a single documented case of these acts being enforced in the participating project villages prior to the start of the project and numerous examples of farmers clearing in stream valleys and on hazard lands.

The second project instance consists of a mixture of village and local-authority forest reserves predating the project, new village forest reserves created specifically for the project, and village forest reserve expansions created specifically for the project. Through establishing new villages forest reserves and encouraging expansion of existing village forest reserves, an additional 97,919 ha was placed into village forest reserves because of the project activities. As was the case with the original project instance, conversion of forests in the new village forest reserves and village forest reserve expansions created for the project would have been legal in the baseline scenario because they would not be in village forest reserves in the baseline scenario. It should also be noted that 7 Kilosa district village forest reserves now part of the project covering 82,659 ha were established as part of a different prospective REDD project developed by the Tanzania Forest Conservation Group and MJUMITA during the same period that these organizations developed the first instance of this project. That project failed to produce a project document and in the absence of continued donor funding and a clear market for REDD credits in 2015, was unable to progress to registration. These villages have been supported by TFCG and MJUMITA since 2015 with donor funding from two different projects which ended in 2023.

Conversion of existing village forest reserves or local authority reserves to small holder farming through informal processes is illegal but is commonplace in the absence of substantial funding for forest protection.

[31] https://www.tfcg.org/what-we-do/develop/coforest/

Scenario 2: Changing Village Governments to township or municipal status ends the Village Council's role as the Managing Authority over the Village Land Forest Reserve. This does not automatically convert Village Land Forest Reserves into general land unless legalized through a Government Notice. Converting gazetted Village Land Forest Reserves to general land requires approval from the Ministry of Forestry and Beekeeping, which is possible but more difficult due to the need for public consultations and multiple endorsements from local level. Thus, scenario 2 is legal, but only a threat to parts of the project area in ungazetted village forest reserves. Supporting the gazettement of more Village Forest Reserves in the project will be a key strategy employed by the project to enhance permanence.

Scenario 3: The 2002 Forest Act allows for the conservation activities in scenario 3 to be established.

Therefore, for a substantial portion of the project area, all the scenarios are compatible with applicable laws and regulations in the baseline scenario. However, there is also a portion of the project area where scenario 1 would not be consistent with the applicable laws and regulations. In such cases, VT0001 requires that non-compliance with those legal requirements be prevalent in at least 30% of the smallest administrative unit that encompass the project area for the land-use to be considered plausible.

The additionality of protecting forests within 30 meters of streams outside of village forest reserves is only claimed in the case of the original project instance. The lack of enforcement of this law was assessed during the initial project validation using Lindi Region. To access the prevalence of deforestation along streams, some reasonable sampling had to be done as there is no map of all the streams in Lindi Region. Therefore, the analysis of deforestation within 30 m of a stream was limited to major streams, for which a GIS shapefile was available. This is reasonable because if this rule is not enforced along major water ways, it is even more likely that the rule is not enforced for minor water ways. Additionally, not all the Region is inhabited, so it is difficult to access the enforcement of a rule where there is no threat. Instead, the sampling was done at the scale of wards. There are 119 wards in Lindi Region and 61 of them overlap a major stream. High resolution imagery available from Google Earth was used to locate agricultural within 30 meters of major streams. If a farm was found, then the search shifted to a new ward. The search was not systematic and did not cover all the wards. Once enough clearings were detected to demonstrate that the law regarding cultivation near streams is not enforced across most of the region, the search stopped. The search revealed agricultural clearings within 30 meters of a major stream in 32 wards with a combined area equal to 50% of the region. Examples of agricultural encroachment in streams were found in all 6 of the region's districts. Shapefiles of the locations of agricultural encroachment in waterways, ward and district boundaries were shared with the validation body.

In the case of the lack of enforcement of rules in existing village and local authority forest reserves, given that the new project instance spans multiple regions, the smallest administrative unit covering the entire project area would be the entire country. There is no national dataset of village and local authority forest reserves, so assessment at the national level would be impossible. Instead, the project looked at protection of village and local authority forest reserves within 11 of the 18 districts making up the reference region using village and local authority forest reserve boundaries collected by the

Tanzania Forest Conservation Group and Mpingo Conservation and Development Initiative. In total, there were 127 villages with forest reserves covering 824,678 ha in the dataset which had been created prior to 2022 and most prior to 2016. The reserves were checked for deforestation using the 2016-2022 reference region land-cover change analysis described in section 3. Ninety-three percent of the reserves had at least 0.5 ha of deforestation during that period and 43% had at least 50 ha of deforestation, indicating that lack of enforcement is widespread. One village in Kilwa district, Nanjirinji A, lost 6,646 ha of forest in its village forest reserve during that period and 8166 ha between 2010 and 2016. The reserve was established in 2012. Another village in Liwale district, Ngumbu, lost 7,481 ha of forest between 2010 and 2016 and 2530 ha between 2016 and 2022 which translated into a total loss of 74% of its village forest reserve during the 12-year period. Lack of enforcement was also prevalent within the village forest reserves in the 55 villages in the dataset that later joined the VCSL project. 98% lost at least 0.5 ha and 56% lost at least 50 ha between 2016 and 2022.

Outcome of sub-step 1b: Scenarios 1, 2 and 3 are consistent with enforced mandatory applicable laws and regulations.

Sub-step 1c. Selection of the baseline scenarios

Scenario 1 and 2, which are the continuation of the land-use trends of the 10 years prior around, and even in, the project area are the most plausible alternative land use scenarios in the absence of this REDD project. While some of the land-use conversions are illegal under national Tanzanian law, these laws were in place during the 10 years prior to the project and the historical deforestation analysis demonstrates that they were not enforced. To justify the selection of Scenario 1 and 2 as the baseline scenario, the relative likelihood of each scenario is briefly considered.

Scenario 1: Continued conversion of communally owned village forest land to small holder agriculture, primarily for annual cash or subsistence crops.

A large portion of the land in the project area prior to the establishment of the project instances was de facto open access village land. Village residents in the project area and in the rest of the reference region were free to clear as much forest as they were able to establish their farms. Furthermore, only through clearing forests could residents obtain customary ownership over the land since they could not simply claim forested land as their own. Farmers in the participating project villages and in the wider reference region frequently clear new farms from the forest to avoid pests and weeds, and access more fertile soil. Due to the lack of capital and knowledge, farmers in the region do not engage in intensive forms of agriculture and are unlikely to come to adopt them in the future in the absence of the project.

The underlying drivers of deforestation are population growth and improved market access, both of which are likely to continue in the future. See 2.2.2 of this methodological annex for a complete description of the drivers of deforestation in the region and a justification of their likely future trajectories.

Scenario 2: Changing Village Governments to township or municipal status ceases the Village Council's role as Managing Authority over the Village Land Forest Reserve, potentially resulting in the conversion

of forests to agricultural. This is legal but rare, having occurred only twice in the past 20 years within the project area. It typically requires multiple consultative meetings and approvals from local to national levels.

Scenario 3: Conservation resulting from an NGO raising the funds necessary to implement all the proposed project activities from sources not related to carbon markets. This scenario is unlikely due to barriers described in Step 3.

Scenario 4: Conservation resulting from the establishment of a new national protected area. This scenario is unlikely due to barriers described in Step 3.

Step 3. Barrier analysis

Following Step 1, VT0001 allows for either conducting an investment analysis or a barrier analysis. We elected for a barrier analysis. The analysis is used to establish whether the type of proposed project activity faces barriers that:

Prevent the implementation of this type of proposed project activity without the revenue from the sale of GHG credits; and

Do not prevent the implementation of at least one of the alternative land use scenarios.

Sub-step 3a. Identify barriers that would prevent the implementation of the type of proposed project activity.

a) Investment barriers

Donor funding can be obtained to pay for establishing village and local authority forest reserves. However, as demonstrated in sub-step 1b, establishment does not automatically lead to long term protection. Donor funded projects are by design, not long term. The hope of community based-forest management in Tanzania has always been that villages will be able to obtain sufficient income from sustainable forest use to pay for and incentivize forest conservation in the long term. That hope has not materialized. The project village forest reserves in Morogoro region that were not established as part of a REDD project have been supported by the Tanzania Forest Conservation Group and MJUMITA since 2015 as part of two multi-million-dollar projects funded by the Swiss Development Corporation aimed at promoting sustainable charcoal and timber. The last phase of the project ended in 2023, but direct support to most villages in Morogoro region ended in 2019.

However, even during the period of donor funding, the project struggled with political opposition to the concept of sustainable charcoal[32]. This opposition resulted in frequent charcoal bans in the project districts, which only affect legal charcoal, and regulations aimed at undermining the project[33]. For

[32] Doggart, N., & Meshack, C. (2017). The marginalization of sustainable charcoal production in the policies of a modernizing African nation. *Frontiers in Environmental Science*, *5*, 27.
[33] Mabele, M. B. (2020). The 'war on charcoal' and its paradoxes for Tanzania's conservation and development. *Energy Policy*, *145*, 111751.

instance, new regulations require villages to charge the same royalties on their charcoal as the Tanzania Forest Service (TFS) is supposed to charge on charcoal coming from general land. TFS charcoal check points ensure that villages strictly adhere to this policy and since in reality, most charcoal from general lands evades paying royalties, villages are at a competitive disadvantage and have struggled to find buyers ever since. In 2022, the last full year of the project, the total income for 30 villages active in sustainably timber production was $92,465[34], or $3,082 per village, which is simply not sufficient finance to fund and incentivize the protection of 140,000 ha of forest under high pressure for conversion. By comparison, 27 of these 30 villages will earn a minimum of 10 times as much annually from this REDD project if they can prevent 85% of baseline deforestation.

Villages focusing on sustainable timber are also forced to charge the same royalties as national government. This, combined with the withdrawal of the company Sound and Fair, which previously purchased FSC certified hardwoods from Lindi Region, has also made it difficult to find buyers. Nanjirinji A for instance is part of an FSC group certification scheme supported by the Mpingo Conservation and Development Initiative. As recent as 2017, the village was earning as much as $90,000 a year from sustainable timber sales. However, it then lost 6,646 ha (10%) of its forest reserve between 2016-2022 due to small holder agricultural encroachment.

Furthermore, revenue from sustainable forest use has never been used to fund activities like agricultural extension services. Short term donor funding can be obtained for such activities, but long-term support is required to reach a substantial proportion of farmers. Thus, even villages that can earn sufficient income from sustainable use to fund and incentivize forest protection will see leakage from those activities in the long run in the absence of REDD.

Thus, while scenario 3 might be credible for a 3-to-5-year donor funded project, it is not possible to secure donor funding to support all the project activities for 40 years or for sustainable forest use established by donor funding to cover all the project activities for 40 years.

Sub-step 3b. Show that the identified barriers would not prevent the implementation of at least one of the alternative land use scenarios (except the proposed project activity).

The barriers described in sub-step 3a facilitate rather than hinder scenario 1. The lack of a business case for community-based forest management in the area both in terms of commercial and subsistence use means that communities would be unwilling to put as much forest aside for forest protection as they have as part of this project.

Scenario 2 is also facilitated by the identified barriers. Without long-term funding for forest protection and technical support from an NGO or similar partner, villagers are less likely to be able to block the transfer of their land to a municipality for sales to investors. This poses a threat even to village forests that have a long conservation history.

Step 4. Common practice analysis

[34] From village charcoal royalty data shared by MJUMITA

As outlined in previous sections, community-based forest management initiatives have been implemented in various regions of Tanzania, including the project area itself, without the explicit incentive of a carbon market. However, the scope, scale, and effectiveness of these initiatives falls short of a REDD+ project. Most importantly, as described in the investment barriers section, the level of financial flows expected from REDD project activities to participating communities will be 10x those from prior forest conservation activities.

Also, typically, villages supported with donor funding to create village forest reserves without carbon finance will leave large portions of their forest outside of protection. For instance, community-based forest management has been supported by donor funded projects for over a decade in Nachingwea district with a focus on sustainable timber harvesting. When TFCG started working in Nachingwea district in 2020 under the COFOREST project with an aim to introduce sustainable charcoal harvesting, they focused on villages that didn't have existing village forest reserves assuming they would have the most interest in creating a reserve. They identified Chimbendenga and Lionja B villages as potential villages for new village forest reserves, but in the end were only able to convince Lionja B to create a reserve, which is just 681 ha of forest. Three years later, when VCSL came into Nachingwea to introduce REDD, the project was able to convince 14 villages, 11 of which already had a village forest reserve, to create and start patrolling 70,528 ha of new or expanded village forest reserves. This was 163% increase in area under village forest reserves accomplishing in months what previous donor supported work had not accomplished in over a decade. The new expanded areas also increased the baseline for those villages by 169% indicating that the expanded village forest reserves had on average slightly higher risk than the existing reserves. The project was able to find additional forests to add to the project area in every village it engaged with in 2023 regardless of how long ago the village had established its village forest reserve. Thus, the scale of the conservation work in the project communities is working is not common practice.

Furthermore, the analysis presented in sub-step 1b shows that even though community-based forest management in the reference region had left ample forests for farmers to clear outside of village forest reserves, encroachment in village forest reserves was widespread. In part, this is because multi-decade support is not common practice with donor funded projects typically having 3-to-5-year timelines. Donors expect villages to achieve financial independence for conservation activities after the initial support to create the village forest reserves. For instance, donor supported forest conservation activities for second instance villages in Morogoro Region ended in 2019 with the end of the TTCS project. In Nachingwea, the Mpingo Conservation and Development Initiative, which had previously supported many of the project villages had no donor funding to support the villages at the time those villages joined the VCSL project. More durable solutions require multi-decade funding that can ensure that conservation and leakage avoidance activities are funded regardless of the policy and market environment for sustainable forest use. Currently this can only be accomplished with carbon finance.

2.2 Description of Baseline Scenario (Step 2): Analysis of Agents, Drivers and Underlying Causes of Deforestation and Their Likely Future Development

In February 2023, the project introduced a new forest patrol technology to forest patrol teams. The system uses Mergin Maps, which has a plugin for QGIS, a cloud server, and a mobile GIS data viewing and collection app. Using base maps from Planet.com, the project mapped all the forest disturbance that occurred within the project area and proposed project areas from May 2022 to February 2023 and synced the deforestation polygons to the cloud server. Then the project provided a smart phone to each forest patrol team and trained them how to use the Mergin Maps mobile app to navigate to the polygons of deforestation, record details about the deforestation, and survey the deforestation agents where possible. Where village forest patrols teams were inactive, or where the forest tenure had been changed from village to municipal land, the project worked with local government to re-establish forest patrol teams from households living adjacent to the project area forests.

Forest patrol teams then continued to collect new data through the monitoring period, though deforestation maps were not regularly updated during the latter half of the 2024 farming season.

In addition to the Mergin Maps data, the project conducted focus group discussions with community leaders and village natural resource committees to gather basic baseline data about the socio-economic conditions in each community.

Taken together, these datasets provided the project with comprehensive and up-to-date information on the agents, drivers, and underlying causes of deforestation within the project area itself, so there is no need to extrapolate from the reference region, though all indications are that the project area is very similar to the reference region.

2.2.1 Identification of Deforestation Agents

As of June 2024, forest patrol teams had made 4,853 forest disturbance agent entries in the Mergin Map system. The dataset includes many duplicates, because data is recorded for each polygon and the same agent is often responsible for multiple forest disturbance polygons. Filtering the data by unique names and ages, and for complete residence length information, the dataset is reduced to 2501 entries, though duplicates remain due to differences in name spelling. However, the pattern of duplication should not systematically bias the data.

With a few exceptions, almost all the deforestation agents resided in a project community (69%) or community adjacent (27.5%) to the project area. There were only 88 records (3.5%) of a deforestation agent living farther than 10km from the project area, mostly comprising smallholder farmers from nearby villages and towns who move to the forests during farming seasons and return to their homes after harvesting. This is because most deforestation is driven by small holder agriculture and the main mode of transportation to farms is walking. Only larger scale commercial farmers have transportation means that would allow them to live farther from the project area and that type of farming is still

relatively rare in the vicinity of the project areas. This conclusion is also supported by the breakdown of household transportation assets from the 2022 census for Morogoro and Lindi Regions (Table 19).

Table 19 Household transportation assets from 2022 census

Region	Bicycle	Motor Vehicle	Motorcycle / Vespa
Morogoro	24.2%	1.9%	7.8%
Lindi	29.2%	0.9%	9%

Deforestation agents can also be grouped by residence length and whether they come from a community neighboring the project area or farther away. Approximately 29% of agents had shifted their residence in the 5 years prior. However, 35% of those agents had simply shifted from a neighboring village. Due to the nature of the survey question, it likely that some of the 19% of agents that reported shifting from outside the project area in the previous 5 years also came from a neighboring village. This is because some of the reports of people coming from a different region are from project areas in Nachingwea that border Mtwara region and Tunduru district. Removing the records where that is likely to have occurred reduces the percent of agents moving to the vicinity of the project area within the past 5 years to 17%. Thus, approximately 83% of deforestation agents have resided in the vicinity of the project area for more than 5 years.

Table 20 Deforestation agent genders

Gender	Percent (total sample size = 2444 entries
Female	10%
Male	90%

Deforestation agents are overwhelmingly male (Table 20). This may be because women are less likely to be involved in the clearing process itself and more likely to work farm areas closer to home. Making new farms in the forest often requires walking substantial distances from home and it may not be practical for women, who are principally responsible for childcare, to walk such distances with young children.

Table 21 Deforestation agent ages

Quantile from youngest to oldest	Age Range

1-25%	18-35
26-50%	36-44
51-75%	45-52
76-100%	53-92

Considering that in 2022 census data for mainland Tanzania, 55% of people over the age of 18 are 35 years or younger, deforestation agents (Table 21) are significantly older than the average Tanzanian adult. However, this may in part be explained by differences in education attainment. Older generations have lower rates of educational attainment and thus have fewer options beyond farming. Another factor is that younger people are more likely to move to cities to look for work. This can be seen in Lindi in particular. In the 2012 census, there were a significant number of missing men (Figure 12) between the ages of 20 and 50 which because many men had shifted to cities to look for work. With the opening of the Mkapa bridge in 2004 and improved roads since then, Lindi has become much better connected to the country's major export cities making cash crop farming more attractive and this has reduced the demographic imbalance (Figure 13), though it is still visible.

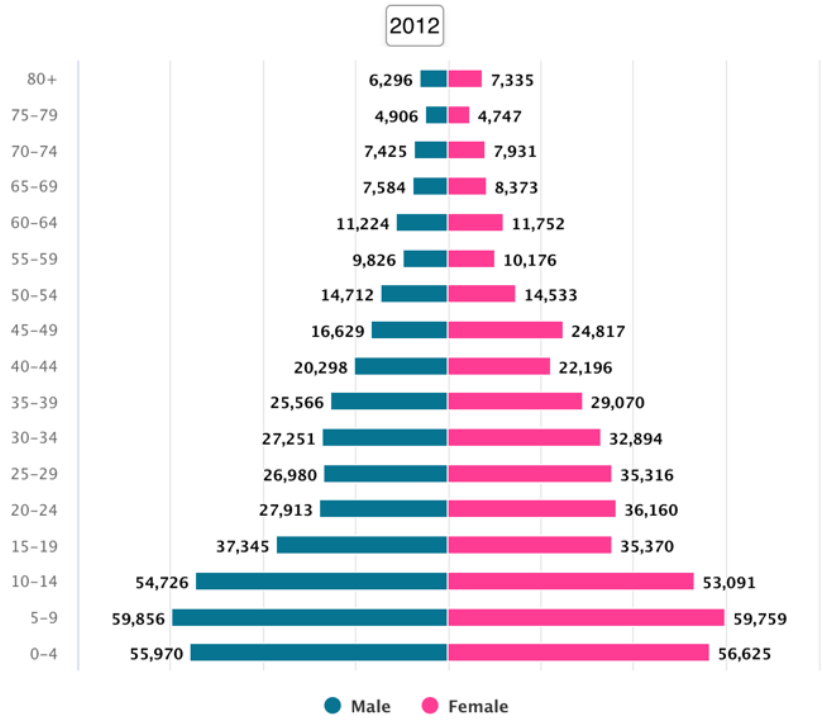


Figure 12 Lindi population pyramid 2012

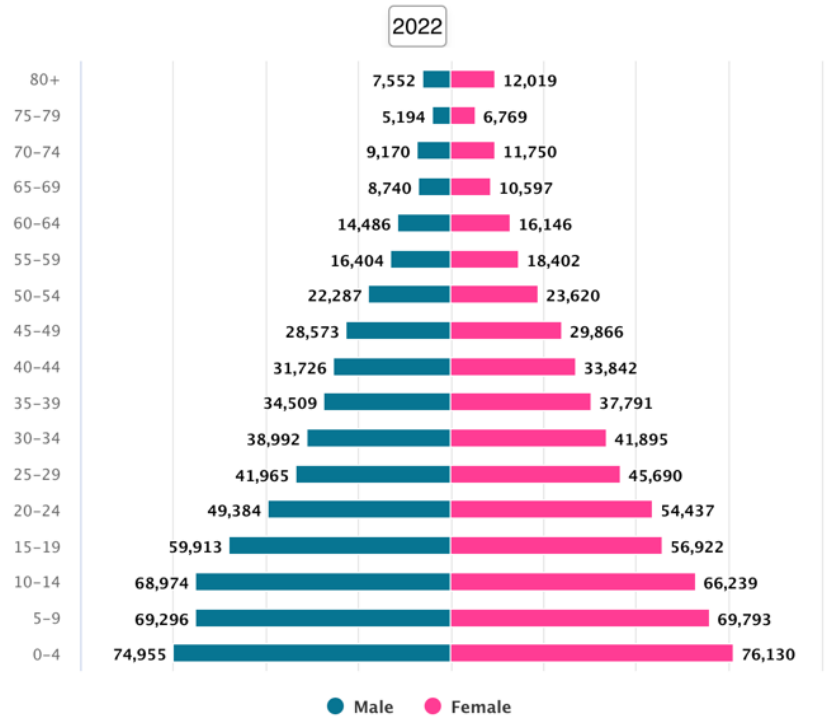


Figure 13 Lindi population pyramid 2022

Table 22 Deforestation agents by education attainment

Education Level	Percent (total sample size = 2468 entries)
None	32%
Primary	64%
Secondary	3.6%
Post-Secondary	0.4%

Considering that that the 2022 census data reports that 22% of Mainland Tanzania adults have secondary or above education, deforestation agents in the project area are significantly less educated than the average Tanzanian adult. This makes sense since people with higher levels of education are less likely to engage in other livelihood options that are not open to those with less education.

Expected changes in deforestation agents.

Tanzania has not produced updated population growth expectations based on the 2022 census but considering that the countries fertility rate is currently 4.7 births per woman and nearly half the

country's population is under the age of 17 (Figure 14), high population growth rates can clearly be expected during the baseline validity period as today's youth come of age. This will also doubtlessly translate into a large growth in absolute terms of the deforestation agent population. According to the project's baseline focus group discussions, the secondary school enrollment for secondary school age children is 33.6%. This is substantially higher than before, but the number of people in the project area with less than secondary school attainment is set to increase substantially during the baseline validity period, both from local and immigrant populations.

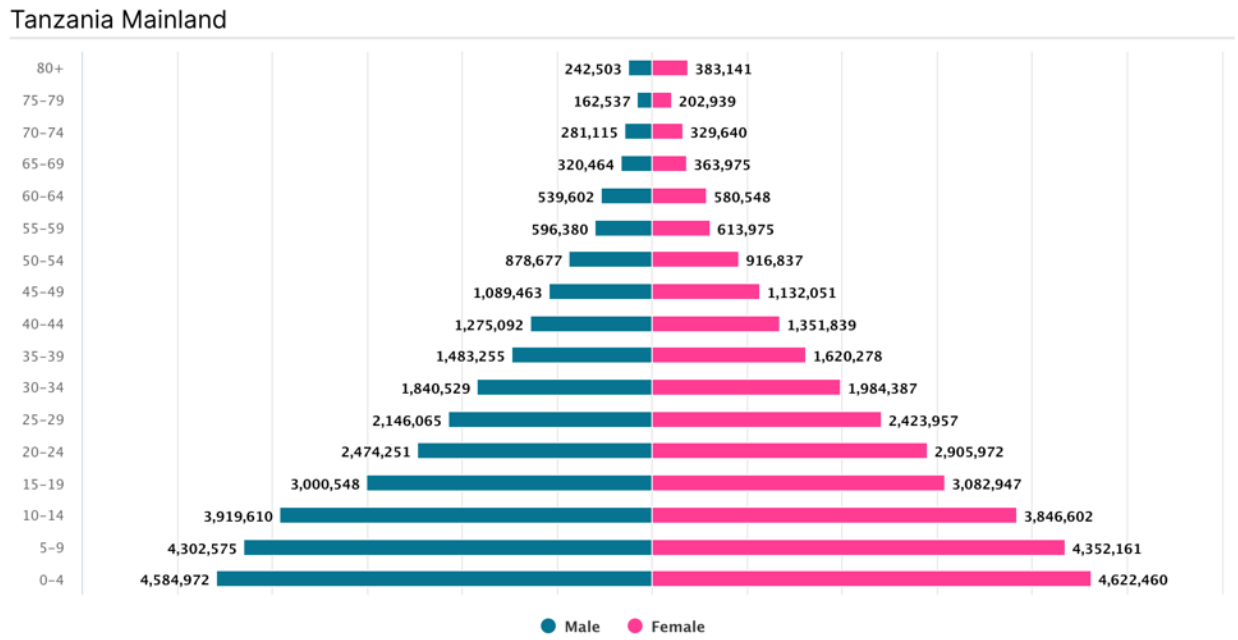


Figure 14 Tanzania Mainland 2022 Population Pyramid

2.2.2 Identification of Deforestation Drivers

Field Data

As of June 2024, the forest patrol teams had uploaded patrol data from 5273 disturbance polygons covering 4,635 acres of disturbance from polygons ranging in size from 0.01 to 24.24 acres.

Forest patrol teams recorded what they believed was the primary cause of the disturbance (Table 23), all other disturbance causes they observed (Table 24), and the crops grown if any (Table 25). There were 4010 records for farm clearings with valid crop records covering 3,843 acres.

The results from Table 23 and Table 24 make it clear that deforestation in the project area is almost exclusively driven by agriculture with most other forest disturbance activities simply being opportunistic activities carried out by farmers as part of farm clearing. Additionally, most of the other disturbance activities are technically drivers of degradation rather than deforestation since they are small scale and unlikely to lead to permanent land-cover change. Charcoal production was the primary driver of disturbance for just 2% of the area cleared. The opportunity cost study conducted in Lindi in 2021

found that the charcoal production opportunity cost was negative in most locations due to the high labor and transport costs. It appears primarily an activity reserved for forest near cities or major roads linking cities, which are becoming increasingly rare due to conversion to agriculture. In the past decade, an increasingly percentage of charcoal sold in Dar es Salaam, Tanzanian's largest charcoal market, has come the southern highlands where it is made from invasive black wattle trees that grow rapidly in fallow farms.

Table 23 Primary cause of forest disturbance in project areas from (May 2022 – May 2024)

Primary Disturbance Factor	Percent of Records	Percent of Area
Farming	91.22%	95.45%
Charcoal	3.79%	2.05%
Grazing	0.68%	0.44%
Building	0.13%	0.05%
Timber	0.19%	0.03%
Firewood	0.09%	0.04%
Fire	3.00%	1.13%
Other	0.64%	0.62%
None	0.23%	0.20%

Table 24 All causes of forest disturbance in project areas from (May 2022 - May 2024)

Disturbance Factor Present	Percent of Records	Percent of Area
Farming	91.69%	95.95%
Charcoal	5.73%	3.91%
Grazing	1.42%	1.22%
Building	2.12%	4.81%
Timber	0.57%	0.22%
Firewood	5.12%	7.27%
Fire	25.98%	24.47%

Building Poles	6.90%	11.59%
Other	1.35%	0.98%

Table 25 Crops grown in farm clearings in project area (May 2022 - May 2024)

Crop	Percent of Records	Percent of Area
Maize	48.60%	46.29%
Sesame	49.48%	55.60%
Cashew	10.27%	14.89%
Orchard	0.10%	0.02%
Peanut	3.29%	4.78%
Sunflower	8.78%	11.98%
Casava	5.64%	5.10%
Beans	4.21%	3.19%
Pigeon pea	22.29%	23.38%
Cowpea	5.26%	6.39%
Hill Rice	15.76%	14.17%
Sorghum	10.72%	9.84%
Vegetables	2.07%	3.17%

Eighty-three percent of farmed land with crop records had either Maize or Sesame or both. The most common stand-alone crop was Sesame, covering 24.44% of area. Principle food crops including maize, sorghum, casava, rice, millet, beans, banana, cowpeas, and pigeon peas were found in 75% of farms representing 79% of farm clearing by area. Principle cash crops including sesame, cashew, sunflower, pigeon pea, cowpea, peanuts, and orchard crops were found in 80% of farms representing 91% by area. Sesame, cashew, and sunflower, which are exclusively cash crops were found in 66% of farms representing 78% of farm clearing by area.

Driver variables explaining quantity of deforestation

Population Growth

The quantity of deforestation within the reference region has been steadily increasing over time (see section 4.1). The primary explanation is faster population growth, particularly the increase in the less

educated population which has few livelihood options outside of farming. The growth rates for Morogoro and Lindi Regions between 2012 and 2022 were much higher than the previous 10 years (Table 26). Some of that growth would have gone into urban areas, but the total 2024 town and city populations[35] of Morogoro and Lindi are less than the 2012-2022 change so obviously there was also substantial growth in rural populations. Nationally, the rates of attainment of secondary or higher education doubled between 2012 and 2022, but the total number of Tanzanian adults with primary or less educational attainment increased by 22%. As shown in the section on deforestation agents, 96% of project area deforestation agents fall into this group.

One of the key project activities is to increase secondary school enrollment in project communities by increasing secondary school accessibility. Over the long run, this will give more project community members more livelihood options beyond farming and thus reduce pressure on forests. Additionally, global studies suggest that increased secondary school attainment for women is associated with reduced population growth as it tends to delay the age of first pregnancy and increase women's empowerment.

Table 26 Morogoro and Lindi Region population from past 3 censuses

Region	2,002	2,012	2022	Change 2002-2012	Change 2012-2022
Morogoro	1,753,362	2,218,492	3,197,104	465,130	978,612
Lindi	787,624	864,652	1,194,028	77,028	329,376

Commodity prices

The field data on disturbance causes suggests that both subsistence food and cash crop production pose a threat to the project area, thought there appears to be increasing focus on cash crop production. An unpublished opportunity cost study of farmers who had cleared forest between 2017 and 2020 in Lindi Region found that 67% reported planting maize and only 42% reported planting sesame. A national study of deforestation from 2010-2017 found maize in 57% of farms and sesame in 20%[36]. Given the apparent shift towards cash crops, it can be expected that commodity prices will play a larger role in deforestation. However, Tanzanian farmers are flexible in the crops they grow and can rapidly respond to market conditions, so individual commodity prices may not matter as much when they can switch to a higher price commodity.

[35] Data from WorldPopulationReview.com
[36] Doggart, N., Morgan-Brown, T., Lyimo, E., Mbilinyi, B., Meshack, C. K., Sallu, S. M., & Spracklen, D. V. (2020). Agriculture is the main driver of deforestation in Tanzania. Environmental Research Letters, 15(3), 034028.

This may in part explain the drop in the percent of farmers cultivating maize, which was identified as the primary driver of deforestation during the first baseline validity period. Maize is the most important cereal crop in Tanzania and in neighboring countries. As reported in the first methodological annex for this project, the Tanzanian government periodically institutes maize export bans. This appeared to have constrained deforestation in Lindi historically as maize cultivation was the biggest driver of deforestation and higher when maize export bans were not in place. In 2012, in response to studies conducted by USAID and the World Bank that showed export bans did not improve food security and increased rural poverty, the Tanzanian government made a commitment not to impose crop export bans in the future. However, the commitment did not last long with the government once again instituting complete bans in 2016 and 2017[37] and then setting up a ridged export licensing system still in place in 2024[38]. Thus, farmers may be switching to cash crops more and more as a strategy to avoid the uncertainty of the maize market policies.

Export volume and value data from Tridge.com suggests that the export price of sesame from Tanzania has increased in recent years after drop in price in 2020 associated with record high production levels. The sesame export value reached a record high in 2023.

Table 27 Tanzania sesame export data (2019-2022) from Tridge.com

Year	Volume (millions of kg)	Value (millions of USD)	Price per kg (USD)
2019	126.93	168.52	1.33
2020	161.46	152.46	0.94
2021	133.46	149.33	1.12
2022	120.99	143.79	1.19
2023	154.88	225.6	1.46

One of the key project activities is supporting agricultural extension services aimed at improving farm yields outside of forests, particularly for Sesame and Maize, which are the crops most associated with deforestation in the project area. Additionally, the project is exploring the possibility of linking project area farmers to commodity dealers who may be able to offer higher prices for deforestation free commodities. Most sesame grown in Tanzania is exported to China, but about 12% in 2023 was shipped to Japan, which is a G7 country. The 2019 G7 Environment Declaration on halting

[37] https://www.thecitizen.co.tz/tanzania/news/national/govt-insists-a-ban-on-maize-export-won-t-be-lifted-2594602
[38] https://www.theeastafrican.co.ke/tea/business/kenya-loses-42pc-of-tanzania-maize-imports-4597522

deforestation recognized the role of commodity supply chains in deforestation. Japan's global deforestation footprint is increasing according to a 2022 report by the Food and Land Use Coalition[39] which also found that sesame seed imports are responsible for 4% of Japan's deforestation footprint. By rewarding deforestation free sesame cultivation, one of the key drivers of deforestation could be transformed into a force for forest protection.

Driver variables explaining the location of deforestation

Accessibility and proximity to markets

The most important factor affecting the location of deforestation is accessibility. Distance to settlements and roads obviously affects accessibility, but these variables do not capture fine scale details about the location of human activity on the ground. In many countries, this can be captured by distance to forest edge, which is the benchmark model under VT0007. However, in the Tanzanian context, distance to forest edge can be misleading due to the presence of many areas of natural grasslands without any human presence. This could be overcome with land-use maps that could distinguish reliably between grasslands and agricultural lands, and natural forests and agroforestry, but it is very difficult to distinguish these land-uses with high accuracy in Tanzania.

Instead, the best way to locate human land-use in the landscape is to map deforestation. There is a very clear relationship between distance to deforestation and the location of future deforestation. An analysis of deforestation in the reference region showed the 50% of 2016-2022 deforestation occurred within 141 meters of 2010-2016 deforestation, 75% within 351 meters and 95% within 1105 meters. This kind of accessibility is constantly expanding as farmers clear the frontier and increase the fragmentation of forests. Thus, forest accessibility should continue to increase during the baseline validity period.

In contrast, for distance to settlements (see 4.2.1 for dataset details), 95% of 2016-2022 deforestation is not accounted for until 7,469 meters from 2015 settlements, while for distance to tertiary and higher-level roads, the 95% mark wasn't accounted for until 16,894 meters. Thus, distance to recent deforestation clearly gives much more spatially detailed information on the location of future deforestation. This makes sense to because most deforestation agents are accessing the forest by foot. Roads and settlements will continue to expand over time, though in the case of roads, it often seems that they follow people in Tanzania rather than people following roads since most frontier expansion begins with foot paths.

Another factor affecting accessibility is land tenure status. Deforestation is much more likely on village land than in reserved lands such as National Parks, Game Reserves, Forest Reserves, and Nature Reserves where it is illegal, and rule enforcement is more likely due to the greater resources of the national government. Despite covering almost 1/3 of the reference region in terms of forest, national protected areas with clear boundaries had less than 1% of deforestation from 2016-2022. It should be

[39] https://www.foodandlandusecoalition.org/wp-content/uploads/2022/09/Assessing-the-G7s-international-deforestation-footprint-and-measures-to-tackle-it.pdf

noted that some of this effect it due to remoteness as deforestation does occur in some protected areas that are near people. There is no expansion of national protected areas expected during the baseline validity period and there are still millions of hectares of forest outside of protected areas available for clearing in the reference region.

Favorability for farming

As farming is the primary cause of 95.45% of cleared area (Table 23), it is important to consider what factors make an area attractive for farming.

Basic topographic variables play a role including elevation, slope, and topographic position index. Elevation can affect a whole range of factors important to farmers such as rainfall, temperature, and soil types. Steep slopes are generally less preferred for agriculture because tractors and draft animals cannot be used on steep slopes. However, in the context of the project area and reference region, most deforestation is driven by farming which is done by hand and as a result, people can often be seen farming on very steep slopes, particularly in mountain areas that have higher rainfall. As a result, what can be even more important than slope is topographic position index which indicates whether a piece of land has a flat, concave, or convex shape. Farmers prefer flat and concave surfaces which will better regain soil moisture.

Soil types also play a role, but soil type maps like those of the FAO and Homogenized World Soil Database are generalized into very large polygons that disregard the much greater heterogeneity at finer scales that is necessary to predict the location of deforestation. Fortunately, Innovative Solutions for Decision Agriculture Ltd. (iSDA), has create a wide variety of soil characteristic maps for the African continent at 30-meter resolution using machine learning[40] and made them available on Google Earth Engine. Of particular interest in the Tanzanian context is the map of soil cation exchange capacity (CEC). CEC can be an indication of soil fertility, but perhaps equally important in the Tanzanian context is that higher CEC indicates higher moisture retention capacity. Almost all farming in Tanzania is rainfed, so soil moisture retention is critically important to farmers.

2.2.3 Identification of Underlying Causes of Deforestation

The 5 main underlying causes of deforestation in the reference region are as follows:

Local and National population growth

As shown in Table 26, the populations in Lindi and Morogoro regions increased by 38% and 44% respectively between 2012 and 2022. Rural population increases contribute to demand for food production and land for food and cash crop cultivation. Urban population increases contribute to demand for food production, and forest products like charcoal. Over the long run, by increasing access

[40] Hengl, T., Miller, M. A., Križan, J., Shepherd, K. D., Sila, A., Kilibarda, M., ... & Crouch, J. (2021). African soil properties and nutrients mapped at 30 m spatial resolution using two-scale ensemble machine learning. *Scientific reports*, *11*(1), 6130.

to secondary education, the project may reduce local population growth by providing more young people with the skills they need to find livelihoods in urban areas and indirectly by delaying the start of childbearing for young women.

Open-access land use regime

Sixty percent of the project area forest reserves were created specifically for this REDD project or in expectation of a REDD project. Prior to that, these forests were open-access land whereby people from the participating villages and to some extent surrounding villages, were free to clear forest for farming. Under the customary land tenure system employed in these villages, clearing forest allowed households to convert forest land from open access communally owned land to individual household tenure. The only constraints on clearing forests were labor supply and demand for farm crops. By establishing village forest reserves and enhancing forest protection and boundary marking methods, the project has transformed these areas from open access to communally owned and protected areas with funding for protection.

Poor enforcement of forest management plans

Forty percent of the project area forests were in village forest or local authority reserves prior to the project. Protection of these forests was mixed prior to the project. As part of establishing the new project instance in 2023, VCSL identified over 25,806 ha of land that had either been part of a VLFR or planned Wildlife Management Area in instance 2 districts prior to the start of project activities that were removed from consideration as potential project areas due to heavy agricultural encroached. The underlying causes of poor enforcement are lack of revenue, technical capacity, failure to involve forest adjacent community members in forest protection activities, and lack of awareness[41] of forest reserves and boundaries. The project addresses these underlying issues by funding forest patrol activities directly, mapping and communicating the location of encroachment to forest patrol teams on a regular basis and establishing new forest patrol teams with members from forest adjacent communities regardless of which community the forest belongs to. The project is also improving boundary marking through boundary clearing and will eventually have aluminum boundary markings placed at regular intervals along boundaries facing people. These boundary marking activities are standard practice for better protected national protected areas in Tanzania, but surprisingly have never been done before for village forest reserves or local authority reserves.

Farming conditions

Farmers in the project villages practice expansive agriculture with low yields rather than intensive agriculture with higher yields. This requires a lot more land that would otherwise be needed to produce the same amount of crop. Baseline focus groups discussions conducted by VCSL in each project village suggest that only 6.8% use fertilizers of any kind despite nationwide government subsidies.

[41] Forest patrol teams found that 27% of the deforestation agents they asked were not aware that they were farming inside a protected area.

Poor soils, weeds, grass, and pests also cause many farmers to shift their cultivation frequently. Maize demands relatively high soil fertility leading farmers to clear forests in search of more fertile soils. Sesame cultivation is susceptible to insect pests, which some farmers avoid by establishing clearings within forest that are isolated from other farms. Historically, when populations within the reference region villages were lower, shifting cultivation was probably sustainable and forests had sufficient time to regenerate between clearings. Today, however, fallow periods have declined substantially, almost never exceeding 10 years with an average of 4 years. Other clearings have been converted to permanent farms and due to changes in soil and fire frequency some clearings failed to regenerate at all despite being abandoned for more than 20 years after cultivation. In the absence of the project, the soil, weed and pest conditions would likely only worsen in the future as population growth would put even greater limitations on fallow lengths.

The project will partially address both underlying drivers through promoting conservation agriculture interventions that help to maintain soil fertility, prevent the buildup of weeds, and increase yields through a combination of improved seeds and labor-intensive soil moisture management techniques. Ironically, poor soils are also part of the reason for low fertilizer use in Tanzania. Increasing active carbon in the soil[42], which increases cation exchange capacity, makes fertilizers more effective. The best methods for doing this in the project context will be determined through experimentation. Potential options include reducing the use of burning to clear fallow farm biomass in favor of slashing and spreading biomass. The project may also explore the use of barrels for charcoaling fallow farm biomass which can then be added as a more permanent soil amendment to increase SOC and CEC.

The other leading explanation for the preference for expansive farming in Tanzania is the unpredictability of profits from farming. Weather and an uncertain government policy environment some crop exports may be restricted or banned play a role in this. While the project cannot impact these factors, the project will explore options for crop insurance, which has been shown elsewhere in Tanzania to encourage the adoption of more intensive farming techniques[43].

Lack of alternatives to farming

Farming is the primary economic activity in the vicinity of the project areas and the primary driver of deforestation. The demographic profiles of deforestation agents, however, suggest that this type of farming and lifestyle is not preferred by younger Tanzanians with more skills and education are shifting in ever greater numbers from rural areas to urban areas. However, so far, this has only happened in relative terms. In absolute terms, rural populations who have few alternative livelihood options continue to increase. In the absence of the project, education and economic alternatives to farming would likely continue to slowly improve in the vicinity of the project areas as economies diversify and education

[42] Chamberlin, J., Jayne, T. S., & Snapp, S. (2021). The role of active soil carbon in influencing the profitability of fertilizer use: Empirical evidence from smallholder maize plots in Tanzania. Land degradation & development, 32(9), 2681-2694.
[43] van Dijk, M. P. (2022). Crop insurance, a frugal innovation in Tanzania, helps small maize farmers and contributes to an emerging land market. Land, 11(7), 954.

levels improve. However, the project will accelerate this process. In addition to community level benefits aimed at improving access to education, REDD earnings paid as dividends to community members can be used to start small businesses or further improve education access. A survey of community members after the REDD test payments in the initial project instance found that 35% of households reported spending REDD dividends on entrepreneurial activities and 20% reported spending dividends on education. Additionally, all villages decided to spend some of their earnings on improving education services.

2.2.4 Analysis of chain of events leading to deforestation

In summary, in the baseline scenario, continued rural population growth, particularly growth in the number of people with less than secondary education and with few livelihood options beyond farming will lead to increased demand for agricultural land for both subsistence food and cash crop production. Continue urban population growth will also help ensure an expanding market for farm products. Variable weather, market conditions, and poor soils lead farmers to practice expansive and shifting rather than intensive agriculture practices, further expanding the total quantity of land required for farming. Most of the remaining forested land in the project areas would be under open access tenure, open to whoever had the labor necessary to clear it and convert it from communal to household ownership. Furthermore, even areas set aside for protection would be encroached at increasing rates as populations expand, donor funding for conservation ends, and the value of sustainable forest use remains uncompetitive with farming due to both ecological and policy factors.

2.2.5 Conclusion

The available evidence about the likely future deforestation trend in the reference region and project area is conclusive. While the country continues to become proportionately more urban, the countries rural population exploded in the past 10 years in total terms and the population pyramid data suggests that trend will continue as nearly half of the country's population is under 18. The threat of encroachment into the project areas is directly observable and the drivers and agents are well documented from the available evidence.

3 ANALYSIS OF HISTORICAL LAND USE AND LAND COVER CHANGE

This section describes the collection and analysis of spatial data to assess the current land-cover and historical land-cover change within the reference region during the historical reference period.

3.1 Collection of Suitable Data

Historical and present land-use mapping in the reference region was conducted in Google Earth Engine using data from Landsat 5, Sentinel-2, and PALSAR I and II satellites. Land-cover mapping in Eastern Tanzania with optical data is exceptionally difficult due to extensive cloud cover throughout most times of year and strong seasonal effects on the appearance of vegetation making it difficult to distinguish land-cover types during the dry season. PALSAR I and II L-band radar satellites provide cloud free coverage that can distinguish many forests and non-forest landcover types accurately, especially during the dry season. However, L-band radar does not work well to distinguish non-forest from forest in areas with steep slopes, or dense perennial crops like sugar cane. It also can't distinguish between agroforestry and natural forests. Thus, it is most effective to use PALSAR data together with optical data when mapping land-cover.

Training and accuracy assessment data was accessed through Google Earth Engine. This included Planetscope basemaps, which are provided free under the Norway's International Climate and Forests Initiative Satellite Data Program, in the case of single year mosaics of Sentinel-2 data, and in the case of GEDI lidar height and cover metrics. Training and accuracy assessment data also came from the collection of high-resolution imagery available on Google Earth.

The complete list of data sources is presented in VM0015 Table 4.

VM0015 Table 4 Data Used for Historical LU/LC Change Analysis

Vector	Sensor	Resolution (m)	Type	Reference Region Coverage	Mosaic Acquisition Pixel dates		
					Min Date	Median	Max
Satellite	Landsat 5[a]	30	Multi-spectral	100%	7-Feb-05	5-May-08	10-Jul-10
Satellite	PALSAR I	25	L-band Backscatter	100%	7-Jul-07	8-Sep-07	14-Oct-07
Satellite	PALSAR I	25	L-band Backscatter	100%	25-Apr-08	12-May-08	31-Jul-08
Satellite	PALSAR I	25	L-band Backscatter	100%	13-Jun-09	7-Jul-09	17-Oct-09
Satellite	PALSAR I	25	L-band Backscatter	100%	1-May-10	10-Jul-10	23-Sep-10
Satellite	PALSAR II	25	L-band Backscatter	100%	30-Jan-15	26-Jul-15	23-Oct-15

Satellite	PALSAR II	25	L-band Backscatter	100%	29-Jan-16	24-Jul-16	7-Oct-16
Satellite	PALSAR II	25	L-band Backscatter	100%	10-Feb-17	30-Aug-17	25-Oct-17
Satellite	PALSAR II	25	L-band Backscatter	100%	4-Mar-18	22-Jul-18	19-Oct-18
Satellite	PALSAR II	25	L-band Backscatter	100%	26-Jul-19	9-Aug-19	1-Sep-19
Satellite	PALSAR II	25	L-band Backscatter	100%	24-Jul-20	16-Aug-20	13-Nov-20
Satellite	PALSAR II	25	L-band Backscatter	100%	28-Jul-21	25-Aug-21	12-Nov-21
Satellite	PALSAR II	25	L-band Backscatter	100%	27-Jul-22	24-Aug-22	11-Nov-22
Satellite	Planetscope[b]	4.77	Visible light	9%	~1-Jan-22	~15-Jan-22	~31-Jan-22
Satellite	Planetscope	4.77	Visible light	9%	~1-Feb-22	~14-Feb-22	~28-Feb-22
Satellite	Planetscope	4.77	Visible light	9%	~1-Mar-22	~15-Mar-22	~31-Mar-22
Satellite	Planetscope	4.77	Visible light	9%	~1-Apr-22	~15-Apr-22	~30-Apr-22
Satellite	Planetscope	4.77	Visible light	9%	~1-May-22	~15-May-22	~31-May-22
Satellite	Planetscope	4.77	Visible light	9%	~1-Jun-22	~15-Jun-22	~30-Jun-22
Satellite	Sentinel-2	10	Multi-spectral	100%	~1-Mar-16	~30-Apr-16	~30-Jun-16
Satellite	Sentinel-2[c]	10	Multi-spectral	100%	~1-Mar-19	~30-Apr-20	~30-Jun-21
Satellite	Sentinel-2	10	Multi-spectral	100%	~1-Mar-22	~30-Apr-22	~30-Jun-22
Satellite	Various sensors from Google Earth	0.3	Visible light	100%	2008		2023
ISS	GEDI	25	Lidar Height and Coverage Estimates	0.004%	20-Apr-19	12-Jun- 20	28-Dec-21
Satellite	PALSAR I	50	AGB estimates from radar backscatter	100%		2010	

[a]The Landsat 5 mosaic used as an input into mapping circa 2010 landcover was created using a javascript tool written for Google Earth Engine created by Kasper Hurni and Lukas Wuersch at the Centre for Development and Environment (CDE), University of Bern, Switzerland. The tool allows the user to specify a range of years and dates within the years to create a mosaic of Landsat data. The tool also filters out scenes with more than 80% cloud cover. All other scenes within the range of years and period within a year are included in the mosaic. The project used the default option of creating a mosaic from median values after masking out clouds. The chosen date range from within years was January through July. June and July are in the dry season and generally not optimal for distinguishing forest land-cover from other land-covers, however, they also are a time of year when there is generally less cloud cover in the mountainous parts of the reference region which remain green at that time of year. Also, it was assumed that PALSAR data would be a more influential variable in the model for mapping land-covers outside of mountainous areas since it is not impacted by seasonality. The range of years was set to 2005 to 2010 since any lower range was insufficient to cover most masked cloud gaps from the mosaic. Extending the range beyond 2010 resulted in a poorer mosaic result as the availability of Landsat 5 imagery after 2010 declines significantly. Again, since PALSAR backscatter is the most powerful variable in the land-cover model areas without steep slopes, it was assumed that including Landsat data from prior to 2010 in the mapping would not bias the model for most of the reference region while improving performance in mountainous areas which make up a minority of the reference region. Also, the deforestation mapping was done using PALSAR change detection, so even areas that were incorrectly mapped as forest in 2010 due to the inclusion of older Landsat 5 data would be unlikely to be mapped as deforested if there was no change in the PALSAR backscatter values. The map accuracy assessment presented in Table 33 appears to support both assumptions.

[b]Planetscope basemaps were only acquired for the project and leakage belts as full reference region coverage would have been too large and costly to export to Google Cloud.

[c]The Sentinel-2 mosaic used to map circa 2020 land-cover was also a multiyear mosaic. It was created in Google Earth Engine using March through June imagery from 2019-2021. It was not used to create a forest benchmark map for a particular timeframe, so the multi-year nature of the mosaic has no effect on the estimation of historical deforestation rates.

Minimum value PALSAR mosaics were created in different combinations of years. This was done to reduce the effects of variable soil moisture associated with variable rainfall in the single year mosaics provided by JAXA. Soil moisture tends to increase backscatter. Since decreases in biomass always results in lower backscatter values, it was assumed that the minimum map was most representative of the final year of the mosaic since any loss of forest in that year would result in a decrease in backscatter in those pixels and their inclusion in the minimum mosaic. Thus, the 2007-2010 PALSAR minimum backscatter mosaic would be most representative of 2010 in terms of distinguishing between forest and non-forest. It would also come with the added benefit of excluding areas of short-term regeneration between 2007 and 2010 and thus actually increase the accuracy of the 2010 map by including backscatter data from 2007-2009 if it was lower than 2010.

3.2 Definition of Classes of Land Use and Land Cover

To map and model land-use land cover change during the historical reference period, the project used the minimum of forest land and non-forest land classes. However, for PA and LB forest carbon stock assessment, forest pixels were stratified into high and low carbon strata based on a 2010 biomass map of Africa created by Bouvet et al in 2018[44]. Note that the Bouvet layer was used as a post-processing layer to stratify the forest cover benchmark map as allowed for under VM0015 v1.2 and that the resulting forest strata map only contains the forested pixels from the historical reference period and is still in the resolution of the forest cover benchmark maps (25 m). Also, estimates of carbon stocks within the strata come from field plots as described in section 6 and not from the Bouvet maps.

VM0015 Table 5 List of All Land Use and Land Cover Classes Existing at the Project Start Date in the Reference Region

Class Identifier		Trend in Carbon Density	Presence In	Baseline Activity			Description
ID_{cl}	Name			LG	FW	CP	
1	High Carbon Forest	stable	RR, LK, PA	x		x	Area of 0.5 ha or more with 10% or more cover of natural trees 5m in height or greater that have a predicted AGB of 55Mg/ha or more in the Bouvet et al 2018 map.
2	Low Carbon Forest	stable	RR, LK, PA	x	x	x	Area of 0.5 ha or more with 10% or more cover of natural trees 5m in height or greater that have a predicted AGB of less than 55Mg/ha in the Bouvet et al 2018 map.
3	Non-Forest	stable	LM		x	x	Area of 0.5 ha or more with less than 10% cover of natural trees 5m in height or greater. Natural trees are defined as any trees not including agroforestry such as cashew, mango, and citrus trees or timber/pole plantation trees such as pine, teak, and eucalyptus.

[44] Table 32, A., Mermoz, S., Le Toan, T., Villard, L., Mathieu, R., Naidoo, L., & Asner, G. P. (2018). An above-ground biomass map of African savannahs and woodlands at 25 m resolution derived from ALOS PALSAR. Remote sensing of environment, 206, 156-173.

3.3 Definition of Land Use and Land Cover Change Categories

The list of possible LULCC categories is shown in VM0015 Table 6 and VM0015 Table 7.

There was no obvious pattern to post-deforestation land-uses in the reference region, especially with regards to post-deforestation carbon stocks. Residual trees, longer fallow lengths, and conversion to agroforestry can all result in higher post-deforestation carbon stocks, but the location and timing of these factors are not easily predictable. Residual trees present immediately after deforestation may or may not be cut down in subsequent years. Areas fallowed for 5 years may go into a much shorter fallow cycle or may continue to be fallowed for another 5 years and areas planted for agroforestry can be cleared for annual crops or even charcoal production.

VM0015 Table 6: Potential Land Use and Land Cover Change Matrix

ID_{cl}		Initial LU/LC class	
		i1	i2
Final LU/LC class	f3	i1/f3	i2/f3

VM0015 Table 7: List of Land Use and Land Cover Change Categories

ID_{ct}	Name	Trend in Carbon Density	Presence in	Activity in Baseline Case			Name	Trend in Carbon Density	Presence in	Activity in Project Case		
				LG	FW	CP				LG	FW	CP
i1/f3	High Carbon	constant	RR, LK, PA	X		X	Non-Forest	constant	RR, LK, PA	X		X
i2/f3	Low Carbon	constant	RR, LK, PA		X	X	Non-Forest	constant	RR, LK, PA		X	X

3.4 Analysis of Historical Land-Use and Land-Cover Change

The LULCC mapping process was designed to leverage more recently available datasets like the Global Ecosystem Dynamics Investigation (GEDI) lidar data to maximize the accuracy of the analysis even for time periods preceding this data. The general process is outlined as follows:

1. Create 2020 land-cover training data from GEDI height and cover metrics and supplementary points.

2. Create a 2020 land-cover classification.
3. Develop a 2010 land-cover training data set from areas of low PALSAR backscatter change between 2010 and 2022 based on the 2020 classification and add supplementary points.
4. Create a 2010 land-cover classification.
5. Create a training data for a change detection model using PALSAR backscatter data from 2010-2016.
6. Map deforestation from 2010 to 2022 in two-year increments using change detection model.
7. Remove false alarms from remote areas with various post processing steps and remove area of planned infrastructure.

Much of the analysis was conducted in Google Earth Engine. QGIS and Google Earth Pro were used to review training data sets against high resolution imagery.

GEDI LIDAR and Supplementary 2020 Land Cover Training Data

Canopy height and cover from processed GEDI shots were obtained for 2019-2021 from the following two Google Earth Engine Dataset:

1. GEDI relative height – 'LARSE/GEDI/GEDI02_A_002_MONTHLY'
2. GEDI cover - 'LARSE/GEDI/GEDI02_B_002_MONTHLY'

The datasets were filtered in Earth Engine using the quality and degrade flags to only obtain the best quality data. Daytime observations were discarded since they are less reliable. Dry season data (from June 15 – November 31) was also removed since the absence of tree leaves would lead to an underestimate of canopy cover. Points overlapping PALSAR pixels that may have undergone deforestation or afforestation between 2019 and 2021 were filtered out. These were defined as pixels that had in reference to the median pixel value in the 2019-2021 dataset had an absolute difference in HV backscatter of 15% or more and where that difference resulted in crossing threshold value of 1867. The threshold value was determined from previous unpublished work using regression of PALSAR HV backscatter values and 2019 GEDI shots classified as either forest or non-forest in Lindi region. The final dataset comprised of 10,992 GEDI shots.

The filtered Lidar shots were split into forest and non-forest training points by defining forest as points with a 98% relative height of greater than or equal to 5 meters and cover of 10% or more and all points as non-forest. Then the points were reviewed for potential error associated with slopes, which lead to height estimate errors, and dense canopies, which lead to height and cover estimate errors, and edge errors associated with the difference between the location of the lidar shot and the pixels boundaries of the PALSAR dataset. All shots falling on slopes of 6 degrees, or more were reviewed using high resolution imagery. Then potential edge and dense canopy errors were identified by reviewing points classed as non-forest with a HV backscatter value of 1867 or more and points classed as forest with a HV value of less than 1867 using high resolution imagery. Identified errors were corrected.

The classification of 2020 land-cover was iterative with additional training points added after each classification run to fix errors identified through comparison of the map to high resolution imagery. The final training set consisted of 11439 points (Figure 15).

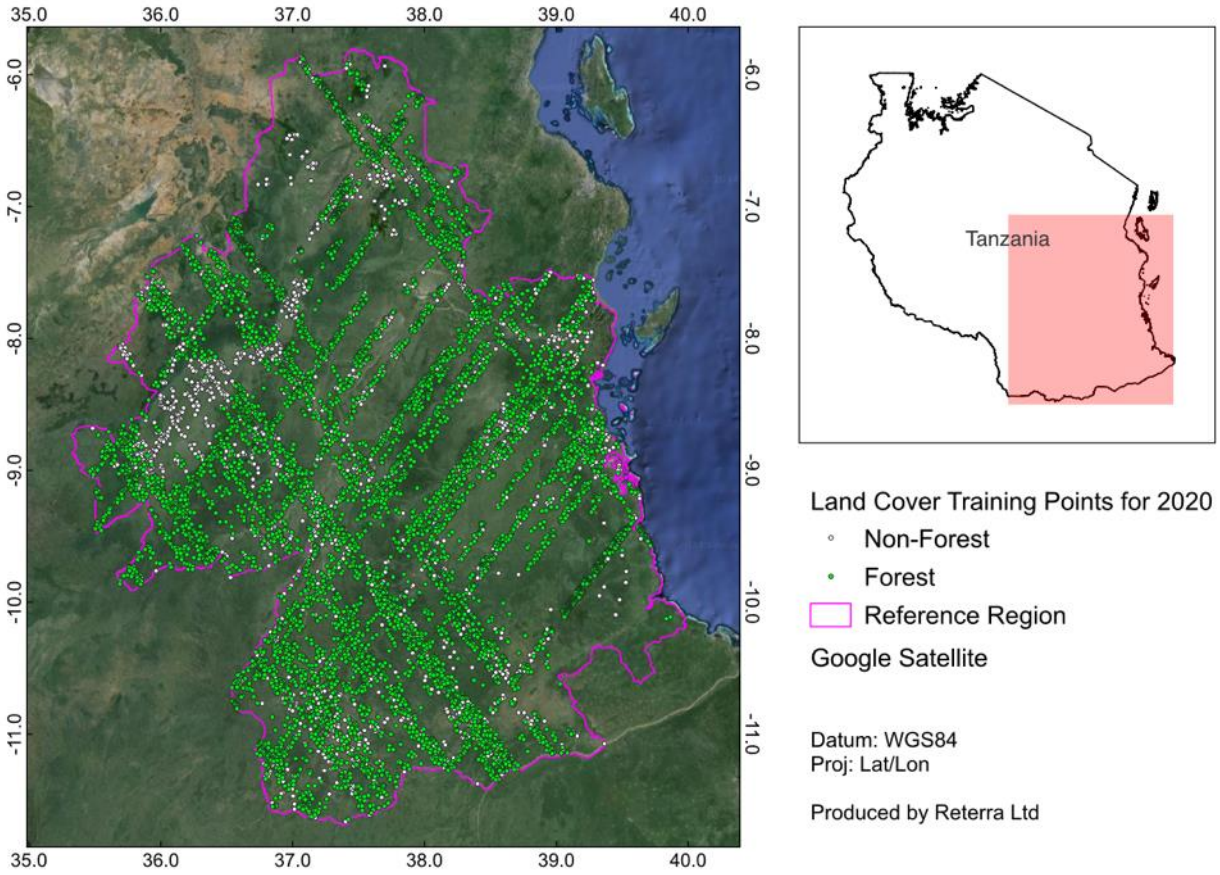


Figure 15 Land cover training points for 2020

Land Cover Classification 2020

The 2020 land-cover classification was made with a smileRandomForest model in Google Earth Engine with the 2020 training data. Default parameters were used except the number of trees which was set to 501. Input variables and processing are listed in Table 28. Twenty percent of the training point dataset was used for validation rather than training. The overall accuracy for the validation set was 91.5%.

Table 28 Land Cover Classification 2020 Input Variables

Google Earth Engine Image Collection	Bands selected / calculated	Date Filter	Preprocessing

	used in model		
'JAXA/ALOS/PALSAR/YEARLY/SAR_EPOCH'	HV, HH/HV	2019-2021	Lee Filter, Median
'COPERNICUS/S2_HARMONIZED'	RED, GREEN, BLUE, NIR, SWIR1, SWIR2	Mar-Jun, 2019-2021	Median, Resampled to 25 meters
'COPERNICUS/DEM/GLO30'	Elevation, Slope, Aspect	NA	Resampled to 25 meters
'OpenLandMap/CLM/CLM_PRECIPITATION_SM2RAIN_M/v01'	Sum of Apr, May, Jun	NA	Resampled to 25 meters

Land Cover 2010 training dataset

The 2010 training dataset consisted of 20,000 random points from pixels showing less than 15% change when comparing a minimum PALSAR HV backscatter mosaic from 2008-2010 to a minimum PALSAR HV backscatter mosaic from 2020-2022, and 198 supplementary points added to improve the 2010 classification accuracy (Figure 16). These should mostly correspond with forest persistence and non-forest persistence between the two time periods. The minimum mosaic is used to reduce noise associated with difference in soil moisture and to include areas with low HV values in 2008 and 2009 in the non-forest class even if they had higher HV values in 2010, which helps reduce woody fallows from 2010 being classified as forest.

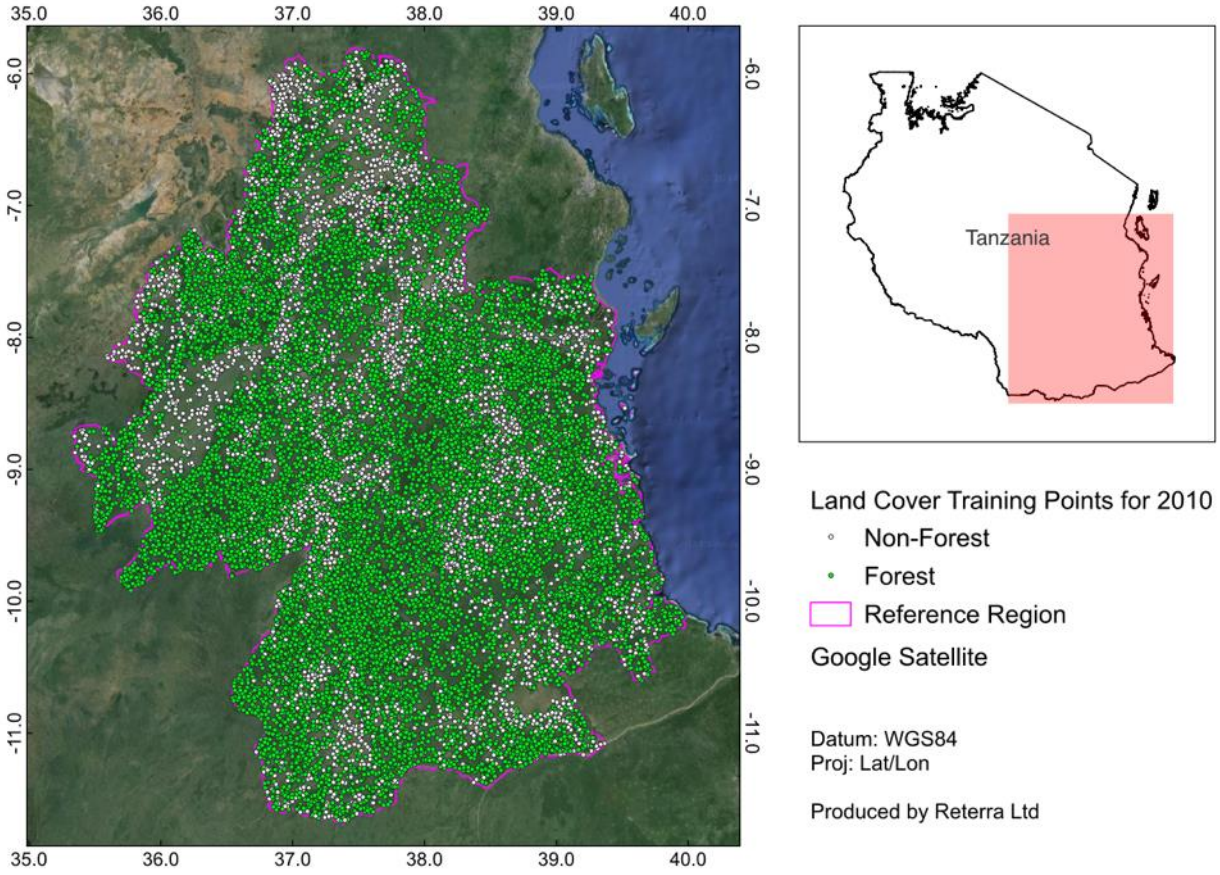


Figure 16 Land cover training points for 2010

Land Cover Classification 2010

The 2020 land-cover classification was made with a smileRandomForest model in Google Earth Engine with the 2010 training data. Default parameters were used except the number of trees which was set to 501. Input variables and processing are listed in Table 29. Twenty percent of the training point dataset was used for validation rather than training. The overall accuracy for the validation set was 93%.

Table 29 Land Cover Classification 2010 Input Variables

Google Earth Engine Image Collection	Bands selected / calculated used in model	Date Filter	Preprocessing
'JAXA/ALOS/PALSAR/YEARLY/SAR_EPOCH'	HV, HH/HV	2008-2010	Lee Filter, Minimum

'LANDSAT/LT05/C01/T1_SR'	RED, GREEN, BLUE, NIR, SWIR1, SWIR2, day of year	Jan-Jul, 2005-2010	Topographic Illumination Correction, Median, registered to Sentinel-2 mosaic used in 2020 classification, Resampled to 25 meters
'COPERNICUS/DEM/GLO30'	Elevation, Slope, Aspect	NA	Resampled to 25 meters
'OpenLandMap/CLM/CLM_PRECIPITATION_SM2RAIN_M/v01'	Sum of Apr, May, Jun	NA	Resampled to 25 meters

Deforestation Change Detection Training

Initial training points for deforestation were selected randomly from pixels classified in 2010 as forest that showed a decrease of 15% or more and ending value below 2500 in HV backscatter between a minimum 2008-2010 HV mosaic and a minimum 2015-2016 HV mosaic. Training points for persistence came from points classified as forest in 2010 not meeting the above criteria. All 2000 potential deforestation and persistence points were reviewed with high resolution imagery overlayed with PALSASR pixel boundaries. Training errors were corrected, and an additional 476 supplementary training points were added to improve the model accuracy.

Deforestation Change Detection Model

The land-cover change model was made with a smileRandomForest model in Google Earth Engine with the 2010-2016 forest persistence and deforestation training data. Default parameters were used except the number of trees which was set to 501. The input variables and processing are listed in Table 30. Twenty percent of the training point dataset was used for validation rather than training. The overall accuracy for the validation set was 95%.

After training, the model was applied to the 2010-2016 period and then to the 2016-2022 period in two years increments. The reference PALSAR mosaic for all change periods was the 2007-2010 minimum mosaic and then the end state PALSAR values came from a minimum mosaic of the final year and preceding year of the timber period. Change detection for each time step was restricted to areas of forest not deforested in a previous timestep where the cumulative change detected between 2010, and the end of the time step was 0.5 ha or greater. This reduces the effects of PALSAR radar speckle on the analysis while allowing for expansions less than 0.5 ha to be mapped if they were an expansion of

previous clearing. The final output had values ranging from 0 to 5, reflecting 0 for initial non-forest, 1 for forest persistence, 2 for 2010-2016 change, 3 for 2016-2018 change, 4 for 2018-2020 change, and 5 for 2020-2022 change.

Table 30 Input variables for the change detection model

Google Earth Engine Image Collection	Bands selected / calculated used in model	Date Filter	Preprocessing
'JAXA/ALOS/PALSAR/YEARLY/SAR_EPOCH'	Start and End Mosaic HV and HH/HV, and ratio of ending mosaic HV over start mosaic HV	2007-2010 and 2015-2016	Lee Filter, Minimum
'COPERNICUS/DEM/GLO30'	Elevation, Slope, Aspect	NA	Resampled to 25 meters
'OpenLandMap/CLM/CLM_PRECIPITATION_SM2RAIN_M/v01'	Sum of Jan-Dec	NA	Resampled to 25 meters

Post change detection corrections

The first post classification step was to split the deforestation analysis into the calibration and confirmation periods. This was accomplished in python by reclassifying the change map to produce 3 forest cover maps for 2010, 2016, and 2022. Each forest cover map was sieved using an 8-pixel sieve to remove any forest patches less than 0.5 ha and then the maps were recombined to reproduce the change map.

Next, some corrections to the change map were made in QGIS using the Serval tools plugin. There were a few areas of clouds in mountainous areas that were not filled in the 2010 Landsat mosaic, which were than excluded from the analysis. These were filled in as 2022 non-forest or forest persistence using recent high-resolution imagery for reference. There were also some small areas of missed

deforestation in the initial project instance in Lindi, which were reclassed to the correct period of deforestation using high-resolution data as reference.

There is a large area of planned deforestation associated with the construction of the Nyerere Hydroelectric Dam in the center of the reference region. Using public reports on the final dam height and a digital elevation model clipped to the area upstream of the dam, the final footprint of the dam was calculated and masked. The footprints of new buildings and roads in the vicinity of the dam were also masked using high resolution imagery as reference.

After correcting errors and removing the dam, the map was reprojected from WGS84 Lat/Lon at approximately 25m resolution to World Cylindrical Equal Area projection at 25m resolution, which ensures that pixel-based area estimates are accurate.

Finally, some simple distance rules were used to remove false alarm and non-anthropogenic deforestation from remote areas. This was done in python. It was observed that most deforestation during the historical reference period occurred near other deforestation and that a 2-ha sieve removed most false alarms. Therefore, values at an extreme distance from at least 2-ha of deforestation were very likely to represent error or non-anthropogenic deforestation. Using a frequency analysis, it was identified that 99% of deforestation during the HRP was within 950 meters of 2 ha or more of deforestation during the HRP. The extreme 1% was reclassified as forest persistence. Then, to remove the remaining few larger blocks of error and non-anthropogenic deforestation, a distance to built-up pixels dataset was employed to identify deforestation pixels at extreme distances from settlements. For processing of the distance to built-up dataset, see VM0015 Table 12. The LULCC map was scanned for examples of anthropogenic deforestation at extreme distances from built-up pixels. It was identified that no anthropogenic deforestation occurred at more than 22400 meters from a built-up pixel. All deforestation pixels farther than that from built-up pixels were reclassified as forest persistence. These steps reduced the total quantity of mapped deforestation by 1.1%.

The final forest cover benchmark maps for 2010, 2016, and 2022 calculated from the land-cover change map are shown in Figure 17, Figure 18 and Figure 19 respectively. The final change map showing forest persistence from 2010-2022, non-forest (assumed to remain non-forest from 2010-2022), and deforestation from 2010 to 2016 and 2016-2022 is shown in Figure 20.

The 2022 Land Cover map with the forest classes used for forest stratification is shown in Figure 21. As permitted under VM0015 as a postprocessing step, this was created by stratifying the 2022 Forest Cover Benchmark map forest classes based on a 2010 biomass map of Africa created by Bouvet et al in 2018[45]. Forest pixels in the FCBM with less than 55 Mg/ha of aboveground biomass in the Bouvet map were reclassified as low carbon forest while all other forest pixels in the FCBM were put into the

[45] Bouvet, A., Mermoz, S., Le Toan, T., Villard, L., Mathieu, R., Naidoo, L., & Asner, G. P. (2018). An above-ground biomass map of African savannahs and woodlands at 25 m resolution derived from ALOS PALSAR. Remote sensing of environment, 206, 156-173.

high carbon class. The resulting forest strata map is in the same resolution as the FCBM, which is 25 meters.

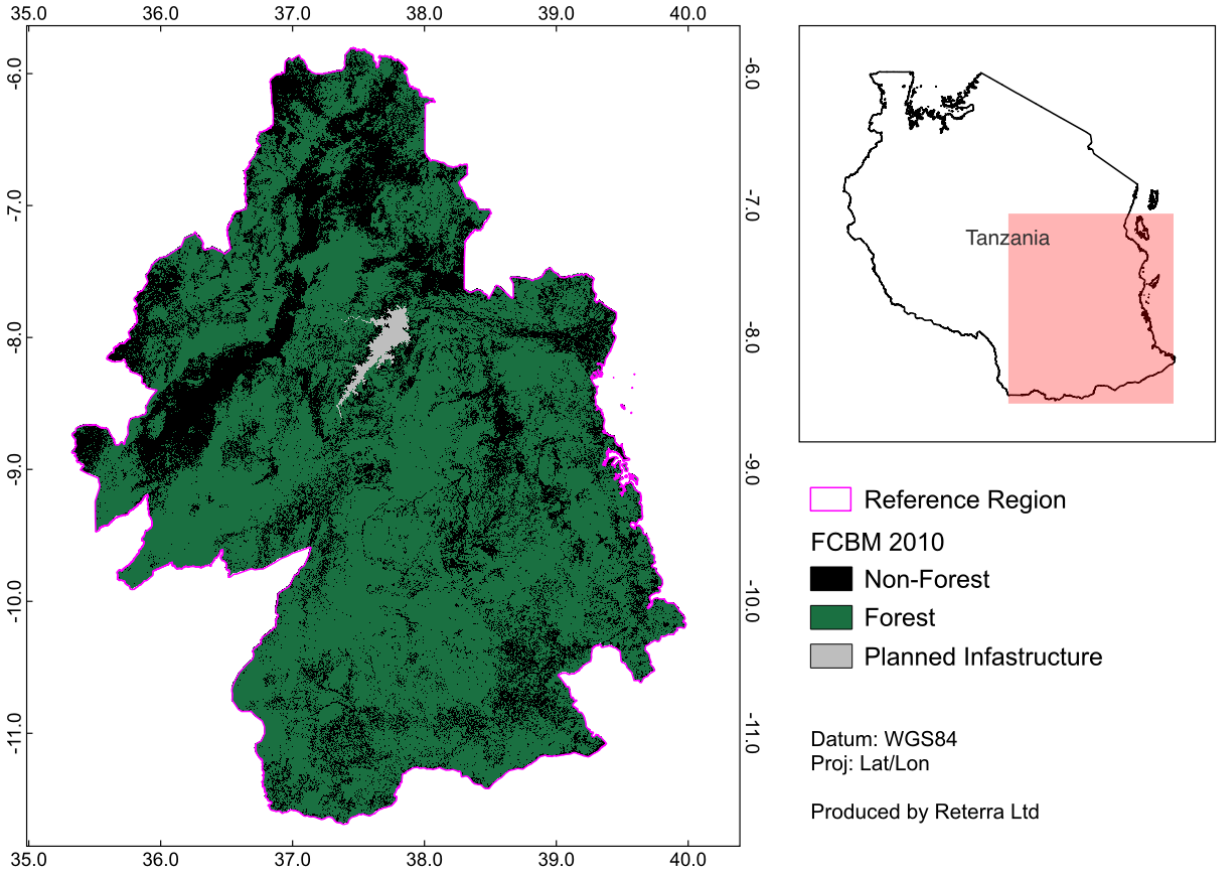


Figure 17 Forest Cover Benchmark Map 2010

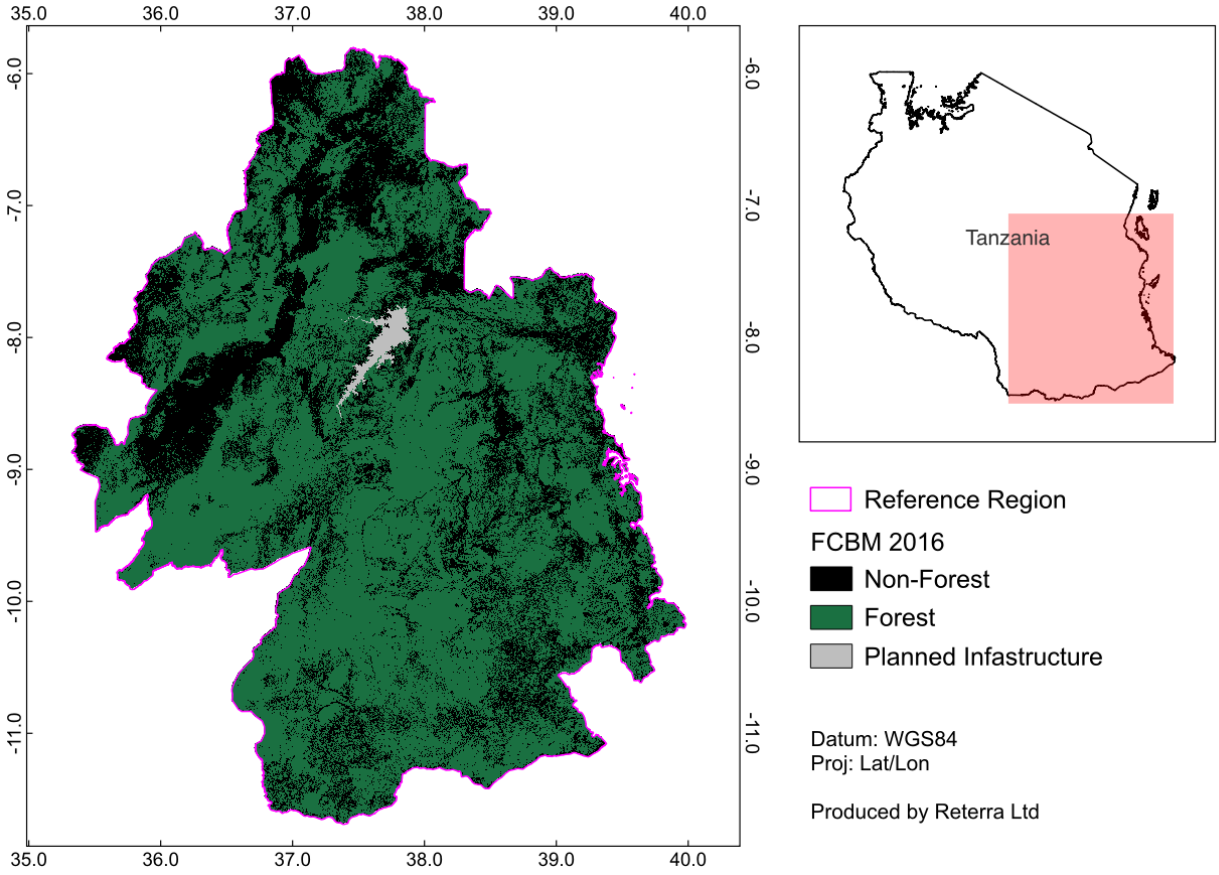


Figure 18 Forest Cover Benchmark Map 2016

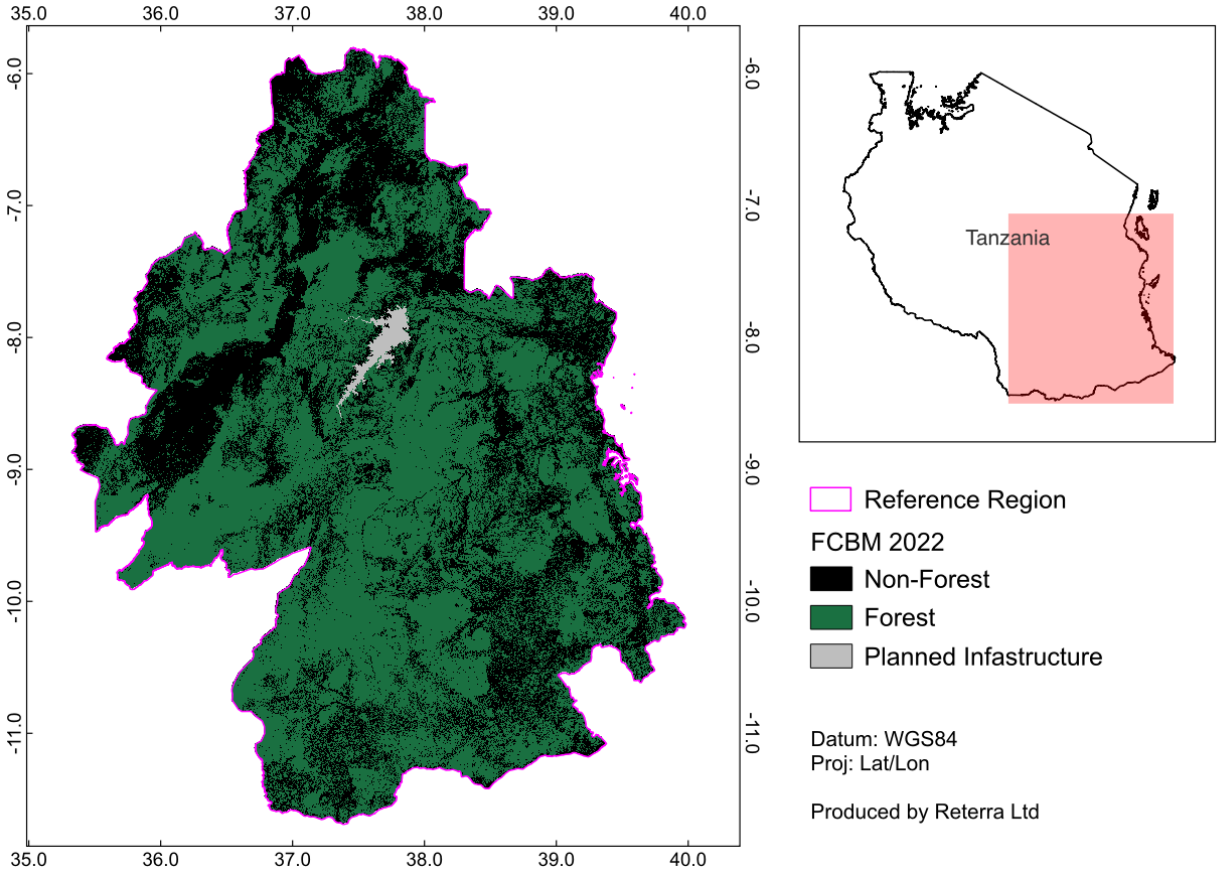


Figure 19 Forest Cover Benchmark Map 2022

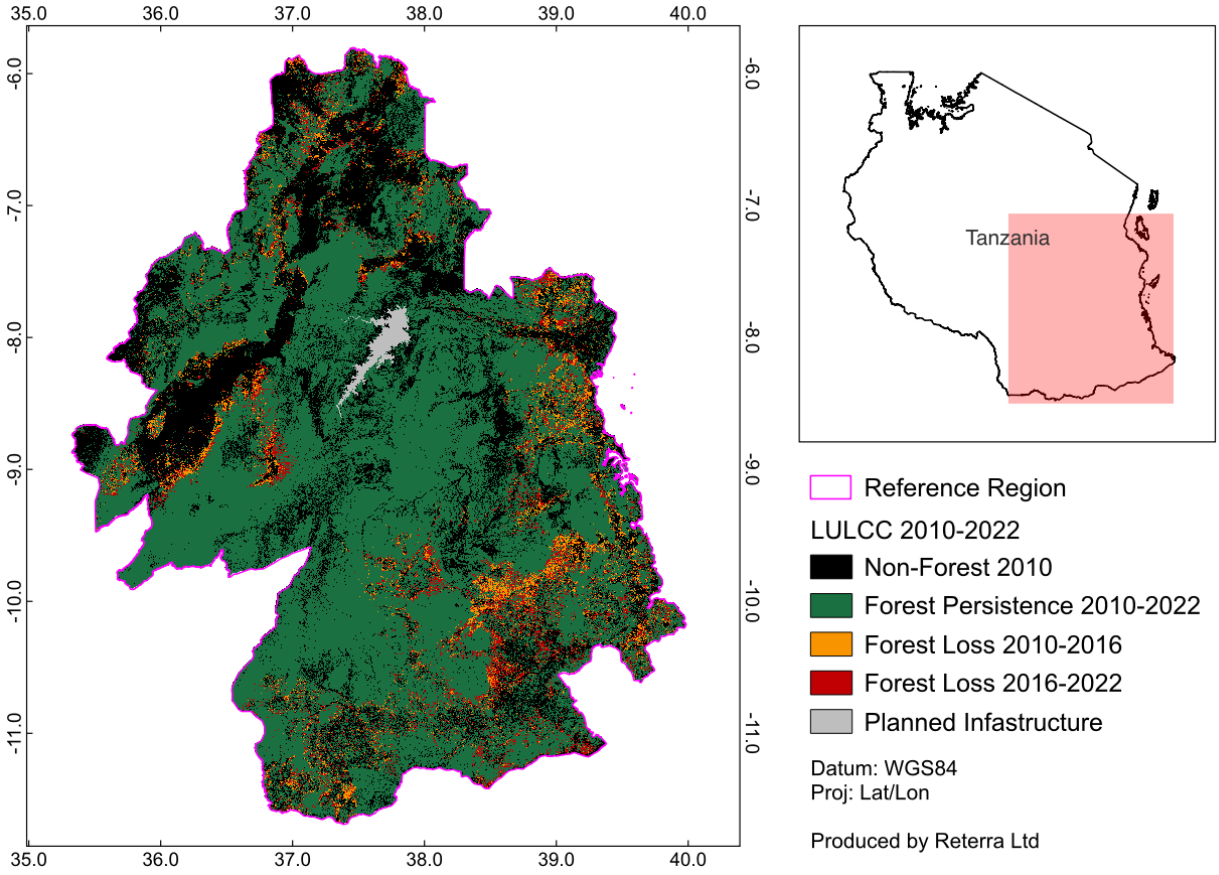


Figure 20 Land Use and Land Cover Change 2010-2022

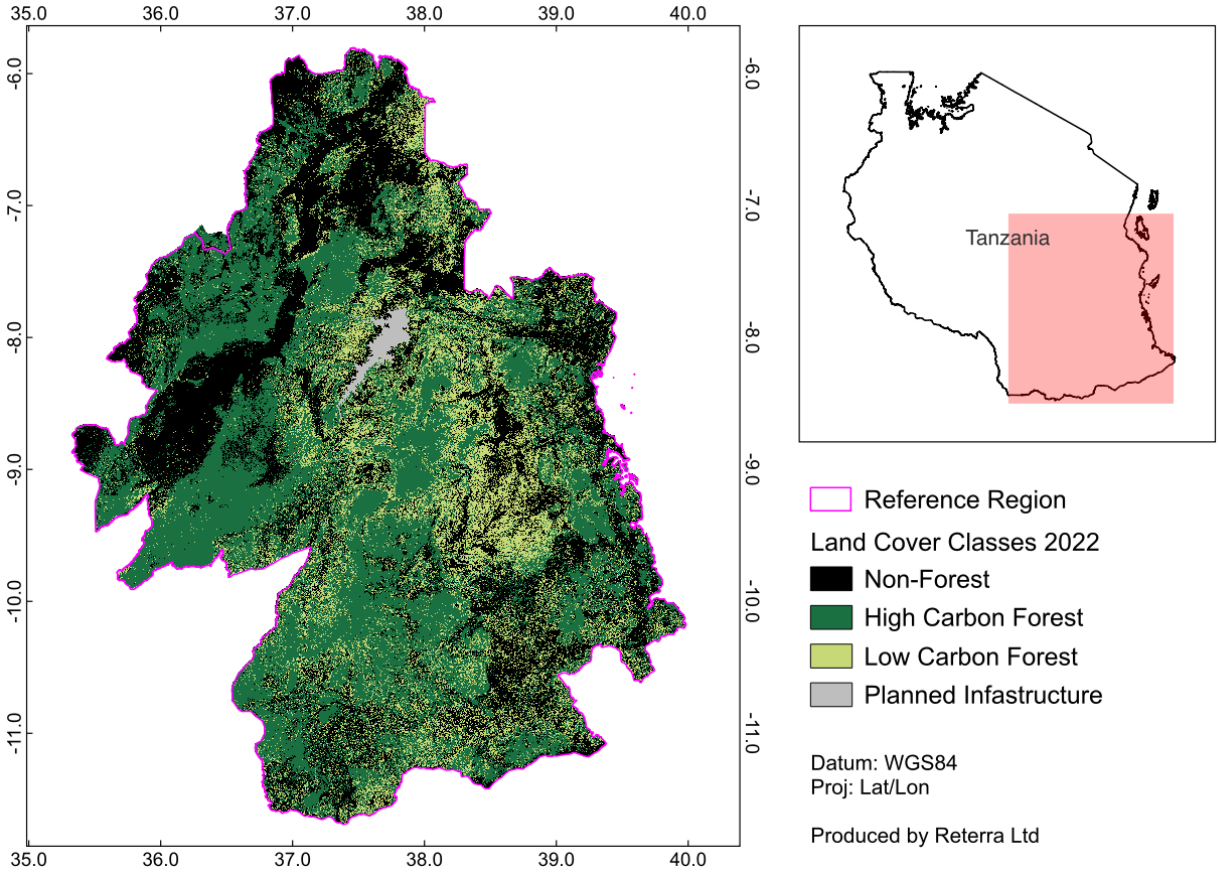


Figure 21 Land Cover Classes 2022

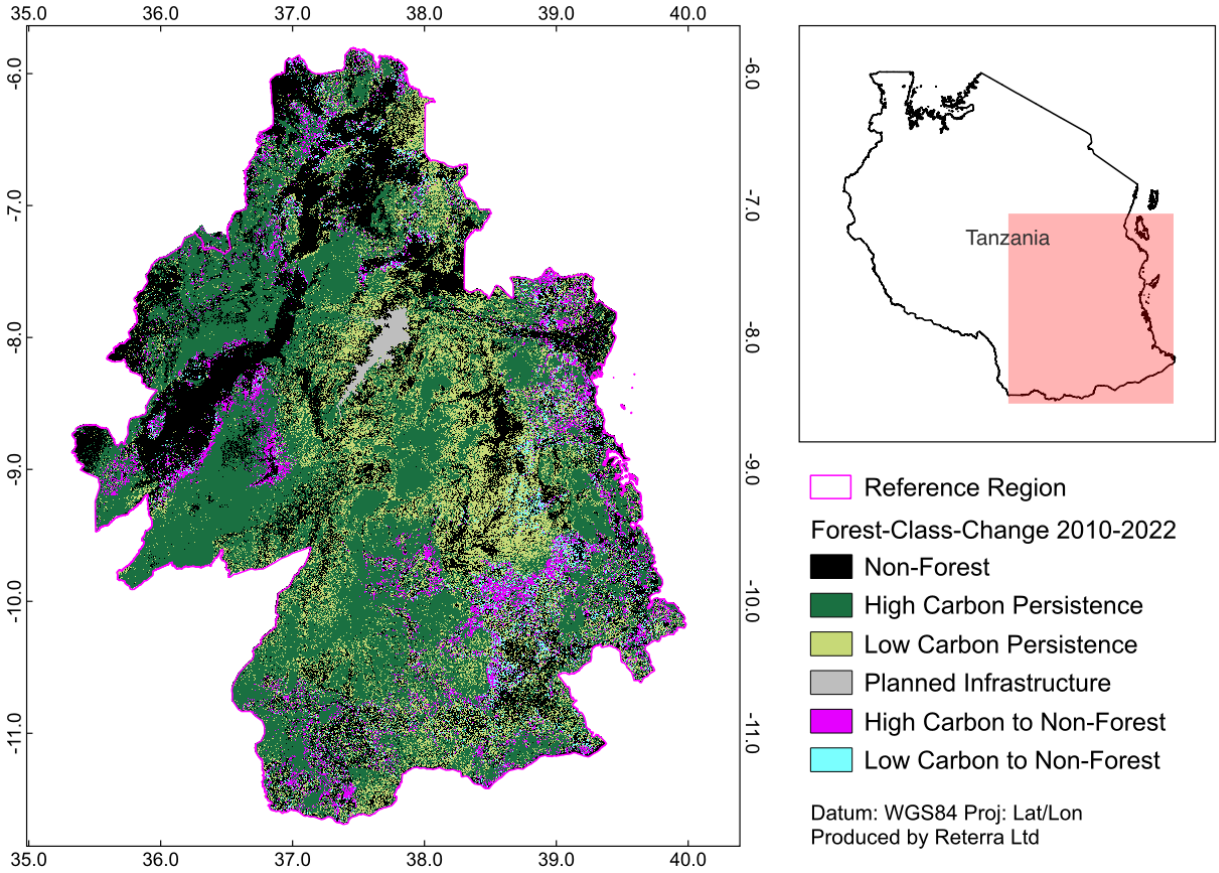


Figure 22 Forest Class Change 2010-2022

Table 31 Land Use Land Cover Change Matrix 2010-2012 in ha

Final \ Initial	High Carbon Forest	Low Carbon Forest	Final Area
High Carbon Forest	8,137,513		8,137,513
Low Carbon Forest		3,456,890	3,456,890
Non-Forest	1,052,899	561,153	1,614,052
Initial Area	9,190,412	4,018,043	13,208,455
Net Change	-1,052,899	-561,153	

Land cover mapping in Eastern Tanzania is exceptionally complicated due extensive cloud cover throughout most of the year, strong season effects on the appearance of vegetation, extensive dry

season fires, and highly variable topography and land-covers. Dry season optical imagery can be difficult to interpret regardless of resolution, constraining the best analysis to wetter times of years which are also cloudier. For some Landsat scene footprints, there are historical gaps of up to 10 years in the availability of Landsat scenes with 10% or less cloud cover during the same month.

Fortunately, PALSAR I and II L-band radar data is available for the historical reference period, is cloud penetrating, and less sensitive to seasonal variation in the appearance of data. The Japanese Space Agency, JAXA, provides free annual global mosaics of processed PALSAR I and II HH and HV backscatter data and has uploaded the mosaics to a Google Earth Engine dataset. The mosaic product covering Tanzania is generally comprised of dry season data, which is perfect for mapping forest cover due to lower scene variances associated with soil moisture. L-band radar penetrates leaves and instead interacts with larger branches and stems. Thus, trees are distinguishable from other vegetation regardless of whether they have shed their leaves.

L-band radar however is influenced strongly by topography. The JAXA mosaic products have been terrain flattened, but this cannot correct for the effects of more extreme slopes. Thus, optical data is still useful in mapping the most rugged parts of the landscape.

3.5 Map Accuracy Assessment

Map accuracy assessment was carried out using an initial stratified random sample of 400 non-forest, 880 forest, and 250 deforestation pixels from the Land Use and Land Cover Change 2010-2022 map. Deforestation was oversampled to reduce the uncertainty of the area estimate for that class. However, the sample was drawn from the map before the footprint of the Nyerere dam was added. Additionally, the boundaries of the reference region were slightly modified when the National Bureau of Statistics released an updated ward boundary map in June 2022. As a result, 20 sample points fell outside the final reference region leaving 1510 total accuracy assessment points (Figure 23).

Points were reviewed using high resolution imagery from Google Earth and Planet.com basemaps. PALSAR 1-2 mosaics, Sentinel-2 Mosaics and the Landsat 5 mosaic were also used to aid interpretation. Forest cover at edge pixels was assessed using pixel boundaries from the original map projection as exported from Google Earth Engine, EPSG:4326.

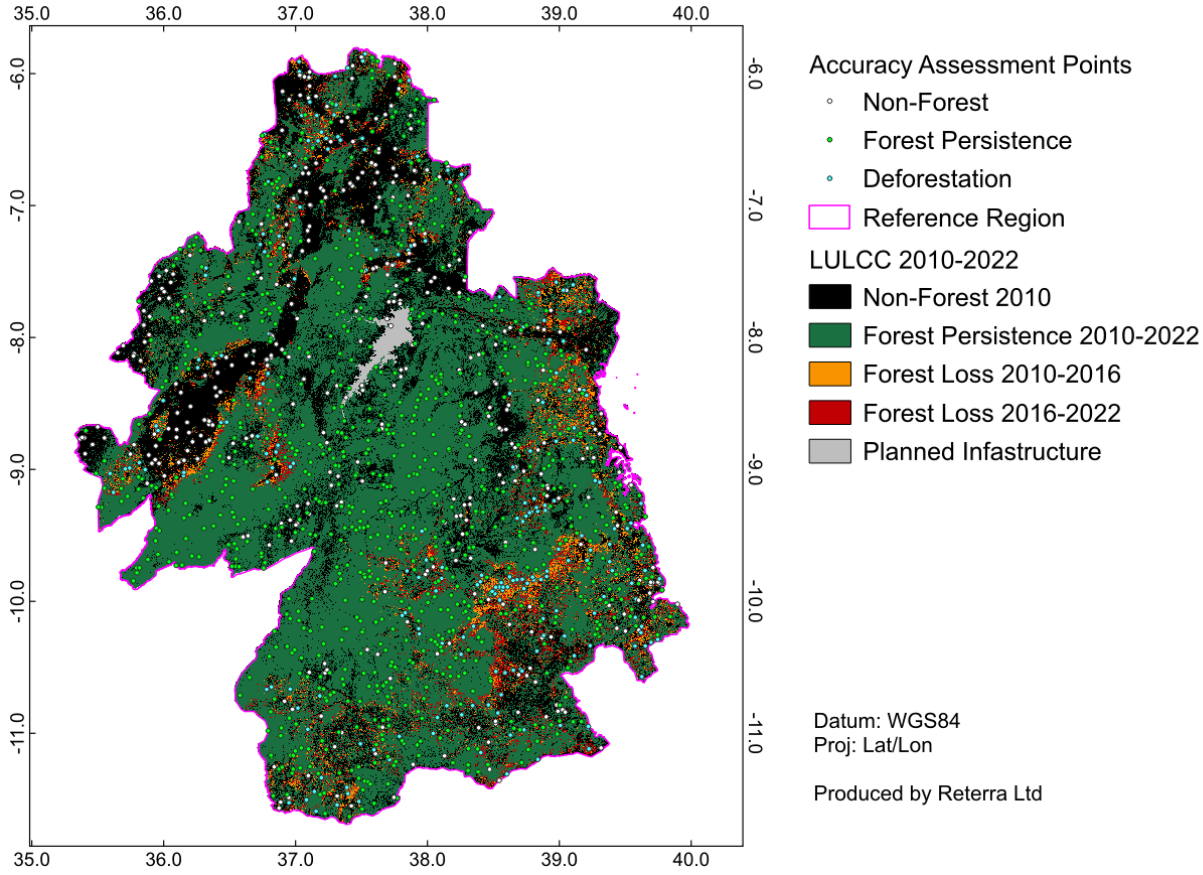


Figure 23 LULCC Accuracy Assessment Points

A confusion matrix of the sample data compared to the mapped classes is shown in Table 32. Table 32 also shows the mapped class areas and class weights for each class which were used to calculate an area weighted confusion matrix (Table 33). The area weighted confusion matrix shows that the accuracy of all categories is greater than 80%, meeting the requirements of the methodology.

Table 32 Accuracy Assessment Point Count Confusion Matrix

Mapped Class	Sample Class			Total	Mapped Class Area	Class Weight
	Non-Forest	Forest	Deforestation			
Non-Forest	353	37	1	391	5,243,087	0.2842
Forest	32	829	12	873	11,594,403	0.6284
Deforestation	9	17	220	246	1,614,052	0.0875

Total	394	883	233	1510	18,451,542	

Table 33 Area Weighted Accuracy Assessment Confusion Matrix

Mapped Class	Sample Class			User's Accuracy	Overall Accuracy
	Non-Forest	Forest	Deforestation		
Non-Forest	0.257	0.027	0.001	0.903	0.931
Forest	0.023	0.597	0.009	0.950	
Deforestation	0.003	0.006	0.078	0.894	
Producer's Accuracy	0.907	0.948	0.893		

Finally, the accuracy of the 2010 and 2022 forest cover benchmark maps were assessed by combining the deforestation areas weighted counts into the 2010 forest class and 2022 non-forest class respectively. The overall accuracies for the 2010 FCBM (Table 34) and 2022 FCBM (Table 35) exceeded the requirement of 90% set by the methodology.

Table 34 2010 Forest Cover Benchmark Map Accuracy

Mapped Class	Sample Class		User's Accuracy	Overall Accuracy
	Non-Forest	Forest		
Non-Forest	0.2565	0.0276	0.9028	0.9462
Forest	0.0262	0.6896	0.9634	
Producer's Accuracy	0.9072	0.9615		

Table 35 2022 Forest Cover Benchmark Map Accuracy

Mapped Class	Sample Class		User's Accuracy	Overall Accuracy
	Non-Forest	Forest		

Non-Forest	0.3387	0.0355	0.9051	0.9354
Forest	0.0291	0.5967	0.9535	
Producer's Accuracy	0.9209	0.9438		

3.6 Estimation of Land Cover and Land Cover Change Areas

The area of total deforestation during the historical reference period and the 90% confidence interval was estimated using the area weighted accuracy data as proposed by Olofsson et al. 2014[46]. The half-width of the two-sided 90% confidence interval (Table 36) was less than 10%, meeting the requirements of VM0015.

Table 36 Bias corrected area estimates and confidence intervals.

Class	Bias corrected %	Bias corrected ha	SE (ha)	90% CI (ha)	%error
Non-Forest	28.3%	5,217,575	109,559	± 180,225	3.45%
Forest	63.0%	11,617,724	118,749	± 195,342	1.68%
Deforestation	8.8%	1,616,244	57,226	± 94,137	5.82%

4 PROJECTION OF FUTURE DEFORESTATION

4.1 Projection of the Quantity of Future Deforestation

To best align with VM0048, the project elected for no stratification of the reference region (VM0015 Table 8) and a historical average approach for estimating the quantity of future deforestation. An analysis of the Land-Use Land-Cover map (Figure 20) showed that there was 647,956 ha of deforestation from 2010-2016 compared to 966,095 ha from 2016-2022. That is an increase of 50% more deforestation during the more recent period, suggesting that deforestation rates increased during

[46] Olofsson, P., Foody, G. M., Herold, M., Stehman, S. V., Woodcock, C. E., & Wulder, M. A. (2014). Good practices for estimating area and assessing accuracy of land change. Remote sensing of Environment, 148, 42-57.

the historical refence period. Furthermore, the analysis of deforestation drivers and agents showed that there was a large increase in population in the reference region during historical reference period, including amongst the main agents of deforestation - older, less educated men living in rural areas. Taken together, this is conclusive evidence that the trend of deforestation during the historical reference period was increasing, and thus it is conservative to use a historical average approach to estimate future deforestation.

VM0015 Table 8 Stratification of the Reference Region

Stratum ID		Description	Area at start of baseline validity period (ha)
IDi	Name		
1	All forest	All forest in the reference region	11,617,724

The area weighted dates of the starting 2010 PALSAR mosaic and ending 2022 PALSAR mosaics used in the HRP mapping were July 7th and September 4th respectively, so the mapped length of the HRP was slightly longer than 12 years, but conservatively rounded to 12 years for the purpose of estimating average annual deforestation. The projected future annual deforestation was estimated by dividing the bias corrected deforestation during the historical reference period (1,616,244 ha) by the length of the reference period (12 years). This gave a projected average annual deforestation rate of 134,687 ha/yr for the revised baseline validity period.

Annual areas of baseline deforestation for the reference region during the baseline validity period starting from April 21, 2022 (the previous baseline validity period ended on April 20th, 2022) were then calculated by distributing the 6 years of deforestation into calendar years based on the number of days during the baseline validity period in each year (VM0015 Table 9). VM0015 Table 10 and VM0015 Table 11 show the same for the project area and leakage belt based on projected annual deforestation in each area (see section 4.2.3) except that the baseline for the project area and leakage belts for the second project instance start on February 9, 2023, rather than April 21, 2022. Additionally, as per VM0015, the 931 ha already credited under the previous baseline validity period (Figure 24) were not considered for crediting in the new baseline validity period. This was accomplished by subtracting the projected baseline deforestation for those areas from the instance 1 baseline for the new baseline validity period, which is equivalent to removing those areas from the project area polygon used to calculate the baseline deforestation from the VM0048 style risk map. Also note that the same 2022 PALSAR mosaic was used to monitor deforestation in the first project instance in the last monitoring report. Thus, any deforestation in project instance 1 between the start of the new baseline validity period (April 21, 2022) and the area weighted date of the 2022 PALSAR mosaic (Sept 4th, 2022) was captured in that monitoring report.

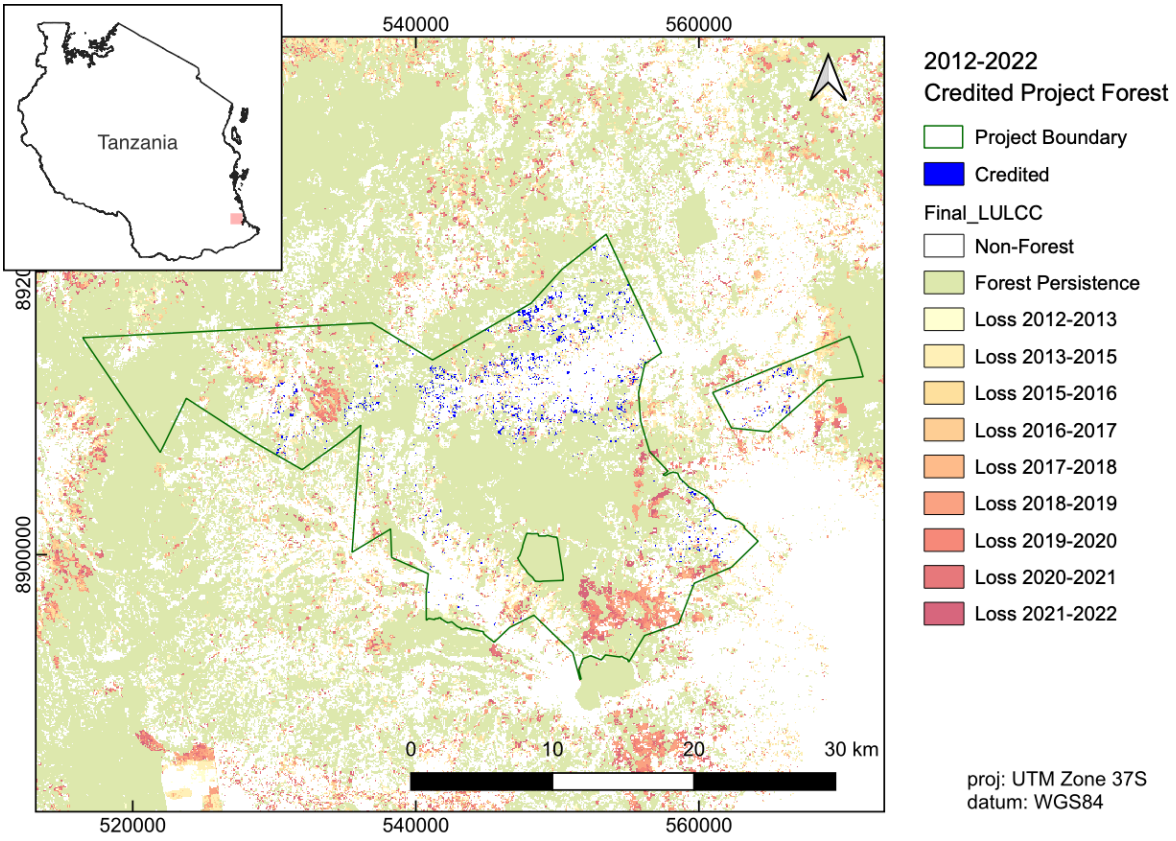


Figure 24 Cumulative Deforestation and Credited Avoided Deforestation 2012-2022 from the verified 2013-2022 monitoring report.

VM0015 Table 9 Annual Areas of Baseline Deforestation in the Reference Region

	Stratum *i* in the reference region	Total	
	1	Annual	cumulative
	$ABSLRR_{i,t}$	$ABSLRR_t$	*ABSLRR*
Project year *t*	ha/yr	ha/yr	ha
2022	94,096	94,096	94,096
2023	134,687	134,687	228,783
2024	134,687	134,687	363,469
2025	134,687	134,687	498,156
2026	134,687	134,687	632,843

2027	134,687	134,687	767,529
2028	40,848	40,848	808,377

VM0015 Table 10 Annual Areas of Baseline Deforestation in the Project Area (ABSLPA)

	Stratum *i* in the reference region in the project area	Total	
	1	Annual	cumulative
	$ABSLPA_{i,t}$	$ABSLPA_t$	*ABSLPA*
Project year *t*	ha/yr	ha/yr	ha
2022	728	728	728
2023	4,783	4,783	5,512
2024	5,231	5,231	10,743
2025	5,231	5,231	15,973
2026	5,231	5,231	21,204
2027	5,231	5,231	26,435
2028	1,586	1,586	28,022

VM0015 Table 11 Annual Areas of Baseline Deforestation in the Leakage Belt (ABSLLK)

	Stratum *i* in the reference region in the leakage belt	Total	
	1	Annual	cumulative
	$ABSLLK_{i,t}$	$ABSLLK_t$	*ABSLLK*
Project year *t*	ha/yr	ha/yr	ha
2022	1,010	1,010	1,010
2023	6,448	6,448	7,458
2024	7,046	7,046	14,504

2025	7,046	7,046	21,551
2026	7,046	7,046	28,597
2027	7,046	7,046	35,643
2028	2,137	2,137	37,780

4.2 Projection of the Location of Future Deforestation

The projection of future deforestation location was done following VM0015 except for one deviation. Instead of projecting individual pixels of future deforestation based on order of deforestation risk, the project used the approach from VT0007 where future deforestation location is predicted as a density map where each pixel in the map is assigned a density representing the proportion of pixels in the same risk class projected to be deforested in each year of the baseline validity period. The proportions are represented in terms of fractions of a hectare so they can be summed to calculate the predicted area of projected deforestation for any discrete area in the landscape. This approach was chosen to align the baseline with that which will be produced by Verra under VM0048, which the project will likely adopt in 2025 subject to data availability from Verra. The density approach was also shown to be more accurate and thus an accepted deviation.

4.2.1 Preparation of Factor Maps

Deforestation in the reference region is primarily driven by the expansion of small holder agriculture for both subsistence and cash crop production. Likely predictors of the future location of deforestation include proximity to deforestation agents, factors that affect the suitability of an area for crop production, proximity to markets and proximity to roads that access markets. VM0015 Table 12 shows the list of the factor maps that were created to represent these different predictors, and the processing steps used to create the maps. For each factor, a map was produced for the beginning of the calibration period (2010), the beginning of the confirmation period (2016), and the beginning of the baseline validity period (2022). In addition to the processing steps described in VM0015 Table 12, all factor maps were projected to match the Land Cover Change Map (Figure 20) projection and pixel spacing, masked by the remaining forest at the time period and then rescaled to a common scale of 0 to 1, which can help to improve modeling performance with multi-layer perceptron models. As required by the methodology, flow-charts outlining how each risk map was generated are presented in Figure 25 through Figure 34. Finally, as visual examples, the 2010 versions of each factor map are presented in Table 37.

VM0015 Table 12 List of Variables, Maps and Factor Maps

Factor Map		Source	Variable Represented		Meaning of the Categories or Pixel Value		Other Maps and Variables used to Create the Factor Map		Algorithm or Equation Used / Comments
ID	File Name		Unit	Description	Range	Meaning	ID	File Name	
1	d_rec_yyyy	HRP LULCC map (Figure 20)	NA	Distance to recent deforestation. This shows where deforestation agents are most active in the landscape and is a much better predictor than distance to forest edge in a landscape like Tanzania where there are significant areas of non-forest which are not anthropogenic.	0-1	Rescaled from meters. Lower values represent forest closer to deforestation in the previous 6 years.	2	HRP_LULCC	Euclidian distance from historical deforestation during the HRP and a proxy for deforestation in the 6 years prior to the HRP assumed to be non-forest at start of HRP within 355 meters of 2010-2016 deforestation. An analysis comparing the distance to the proxy for 2004-2010 to the 2010-2016 deforestation showed that cumulative amount of deforestation observed at increasing distances were nearly identical to the cumulative frequencies of distance to 2010-2016 compared to 2016-2022 deforestation.

									See Figure 25 and Figure 26 for flow-chart diagram of steps.
3	d_built_yyyy	Earth Engine Dataset "JRC/GHSL/P2023A/GHS_BUILT_S/yyyy" built_surface Data comes in 5-year intervals, so 2010 was used for 2012, 2015 was used for 2016, and 2020 was used for 2022.	NA	Distance to built-up pixels in a particular year. This shows where settlements, representing potential markets for farmers are located. They are also related to distance to basic services such as markets, schools, and health facilities.	0-1	Rescaled from meters. Lower values represent forest closer to built-up pixels.	4	built_yyyy	Calculated based on Euclidian distance from built-up pixels. After experimentation, it was determined that filtering out pixels with less than 300 square meters of built surface and applying a 2-pixel sieve removed almost all errors in the map where natural surfaces were classified as built. Then, built up pixels within protected areas were also reviewed and built surfaces associated with planned infrastructure, ranger camps, and safari camps / hotels were removed. Reprojected from 100m to 25m pixels using nearest neighbor before calculating distance. See Figure 27 for flow-chart diagram of steps.
5	d_road_yyyy	Open Street Maps downloaded June 23, 2024.	NA	Distance to roads that connect major population centers. Roads	0-1	Rescaled from meters. Lower values represent forest closer to major roads.	6	roads	Openstreetmap roads vector data was filtered to trunk, primary, secondary, and tertiary roads and then rasterized using into a 25-meter pixel binary

				are important for moving commercial crops and charcoal; thus, deforestation may be more common near roads.					map (0 for no road, 1 for road). Then Euclidian distance was calculated from the road pixels. See Figure 28 for flow-chart diagram of steps.
7	d_river_yyyy	Downloaded from hydrosheds.org/products/hydrosheds	NA	Distance to rivers and streams in the hydrosheds dataset. People are unlikely to settle far from rivers and streams as they often do not have other means of accessing water.	0-1	Rescaled from meters. Lower values represent forest closer to a river or stream.	8	rivers	The hydroshed channel data was rasterized into a 25-meter pixel binary map (0 for no channel, 1 for channel). Then Euclidian distance was calculated from the channel pixels. See Figure 29 for flow-chart diagram of steps.
9	pa_yyyy	From a variety of official and unofficial sources collected by the project	NA	Protected areas under national authorities in the reference region with clearly marked boundaries and	0,1	0 = unprotected 1 = protected			Each polygon included was overlayed on high resolution imagery to confirm that the polygon boundaries line up with the cutlines, roads, and rivers that make up the real

		partners over the years, including Protected Planet data.		where conversion to agriculture would be illegal. This included national parks, game reserves, forest reserves, and nature reserves.					on the ground boundaries that are enforced. Protected areas polygons with no agreement with the shape of undisturbed areas in high-resolution imagery and no alternative clearly distinguishable boundaries in high-resolution imagery were excluded. The final boundaries were rasterized into a 25 m pixel binary map. See Figure 30 for flow-chart diagram of steps.
10	elev_yyyy	Google Earth Engine Dataset: "COPERNICUS/DEM /GLO30"	NA	Elevation above sea level. Elevation is correlated with rainfall and temperatures which may influence the relative suitability of an area for cultivation.	0-1	Rescaled from meters. Lower values represent lower elevation			Reprojected from 30m to 25m pixels using bicubic convolution. See Figure 31 for flow-chart diagram of steps.

11	slope_yyyy	Calculated from "COPERNICUS/DEM /GLO30" in Google Earth Engine	NA	Slope in degrees. Areas with lower slope can be more favorable for farming and easier to access.	0-1	Rescaled from slope in degrees. Lower values represent lower slope.			Calculated using the ee.Terrain.slope function in Earth Engine. Reprojected from 30m to 25m pixels using bicubic convolution. See Figure 32 for flow-chart diagram of steps.
12	tpi_yyyy	Calculated from "COPERNICUS/DEM /GLO30" in Google Earth Engine	NA	Topographic position index. This indicates whether the topography of an area is flat, concave, or convex. Flat and concave areas are more favorable for cultivation because they retain soil moisture longer than convex areas.	0-1	Rescaled from topographical index values. Low values represent concave positions, mid values represent flat positions, and high values represent convex positions.			Calculated using a custom Google Earth Engine javascript. Reprojected from 30m to 25m pixels using bicubic convolution. See Figure 33 for flow-chart diagram of steps.

13	cec_yyyy	From Google Earth Engine dataset: "ISDASOIL/Africa/v1/cation_exchange_capacity" Band: mean_0_20	NA	Soil cation exchange capacity. Mean soil cation exchange capacity of the top 20 cm of soil. CEC is an important predictor of general soil fertility and moisture retention capacity.	0-1	Rescaled from cmol(+)/kg. Lower values represent lower cation exchange capacity.			Reprojected from 30m to 25m pixels using bicubic convolution. See Figure 34 for flow-chart diagram of steps.

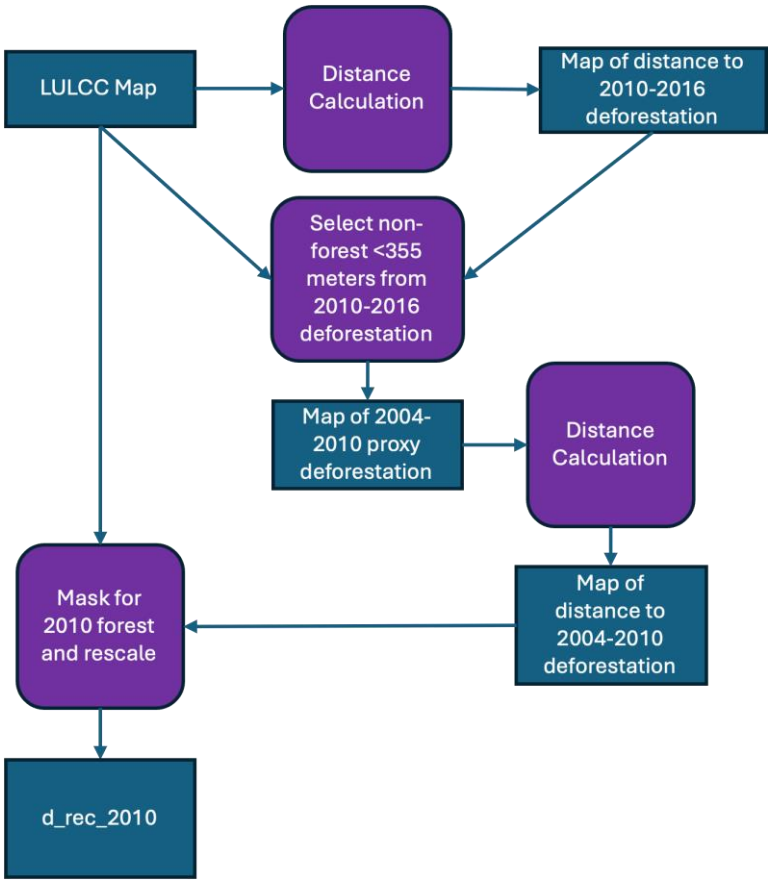


Figure 25 Steps to produce d_rec_2010

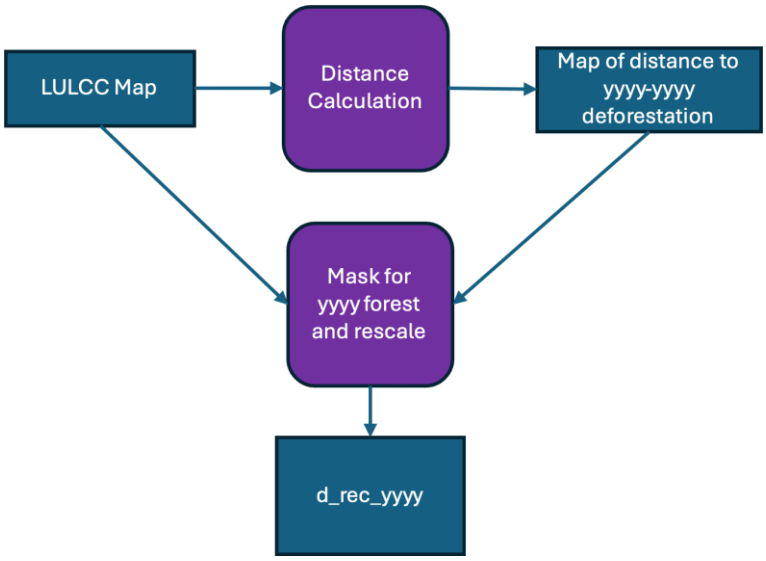


Figure 26 Steps to produce d_rec_2016 and d_rec_2022

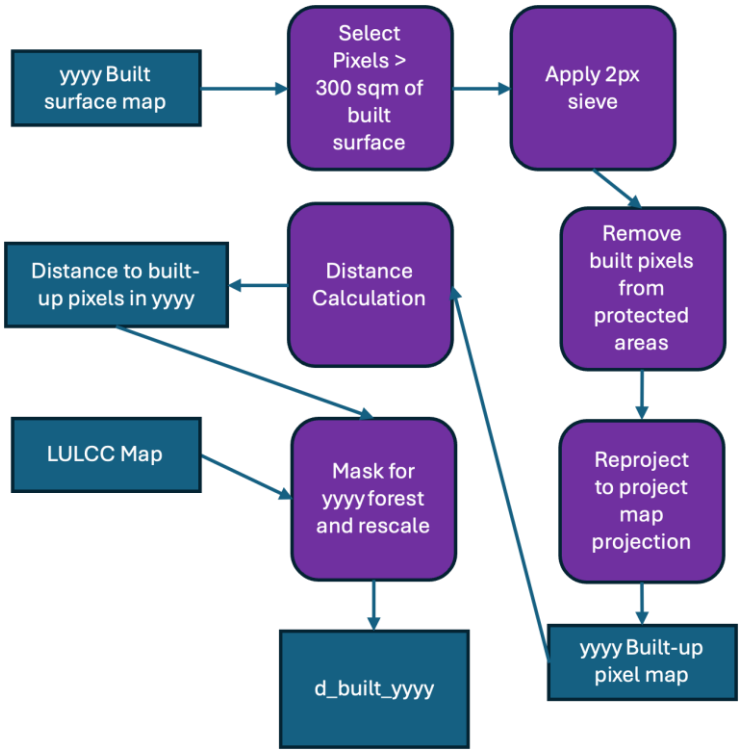


Figure 27 Steps to produce d_built_yyyy

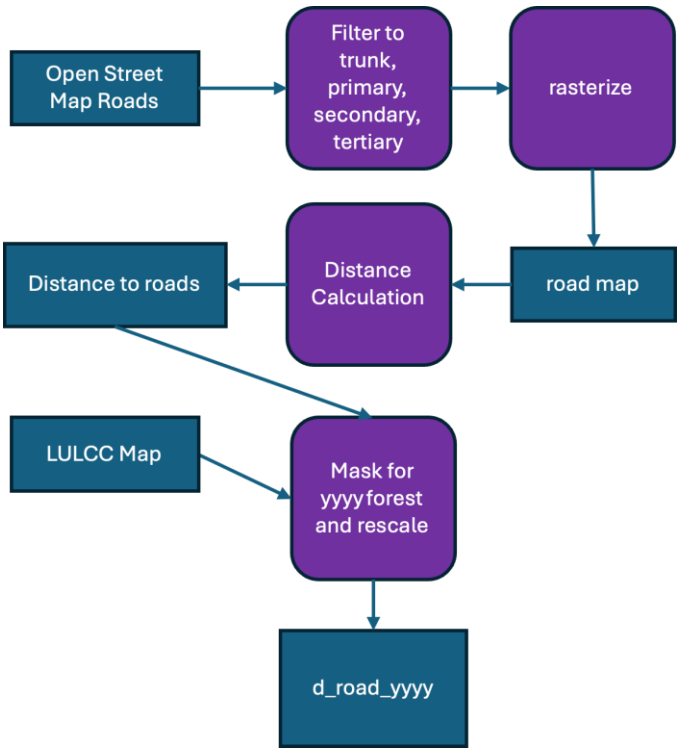


Figure 28 Steps to produce d_road_yyyy

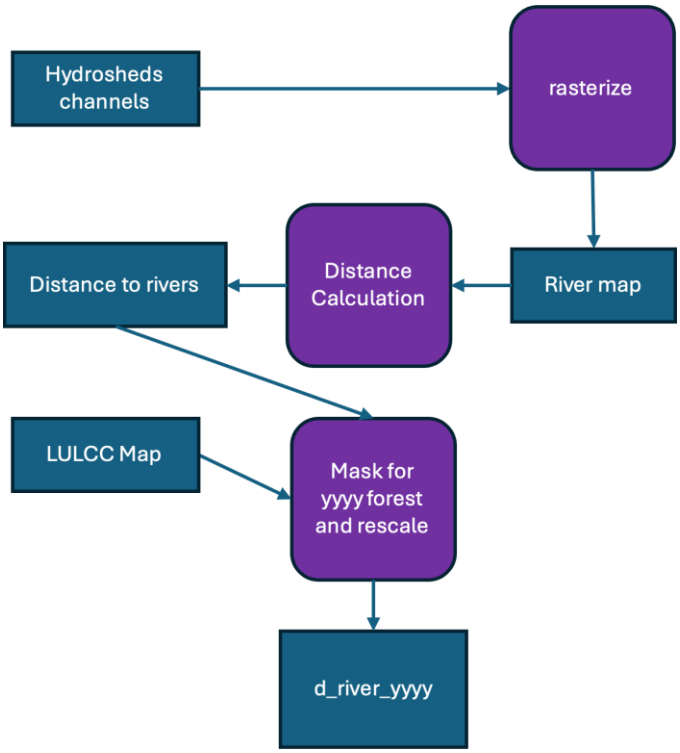


Figure 29 Steps to produce d_river_yyyy

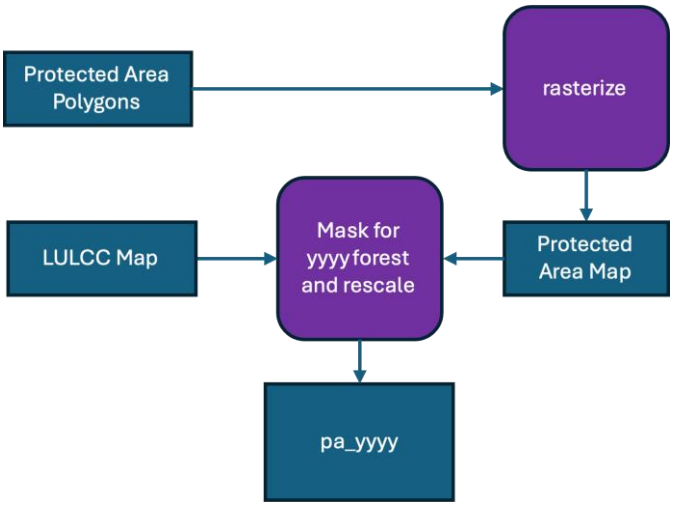


Figure 30 Steps to produce pa_yyyy

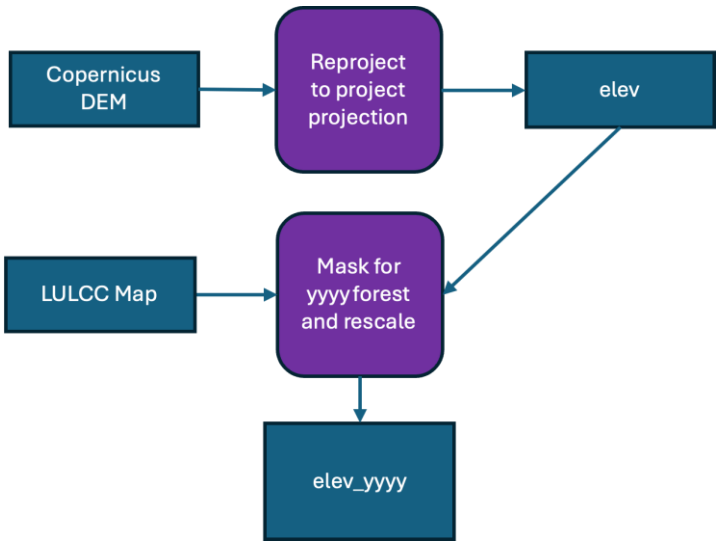


Figure 31 Steps to produce elev_yyyy

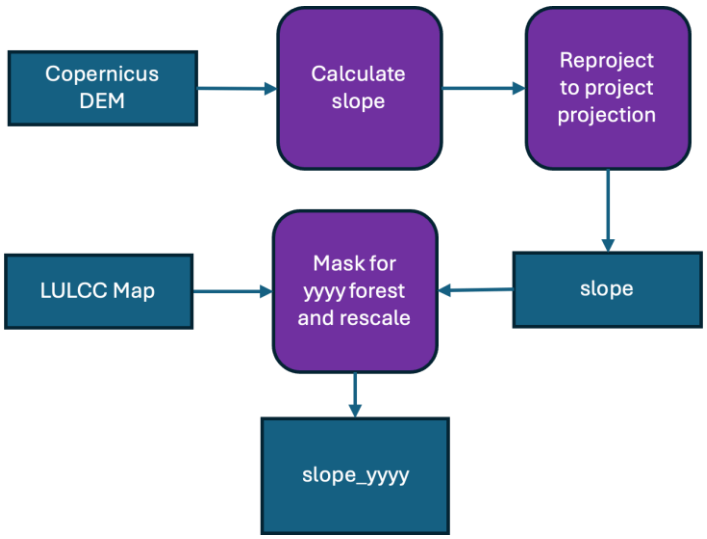


Figure 32 Steps to produce slope_yyyy

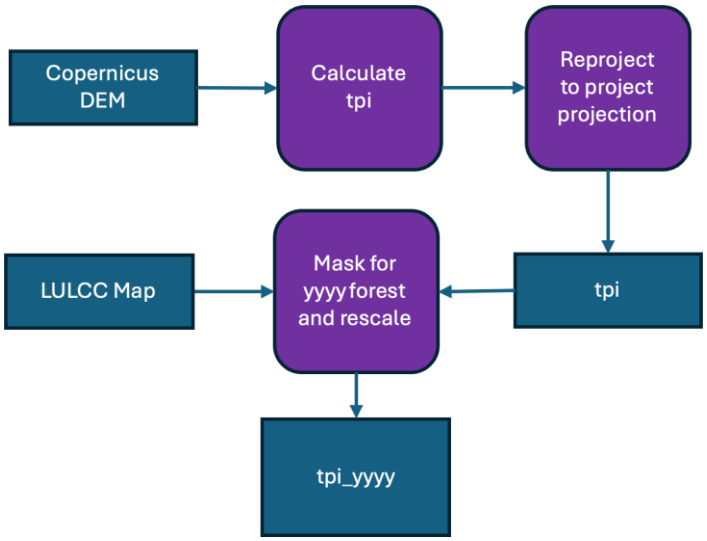


Figure 33 Steps to produce tpi_yyyy

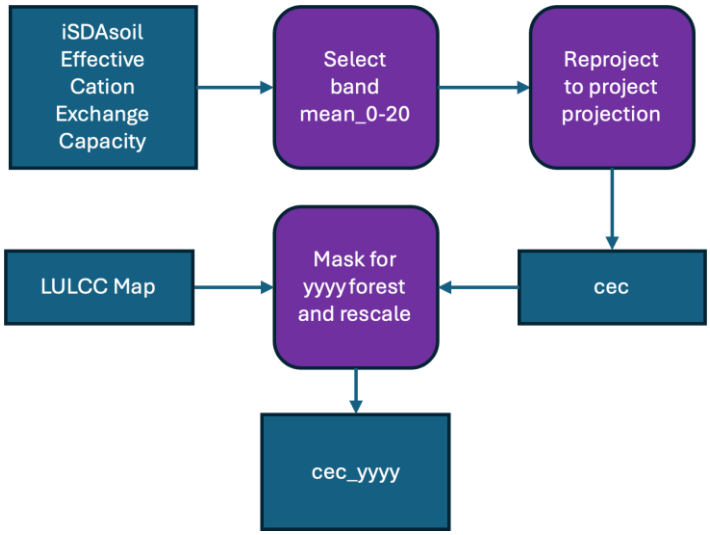
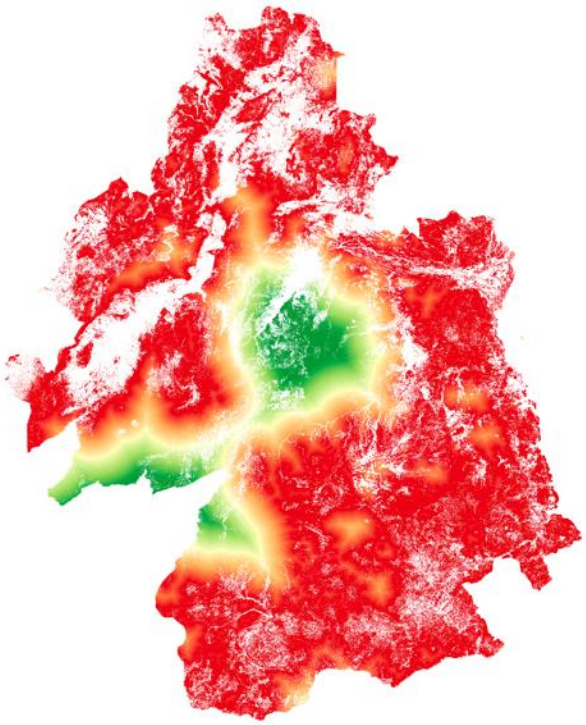
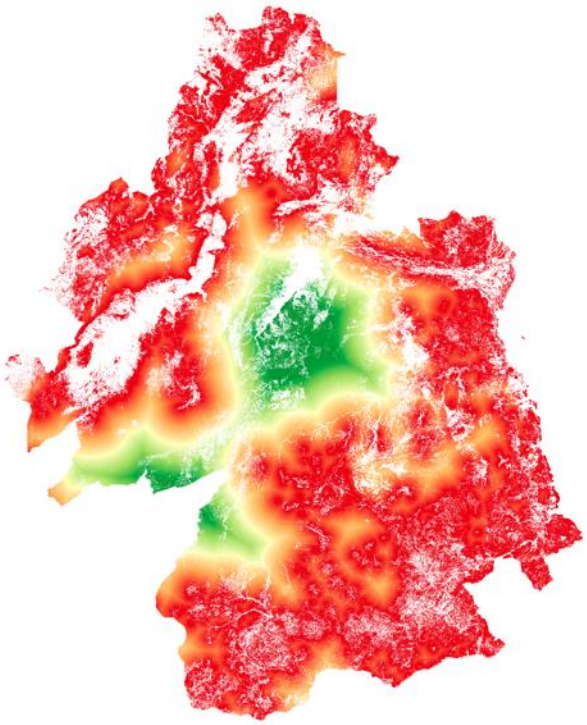


Figure 34 Steps to produce cec_yyyy

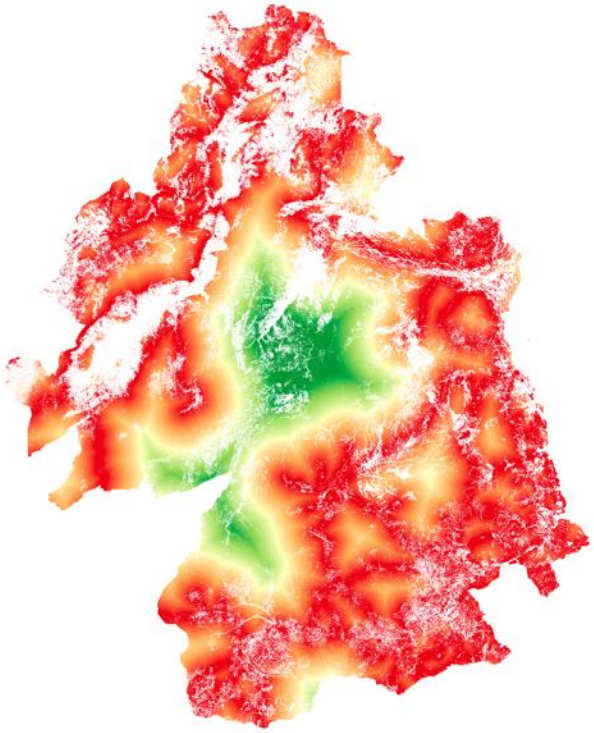
Table 37 Factor maps for 2010 (visualized with 98% histogram stretch. Red = low values, yellow = moderate values, green = high values)



d_rec_2010



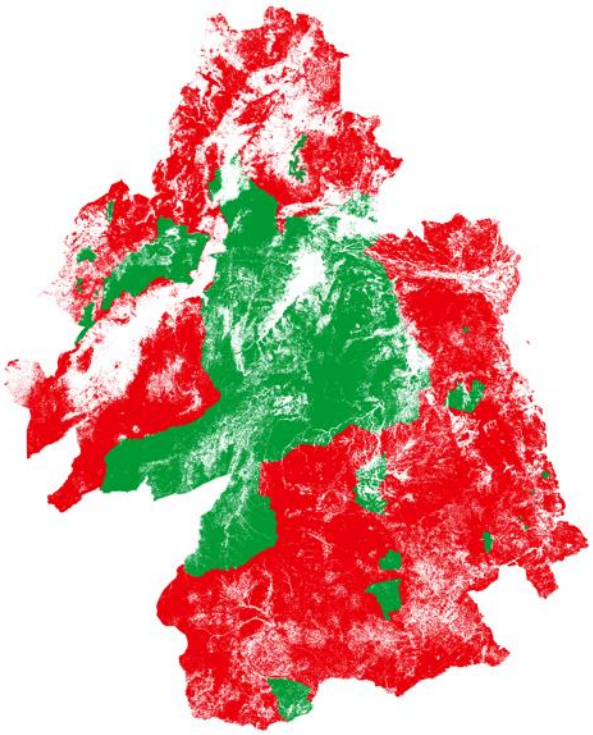
d_built_2010



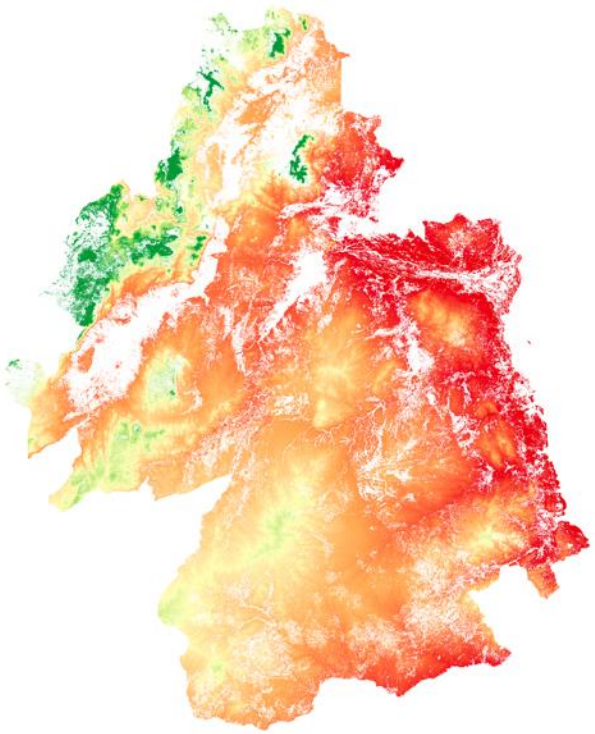
d_road_2010



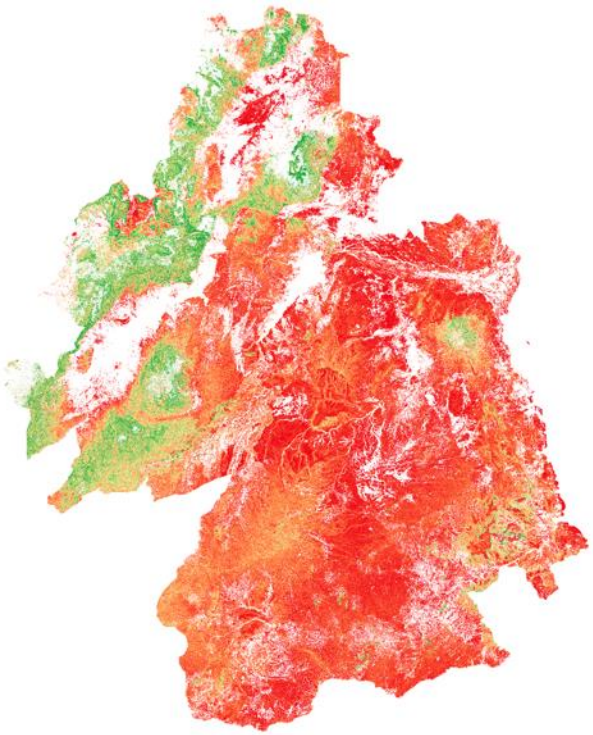
d_river_2010



pa_2010



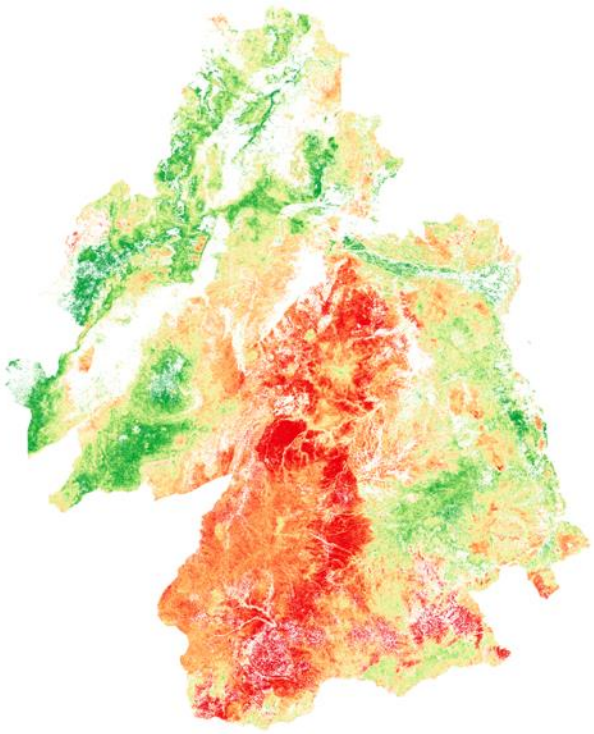
elev_2010



slope_2010



tpi_2010



cec_2010

4.2.2 Selection of the Most Accurate Deforestation Risk Map

As per VM0015 and VT0007, risk model performance was assessed by using the 2010-2016 as a calibration period and 2016-2022 as a confirmation period. Different risk models were created by modeling deforestation risk using different combinations of factor maps and different modeling algorithms including multi-layer perceptron (MLP) and Randomforest (RF).

The models were executed in python using the Sklearn libraries for MLP and RF. Training data consisted of factor map values from a stratified random sample of 30,000 forest persistence and 30,000 deforestation pixels. Ten percent of training data was withheld to calculate pixel-based accuracy for the calibration period which helped inform which model variables to drop to test more parsimonious models. The MLP and RF model parameters are shown in Table 38.

Table 38 Risk Model parameters

Multi-layer perceptron model parameters	Randomforest model parameters
MLPClassifier(hidden_layer_sizes=(5), alpha=0.0001, max_iter=15000, validation_fraction=0.3,	RandomForestClassifier(n_estimators=1000, random_state=42, max_depth=7, oob_score=True)

n_iter_no_change=1000, early_stopping=True, random_state=42)	

Risk maps were generated for both the calibration period and confirmation period. Each risk map showed the relative certainty of the model that a forest pixel would be deforested during the time based on the training set which was 50% deforestation and 50% forest persistence. A value of 0 represents 0 chance of deforestation, where as a value of 1 represents 100% certainty of deforestation. VM0015 assumes that deforestation will only happen in the highest risk pixels equal to the projected amount of deforestation in the reference region. The quantity of deforestation projected into a particular area is determined by calculating the area of predicted deforestation pixels in the area. However, this means that no risk is projected into pixels with moderate and low risk of deforestation, which may bias the model. Alternatively, VT0007 uses a density map approach whereby pixels with different probabilities of deforestation are assigned different densities of deforestation as a fraction of a hectare. This allows for risk to be projected into all pixels in proportion to the relative risk of each location. The quantity of deforestation projected in a certain area is then calculated by summing the pixels values in that area. The project tested both approaches.

To produce the predicted pixels of deforestation maps as per VM0015, NumPy in python was used to identify the risk threshold in each risk map with the required number of pixels equal to the observed deforestation in the confirmation period. Then those pixels were set to 100% deforestation in terms of a proportion of a hectare, which is 0.0625 ha per pixel while all other pixels were set to zero. Thus, the predicted deforestation in any area can be calculated by summing the pixels values in that area.

For VT0007 style density maps, v2.09 of the UDEF-ARP tool was used. The tool divides risk map values within each jurisdiction into 30 different vulnerability classes and uses the observed amount of deforestation in each vulnerability class in the calibration period to calculate the deforestation density for each pixel in each risk class. Then, for the confirmation period risk map, after splitting the map into 30 vulnerability classes, the densities from each corresponding risk class in the calibration period are applied. If, like in the case of this project, the quantity of deforestation in the confirmation period is higher than in the in-calibration period, an adjustment factor is applied to each risk class to bring the total predicted deforestation for the confirmation period equal to the observed deforestation for the confirmation period.

Thus, for predicted deforestation pixel and density maps, there are no quantity errors for the confirmation period at the scale of the reference region. It is only the specific pixels of predicted deforestation or pixel density of deforestation which varies from model to model.

As suggested by VM0015, risk map accuracy was assessed at the polygon level using Figure of Merit (FOM). The polygons consisted of a grid of 10x10 km test squares over the entire reference region generated by the UDEF-ARP tool. The projected confirmation period deforestation within each 10x10 km square was compared to the total observed deforestation within each square to calculate the total deforestation quantity agreement and over prediction or under prediction for each square. A 10x10 km grid was chosen because it corresponds roughly with the average size of a village in the project.

FOM = B / (A+B+C)

Where:

FOM = Figure of Merit (dimensionless)

A = Sum of absolute value of all under predictions in test grid cells

B = Sum of the quantity agreement between observed and predicted deforestation within each test cell

C = Sum of all over predictions in test grid cells

FOM scores for different models ranged from 0.507 to 0.658, which is well above the fraction of the landscape representing change in the confirmation period 0.08, the minimum requirement for models under VM0015. Using the VM0015 approach of assigning deforestation to only high-risk pixels resulted in the lowest FOM score. The details of the model with the highest FOM are shown in Table 39.

Table 39 Best FOM Risk Model Details

Factor Maps Included	Model Algorithm	Risk projection approach	FOM
d_rec, d_road, pa, slope, tpi, cec	RandomForest	VT0007 density map produced by UDEF-ARP[47]	0.658

4.2.3 Mapping the Location of Future Deforestation

To project deforestation during the baseline validity period, the project drew a new stratified training sample using persistence and deforestation data for the entire historical reference period and reran the model described in Table 39. Then the calibration and projection risk maps were plugged into the UDEF-ARP tool to generate a projected deforestation density map for the baseline validity period (Figure 35). In the UDEF-ARP tool, future annual reference region deforestation was set to the estimated average annual deforestation of 134,687 ha/yr from the historical reference period as estimated in section 4.1. The resulting density map gives densities in terms of projected annual deforestation density, and it is assumed that the same densities apply to each year of the baseline validity period.

[47] Note that the reference region was treated as a single administrative unit. VT0007 calls for the use of administrative boundaries to subdivide countries into smaller jurisdictions whereby vulnerability classes are calculated separately for each jurisdiction. However, when the project used a district boundary map as the input for that step in the UDEF-ARP tool, the resulting density maps had consistently had lower FOMs. This is because there were changes in deforestation rates in some districts between the calibration and confirmation periods and the model variables can explain some of this change when the model is not constrained to projecting a specific amount of deforestation within a particular district.

The total quantity of projected deforestation in the density map was confirmed using the Zonal statistics tool in QGIS which arrived at a sum of 134,686.9993 ha.

This approach is a deviation from VM0015, where annual deforestation is predicted by working backwards from the highest risk pixels, leaving no risk projected into pixels with more moderate risk of deforestation. However, as demonstrated during the selection of the most accurate risk map, the density map approach resulted in substantially more accurate quantity predictions in the 10x10 square kilometer test grids and thus is a justifiable methodological deviation.

The projected annual baseline deforestation for the project areas and leakage belts during the baseline validity period were calculated by summing the pixel density values within the corresponding polygons using the QGIS zonal statistics tool.

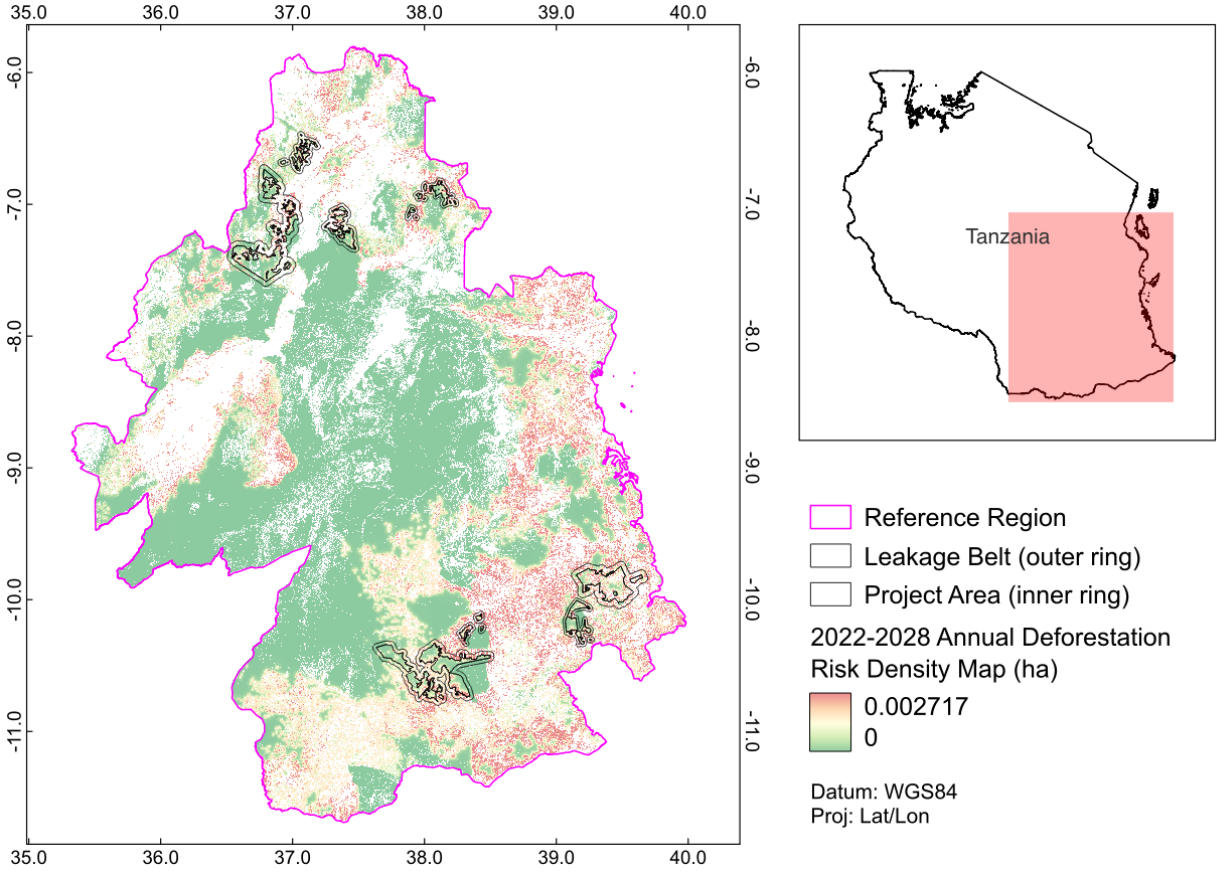


Figure 35 Projected annual deforestation density 2022-2028

5 DEFINITION OF LAND USE AND LAND COVER CHANGE COMPONENT OF THE BASELINE

5.1 Calculation of Baseline Activity Data Per Forest Class

Activity data per forest class per area of interest was calculated in python by summing density map values after masking density values outside the area of focus. For the reference region, the mask applied is the forest class in question, whereas for the project area and leakage belt, the mask applied was a combination of the forest class and area of interest. Then the projections for each area in each forest class were distributed to calendar years across the baseline validity period (starting from April 21, 2022) based on the numbers of days in each year. The temporal distribution of the baseline for the project area and leakage belts for the second project instance was adjusted to reflect the February 9, 2023, start date, rather than April 21, 2022. Finally, as per VM0015, the 931 ha already credited under the previous baseline validity period (Figure 24) were not considered for crediting in the new baseline validity period. This was accomplished by subtracting the projected baseline deforestation for those areas from the instance 1 baseline for the new baseline validity period, which is equivalent to just removing those areas from the project area polygon used to calculate the baseline deforestation from the VM0048 style risk map. Annual Areas Deforested Per forest class in the reference region, project area, and leakage belt are shown in VM0015 Table 13, VM0015 Table 14, and VM0015 Table 15 respectively.

VM0015 Table 13 Annual Areas Deforested Per forest Class *icl* Within the Reference Region in the Baseline Case (Baseline Activity Data Per Forest Class)

Area deforested per forest class *icl* within the reference region			Total baseline deforestation in the reference region	
ID_{icl}>	1	2		
Name >	High Carbon	Low Carbon	$ABSLRR_t$	*ABSLRR*
			annual	cumulative
Project year *t*	ha	ha	ha/yr	ha
2022	60,535	33,561	94,096	94,096
2023	86,648	48,039	134,687	228,783

2024	86,648	48,039	134,687	363,469
2025	86,648	48,039	134,687	498,156
2026	86,648	48,039	134,687	632,843
2027	86,648	48,039	134,687	767,529
2028	26,279	14,569	40,848	808,377

VM0015 Table 14 Annual Areas Deforested Per forest Class icl Within the Project Area in the Baseline Case (Baseline Activity Data Per Forest Class)

Area deforested per forest class *icl* within the project area			Total baseline deforestation in the project area	
ID_{icl}>	1	2		
Name >	High Carbon	Low Carbon	$ABSLPA_t$	*ABSLPA*
			annual	cumulative
Project year *t*	ha	ha	ha/yr	ha
2022	544	185	728	728
2023	3,854	930	4,783	5,512
2024	4,222	1,009	5,231	10,743
2025	4,222	1,009	5,231	15,973
2026	4,222	1,009	5,231	21,204
2027	4,222	1,009	5,231	26,435
2028	1,280	306	1,586	28,022

VM0015 Table 15 Annual Areas Deforested Per forest Class icl Within the Leakage Belt in the Baseline Case (Baseline Activity Data Per Forest Class)

Area deforested per forest class *icl* within the leakage belt			Total baseline deforestation in the leakage belt	
ID_{icl}>	1	2		
Name >	High Carbon	Low Carbon	$ABSLLK_t$	*ABSLLK*
			annual	cumulative

Project year *t*	ha	ha	ha/yr	ha
2022	703	307	1,010	1,010
2023	4,333	2,115	6,448	7,458
2024	4,731	2,315	7,046	14,504
2025	4,731	2,315	7,046	21,551
2026	4,731	2,315	7,046	28,597
2027	4,731	2,315	7,046	35,643
2028	1,435	702	2,137	37,780

5.2 Calculation of Baseline Activity Data Per Post-Deforestation Forest Class

The project chose the Historical LU/LC approach to estimate the proportion of future post-deforestation land uses. Since there was only a single post-deforestation stratum, a single zone was used. The zone was equal to the entirety of the project area, leakage belt, and leakage management areas.

VM0015 Table 16 Zones of the Reference Region Encompassing Different Combinations of Potential Post-Deforestation LU/LC Classes

Zone				Total of all other LU/LC classes present in the zone		Total area of zone	
		Name:					
		F1					
		IDfcl	3				
		Area	% of Zone	Area	% of Zone	Area	% of Zone
iD_z	*Name*	ha	%	ha	%	ha	%
1	Zone 1	928,376	100	928,376	100	928,376	100

VM0015 Table 18 Annual Areas Deforested in Each Zone Within the Project Area in the Baseline Case (Baseline Activity Data Zone)

iD_z >	1	Total baseline deforestation in the project area	
Name >	Zone 1	ABSLPAt	ABSLPA
Project year t	ha	ha/yr	ha
2022	728	728	728
2023	4,783	4,783	5,512
2024	5,231	5,231	10,743
2025	5,231	5,231	15,973
2026	5,231	5,231	21,204
2027	5,231	5,231	26,435
2028	1,586	1,586	28,022

VM0015 Table 19 Annual Areas Deforested in Each Zone Within the Leakage Belt in the Baseline Case (Baseline Activity Data Zone)

		Total baseline deforestation in the leakage belt	
iD_z >	1		
Name >	Zone 1	ABSLPAt	ABSLPA
Project year t	ha	ha/yr	ha
2022	1,010	1,010	1,010
2023	6,448	6,448	7,458
2024	7,046	7,046	14,504
2025	7,046	7,046	21,551
2026	7,046	7,046	28,597
2027	7,046	7,046	35,643
2028	2,137	2,137	37,780

6 ESTIMATION OF BASELINE CARBON STOCK CHANGES AND NON-CO2 EMISSIONS

6.1 Estimation of Baseline Carbon Stock Changes

Average carbon stocks were estimated for forest classes existing within the project area and leakage belt using carbon plot data from the project area. There is no reason to suspect that the carbon stocks within the same forest classes within the leakage belt would be higher than in the project area, so the project area is a reasonable proxy for the leakage belt since the same forest class stratification is applied to both areas. The disturbance driver data collected by the village forest patrol teams shows that conversion to agriculture is the primary driver 95.5% of significant forest disturbances and that most resource harvesting is opportunistic as part of the deforestation process. This is because legal and illegal charcoal harvesting is unprofitable for much of the project area and timber harvesting is always highly selective due to the nature of the forests where a limited number of species are targeted for timber and most trees are too small for timber making. Furthermore, fuelwood harvesting is generally extracted in the form of dead wood, which the project has conservatively excluded from biomass pools, or as part of woody fallow farm clearing and thus does not typically cause degradation in project area forests. Thus, apart from where deforestation occurs due to deforestation drivers, the project area carbon stocks are expected to remain roughly stable, with any legal or illegal small-scale harvesting offset by growth.

Post deforestation carbon stocks were estimated using carbon plots in farms of a known age within the leakage belt polygon. Given the proximity to the project area, these areas provide the most relevant proxy for post-deforestation land-uses in the project area in the baseline scenario.

The project used a combination of carbon stock data gathered from previous studies and from its own carbon stock inventory plots. The existing plot data, which primarily covered Morogoro region, met the requirements of the methodology:

a) All the existing data used to estimate carbon stocks was measured between 2019 and 2022, which is less than 10 years prior to this baseline revision.

b) The existing data was measured in 114 plots that overlap the project area in 2022.

c) The minimum diameter at breast height for inclusion in the plots was 2 cm.

d) The plot data was from random stratified plots from within the project areas and the stratification was known and accounted for when combining the plot estimates.

Carbon Plots

There were 3 sets of carbon plot data:

- COFOREST Morogoro region project forest carbon plot data measured between 2019 and 2022
- VCSL Lindi region and Morogoro region project forest plot data measured in 2024
- VCSL all region post-deforestation plot data measured in 2024

All sets used 15-meter radius plots, which is consistent with the radius used by the National Forestry Resources Monitoring and Assessment of Tanzania (NAFORMA). Trees with a diameter at breast height greater than or equal to 1cm and less than 5cm were measured only within a 1-meter radius subplot. Trees larger than 5cm were measured throughout the entire plot. Diameter at breast height was recorded for every stem meeting the requirements for inclusion. Tree species was also recorded for every measured tree. Height was not recorded in the COFOREST data and only recorded for some trees in the other datasets. Plot area on slopes was kept consistent by applying a slope correction factor (Equation 1) to increase the length of the plot radius[48].

Equation 1

$$\frac{1}{\sqrt{\cos \alpha}}$$

Where: α = *slope in degrees*

Soil samples for determining SOC were sampled in a random subset of carbon plots. Samples were collected from subplots at the north and south of project area using a 30 cm soil probe following the guidance on page 182 of VM0015 v1.2. The samples were then sent to Department of Ecosystem and Conservation; College of Forestry, Wildlife and Tourism; Sokoine University of Agriculture for determination of percent SOC and bulk density as per the guidance on page 182 of VM0015 v1.2.

Plot measurements were conducted by experienced teams trained and supervised by Dr. Wilson Mugasha, who is one of Tanzania's leading experts in biomass measurement. Data was recorded into ODK forms and uploaded to ODK central servers controlled by the project and the Tanzania Forest Conservation Group. From there, data was downloaded into excel spreadsheets and analyzed. Analyzed data is stored on the project's OneDrive account where it can be shared with the VVB and Verra.

The ODK collect biomass plot form, includes some built in data quality checks:

[48] See http://wiki.awf.forst.uni-goettingen.de/wiki/index.php/Slope_correction

At the start of the form, the user is prompted to record the plot centre using GPS in the ODK form. The plot centre records from ODK are compared to the centres from the sample plots to ensure that data was gathered from the correct locations and that the correct plot names were selected in the ODK form.

The form also requires the user to measure the plot slope and enter it. The form then calculates the slope adjusted plot radii and returns them to the user. The ODK form then prevents the user from entering trees which are too far from the plot centre for their reported size class, which is also an automatic check of unusually small cbh values in the outer plot radius.

As a check of unusually large stems, the user is prompted to double check the measurements of any tree with a dbh of over 64 cm, and if correct, take a photo of the tape measure at 1.3 cm.

The user is prompted to record the health and decay class of the stem and then requires the user to measure the stem basal diameter and height if the tree is in decay class 2 or higher. This avoids dead stems being recorded as live and stumps being estimated as whole dead trees.

During the data analysis, the plot records were sorted by species and size classes to look for any anomalous values. The plot measurement team was asked to explain any unusual values. High resolution imagery was used to confirm the lack of trees in plots with no reported trees. Likewise, the presence of exceptionally large trees on plots will also be confirmed with high resolution imagery. In any case where anomalous values are not well explained, the plot would be remeasured Dr. Wilson Mugasha with his field team. Rejected plot data would be marked as such in ODK Central and excluded from analysis. High values were found during the analysis, but the quality checks showed no non-conformities.

Sampling Framework

The target precision levels were +/- 10% error at the 90% confidence interval for the combined uncertainty of pools within a forest class.

The COFOREST data was gathered under the Tanzania Forest Conservation Group's COFOREST project which ran from 2019 through 2023. The original plot sampling was a stratified random sample in village forest reserves. Roughly equal size samples were made within forest management units where sustainable charcoal harvesting was allowed and the rest of the village forest reserves where only sustainable timber harvesting would be allowed. There was no stratification by forest type. Therefore, before analysis for this project, the dataset was stratified again by eliminating plots from areas mapped as non-forest and then splitting plots into either the high or low carbon initial forest classes from Figure 21. Plots in villages not involved in the VCSL REDD project were also removed. This left 114 plots in Morogoro villages.

Forest carbon plots in Lindi were created from a random sample of points stratified by initial forest class. Sample sizes were proportion to the relative proportion of each initial forest class in the project areas in Lindi Region. Then, an additional 14 low carbon forest plots were added in Lindi Region and 6 in Morogoro Region to reduce the uncertainty carbon stock in that class since VM0015 considers each

class separately. The full set of biomass plots in Morogoro is shown in Figure 36 and the full set of plots in Lindi is shown in Figure 37.

Soil was sampled in a random subset of 25 plots in Lindi and then in 14 plots added in Morogoro.

Post-deforestation stocks for land-uses existing within the project area in the baseline case and leakage belt in the project case were assumed to be equal to the post deforestation stocks of the post-deforestation land-uses that occurred within the leakage belt polygons in the previous 20 years. A random set of 80 carbon plots stratified by year of first clearing was created by reviewing historical satellite imagery for a larger set of random points in non-forest within the leakage belt polygon. Points were reviewed until there were at least 4 non-forest points with a first clearing year for each year in the previous 20 years. Then a stratified sample was created to so that only 80 points remained with an even distribution of ages.

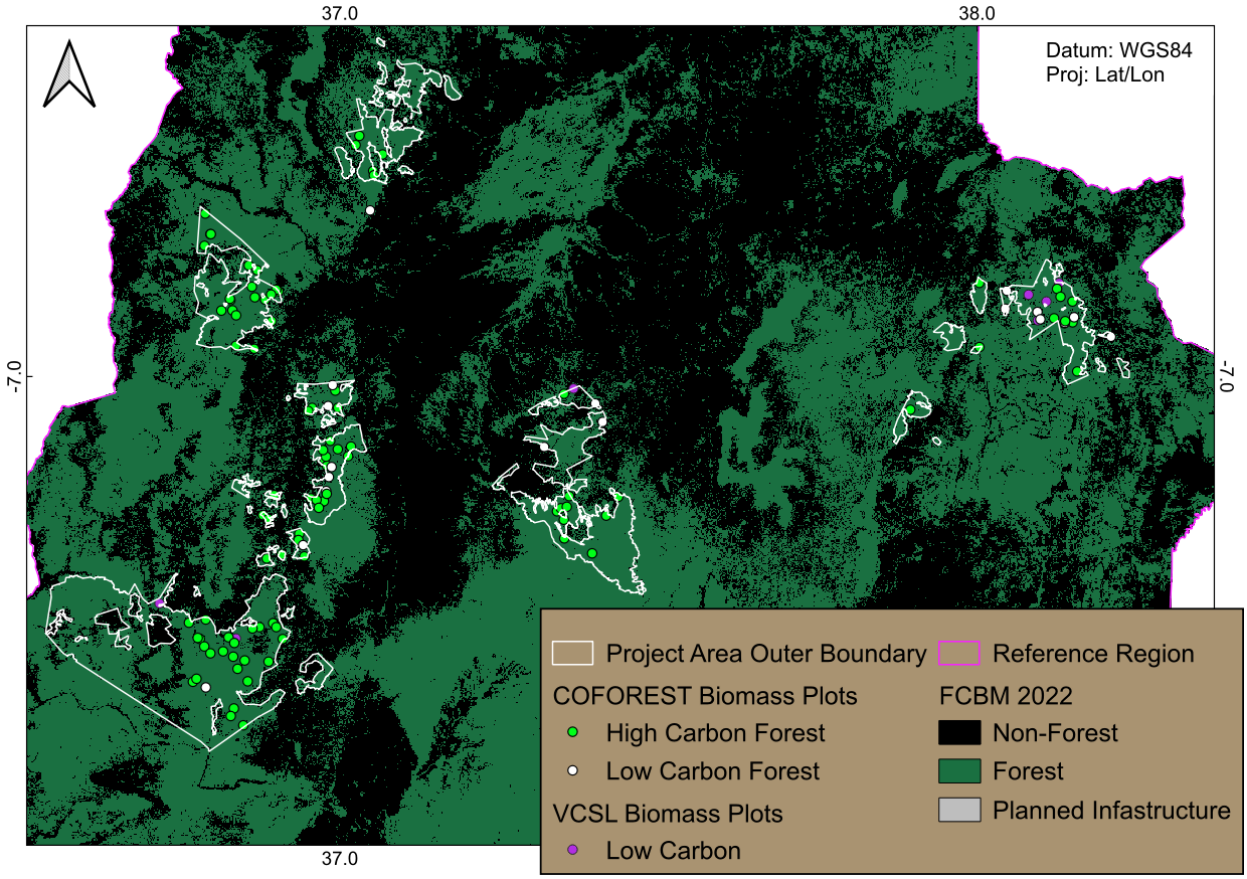


Figure 36 Morogoro COFOREST and VCSL Biomass Plots

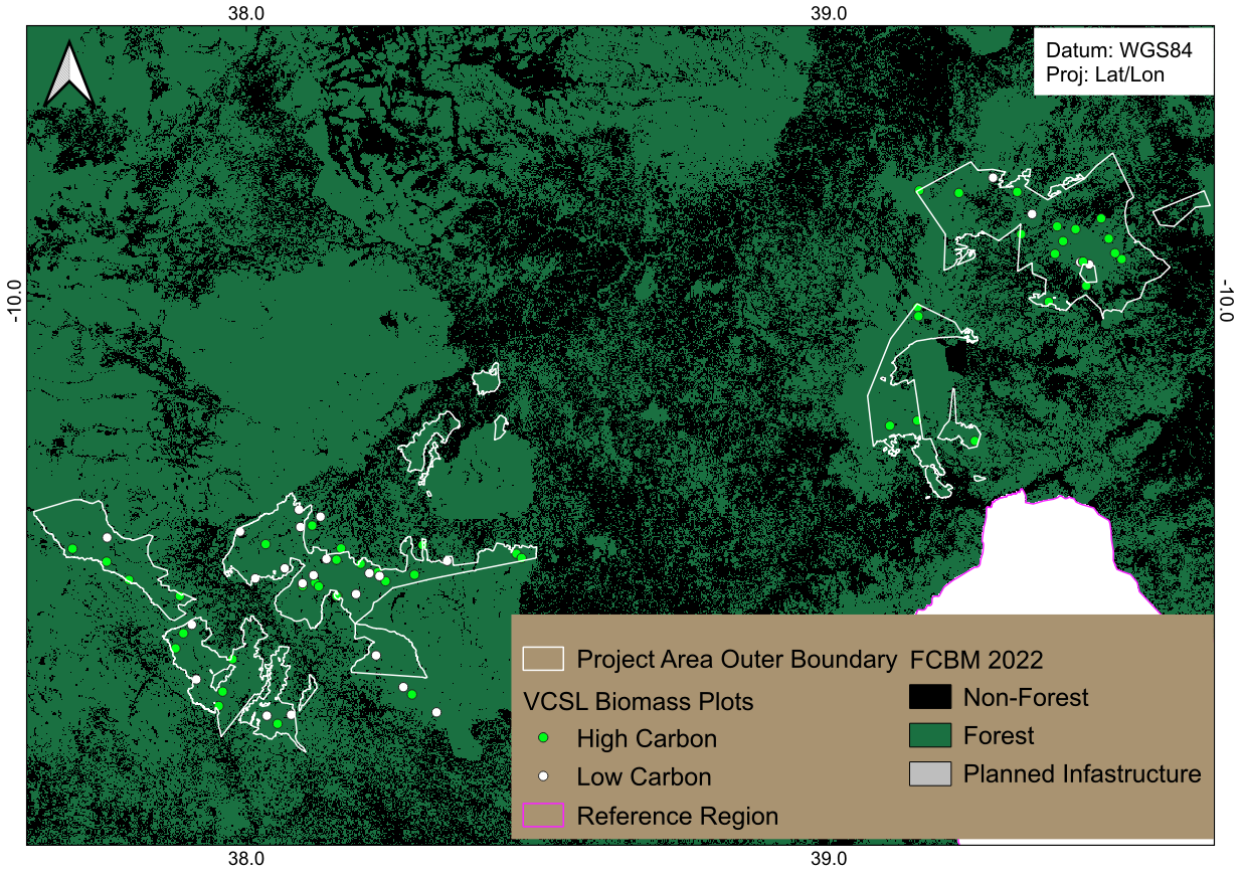


Figure 37 Lindi VCSL Biomass Plots

Allometric equations

Plot stem measurements were converted to estimates of above and below ground tree biomass using allometric questions developed for different forest types in Tanzania. Two forest types, Miombo woodland and lowland forest, were identified by the species compositions in each plot.

For live Miombo trees, the project used the general miombo equations from Mugasha et al 2013[49] that included diameter at breast height (dbh) and height (ht) to estimate above (Equation 2) and belowground tree (Equation 3) biomass. The equations were developed from sample trees in 4 different locations in Tanzania, including Lindi. The aboveground equation was developed from 167 trees and has an r-square of 0.96. The below ground equation was developed from 80 trees and has an r-square of 0.92.

[49] Mugasha, W. A., Eid, T., Bollandsås, O. M., Malimbwi, R. E., Chamshama, S. A. O., Zahabu, E., & Katani, J. Z. (2013). Allometric models for prediction of above-and belowground biomass of trees in the miombo woodlands of Tanzania. *Forest Ecology and Management*, *310*, 87-101.

Equation 2 Aboveground biomass for Miombo trees

$$AGB = 0.0763 \times dbh^{2.2046} \times ht^{0.4918}$$

Where:

AGB = Aboveground biomass (kg)

dbh = Diameter at breast height (cm)

ht = Height (m)

Equation 3 Belowground biomass for Miombo trees

$$BGB = 0.1766 \times dbh^{1.7844} \times ht^{0.3434}$$

Where:

BGB = *Below*ground biomass (kg)

dbh = Diameter at breast height (cm)

ht = Height (m)

For live Lowland Forest tree aboveground biomass, the project developed its own allometric equation with support from Dr. Mugasha from Sokoine University. The equation was developed using 90 trees from two datasets from two forest sites in Tanzania from Masota et al. 2016[50] and from Mugasha et al. 2016[51]. Data from a third site from Mugasha et al. 2016 was not included because the tree species sampling at that site did not result in a representative sample of species. Ricinodendron heudelotii made up 11 or the 30 sample trees including most of the largest trees. These trees did not fit the pattern of diameter to biomass observed in the other sample trees. Ricinodendron heudelotii is not a very common species in lowland forests (e.g., there was none in the project's carbon plots). The new equation includes diameter at breast height (dbh) and tree height (ht) and wood density (wd) to estimate aboveground biomass (Equation 4). The R-square is 0.89. Wood density values were obtained from the BIOMASS package in R, which matches species names to woody density estimates from a database of published studies. When there is no data for the species, the genus, family, or dataset average is substituted depending on the availability of genus and family data in the database. Species or Genus level data was available for most species. Some current species names were reverted to older names to match the corresponding species and genus names in the database.

[50] Masota, A. M., Bollandsås, O. M., Zahabu, E., & Eid, T. (4). Allometric biomass and volume models for lowland and humid montane forests. *Allometric Tree Biomass and Volume Models in Tanzania*, 35.

[51] Mugasha, W. A., Mwakalukwa, E. E., Luoga, E., Malimbwi, R. E., Zahabu, E., Silayo, D. S., ... & Kashindye, A. (2016). Allometric models for estimating tree volume and aboveground biomass in lowland forests of Tanzania. International Journal of Forestry Research, 2016(1), 8076271.

Equation 4 Above ground biomass for lowland forest trees

$$AGB = 0.2527750 \times dbh^{1.8749934} \times ht^{0.5374695} \times wd^{0.5958921}$$

Where:

AGB = Aboveground biomass (kg)

dbh = Diameter at breast height (cm)

ht = Height (m)

wd = wood density g/cm^3

Lowland Forest below ground biomass was estimated using the lower range of the root to shoot ratios for tropical dry forests with greater than 20t/ha of AGB (Equation 5) from Mokany 2006[52]. The lower range was used to avoid having to propagate the uncertainty separately just for lowland forest trees.

Equation 5 Below ground biomass for lowland forest trees

$$BGB = AGB \times rs$$

Where:

BGB = Aboveground biomass (kg)

AGB = Aboveground biomass (kg)

rs = IPCC root to shoot ratio for tropical dry forests with > 20t/ha of AGB (0.271), dimensionless

Some post deforestation plots contained cashew trees. Biomass for these trees was determined using the AGB and BGB equations (Equation 8) developed by Zahabu et al. as reported in Malimbwi and Chamshama 2016[53]. Where tree height was measured, the AGB equation (Equation 7) that include height was used. Otherwise, the dbh only equation (Equation 6) was used. The equations were developed from destructive harvesting of 45 trees in coastal Tanzania. The R-squares for the AGB dbh only, AGB dbh and height, and BGB equations were 0.79, 0.83, and 0.78 respectively.

Equation 6 Cashew tree aboveground biomass where tree height was not measured.

$$ABG = 0.8450 \times (dbh^2)^{0.8873}$$

[52] Mokany, K., Raison, R. J., & Prokushkin, A. S. (2006). Critical analysis of root: shoot ratios in terrestrial biomes. Global change biology, 12(1), 84-96.
[53] Malimbwi, R. E., Eid, T., & Chamshama, S. A. O. (2016). Allometric tree biomass and volume models in Tanzania.

Where:

AGB = Aboveground biomass (kg)

dbh = Diameter at breast height (cm)

ht = Height (m)

Equation 7 Cashew tree aboveground biomass where tree height was measured.

$$ABG = 0.3152 \times dbh^{1.7722} \times ht^{0.5003}$$

Where:

AGB = Aboveground biomass (kg)

dbh = Diameter at breast height (cm)

ht = Height (m)

Equation 8 Cashew tree belowground biomass

$$BGB = 0.09287 \times (dbh^2)^{0.9394}$$

Where:

BGB = Aboveground biomass (kg)

dbh = Diameter at breast height (cm)

For Miombo and Lowland Forest trees, where height was not recorded in the field, height was estimated using the dbh and plot basal area equations for either Miombo or Lowland Forest as appropriate from Mugasha et al 2019[54]. The basal area equations were chosen because they are the simplest to implement with the available data and the difference in standard error with more complex equations was less than 1%. The Miombo equation was developed with data from 20,080 trees sampled all over Tanzania, while the Lowland Forest equation was developed from 2,278 trees sampled all over Tanzania.

Equation 9 Height estimation for Miombo trees

$$ht = 1.3 + (13.4969 \times BA^{0.1491}) \times \left(1 - \exp(-0.0492 \times dbh^{0.8423})\right)$$

Where:

[54] Mugasha, W. A., Mauya, E. W., Njana, A. M., Karlsson, K., Malimbwi, R. E., & Ernest, S. (2019). Height-Diameter Allometry for Tree Species in Tanzania Mainland. *International Journal of Forestry Research*, *2019*(1), 4832849.

ht = *Estimated* tree height (m)

BA = Stand basal area (m^2/ha) calculated from basal area of trees in carbon plot scaled to a hectare

dbh = Diameter at breast height (cm)

Equation 10 Height estimation for Lowland Forest trees

$$ht = 1.3 + (16.0867 \times BA^{0.1052}) \times \left(1 - \exp(-0.0634 \times dbh^{0.7997})\right)$$

Where:

ht = *Estimated* tree height (m)

BA = Stand basal area (m^2/ha) calculated from basal area of trees in carbon plot scaled to a hectare

dbh = Diameter at breast height (cm)

For the Lindi forest carbon plots, there were no trees falling into decomposition class 1 (having lost only leaves). VM0015 provides equation A3-27 for estimating the volume of trees in decomposition class 2, 3, and 4, which is the geometric equation for a truncated cone. However, the project only recorded basal diameter since top diameter is often difficult to measure. So, conservatively, the volumes were estimated using the geometric equation for the volume of a cone[55] and then multiplied by the wood density (Equation 11).

Equation 11 Standing Deadwood Biomass for Trees measured Basal Diameter and Height

$$SdwB = \frac{1}{3} \times \pi \times \left(\frac{bd}{200}\right)^2 \times ht \times wd \times 1000$$

Where:

SdwB = Standing deadwood biomass (kg)

bd = basal diameter (cm)

ht = *measured* tree height (m)

wd = wood density (g/cm^3)

Since basal diameter and height for dead trees was not recorded in the Morogoro dataset, the biomass for standing dead wood was conservatively estimated using the merchantable stem equation from Mugasha et al 2013 that includes dbh and height (Equation 12). That equation was developed from 139 trees and has an r-squared value of 0.78.

[55] https://en.wikipedia.org/wiki/Cone

Equation 12 Aboveground biomass for Miombo tree merchantable stem

$$AGB = 0.0291 \times dbh^{1.8384} \times ht^{0.8790}$$

Where:

AGB = Aboveground biomass (kg)

dbh = Diameter at breast height (cm)

ht = Height (m)

Decomposition class 1 trees were only found in the post-deforestation plots. Standing dead wood biomass was predicted by applying the appropriate allometric equation for live trees as described previously in this section and then subtracting 3% to account for the missing leaves and small twigs as suggested by VM0015 v1.2 on page 179.

Belowground biomass for standing dead trees was assumed to be equal to the above ground biomass of the cone estimated stem or merchantable stem multiplied by the IPCC default root to shoot ratio for tropical dry forests with greater than 20t/ha of biomass (Equation 5).

Plot soil percent organic carbon and bulk density data provided by the lab was used to estimate soil organic carbon using Equation 13.

Equation 13 Soil Organic Carbon

$$C_{SOC} = bd \times sd \times C \times 100 \times \frac{44}{12}$$

Where:

C_{SOC} = Carbon stock per hectare in soil organic carbon (t CO_2e/ha)

bd = soil bulk density (g/cm^3)

sd = soil sampling depth (30 cm)

C = percent soil organic carbon (%)

Forest Carbon Stock Analysis

Carbon plot data analysis was conducted in linked Excel spreadsheets. Biomass was calculated for each stem recorded in a plot with the appropriate allometric equation as described previously in this section. Then the biomass results were converted to carbon dioxide equivalents per plot scaled to 1 hectare equivalent using Equation 14, which is a combined version of A3-11, 12, and 13 from VM0015 that can be applied to all biomass pools. The carbon fraction of tree biomass was estimated using the IPCC defaults for tropical trees with greater than 10 cm dbh (0.49) and less then 10 cm dbh (0.46)

from table 4.3 in IPCC GL2006. A review of the contribution of foliage to AGB in Mugasha et al, 2013 and 2016 datasets showed that it was negligible, contributing an average of 0.3% to Miombo tree AGB and 2% on average to lowland tree AGB. This is because the destructive harvesting was conducted in the dry season when most Miombo and a good number of lowland forest trees had shed their leaves. Thus, there was no need to include foliage in the carbon fraction weighting.

Equation 14 Conversion of stem carbon biomass to t CO_2e/ha

$$PC_{pl,i} = \sum_{st=1}^{st_{pl}} DM_{st,i} \times CF \times \frac{44}{12} \times \frac{XP_{st}}{1000}$$

Where:

$PC_{pl,i}$ = Carbon Stock in Plot *pl* in carbon pool *i* (t CO_2e/ha)

$DM_{st,i}$ = Dry matter in carbon pool *i* in stem *st* (kg)

CF = Carbon Fraction of Dry Matter (0.46 for trees < 10 cm dbh and 0.49 for trees >= 10 cm dbh)

XP_{st} = Plot expansion factor for stem *st* (3184.7 for stems < 5 cm dbh and 14.15 for stems >= 5 cm dbh)

An examination of the plot level estimates showed two large outliers in the low carbon class associated with plots which randomly fell into small, isolated patches of riverine forest equivalent to single forest map pixels. One of the plots had almost twice as much total AGB as the highest plot estimate in the high carbon forest class, while the other plot AGB was nearly equal to the highest plot in the high carbon forest class. To reduce uncertainty, the AGB and BGB values in these two plots were replaced with the next highest estimate for AGB and BGB in the low carbon class.

Once each plot was summed in t CO_2e/ha equivalents, a pivot table was used to calculate the average and standard deviation for the plots in each sampling stratum area from the VCSL and COFOREST project datasets. Then, to calculate the mean stock in each pool for each forest type for the entire project area, we calculated the weighted average mean[56] by applying the area-based weights for each sampling area (Equation 15).

Equation 15 Weighted mean carbon stocks in a carbon pool

$$\Upsilon = \sum_{h=1}^{L} \frac{N_h}{N} \times \Upsilon_h$$

Where

[56] https://en.wikipedia.org/wiki/Weighted_arithmetic_mean

Υ = the mean stock of a pool for the forest type in all sampling areas

N = the total area of the forest type in all sampling area

N_h = the total area of the forest type in sampling area h

Υ_h = the mean stock of a pool of the forest type in sampling area h

Then, the total variance for each pool in each forest type was calculated using Equation 16, which is the appropriate equation for calculating the variance of stratified random sampling[57]:

Equation 16 Total carbon pool variance in a forest type

$$var(\Upsilon) = \sum_{h=1}^{L} \left(\frac{N_h}{N}\right)^2 \times \left(\frac{N_h - n_h}{N_h}\right) \times \frac{s_h^2}{n_h}$$

Where

$var(\Upsilon)$ = total pool variance of forest type in all sampling areas

N = the total area of the forest type in all sampling areas

N_h = the total area of the forest type in sampling area h

n_h = the number of sample plots in the forest type in sampling area h

S_h = the standard deviation of the forest type pool in sampling area h

Then the 90% confidence interval of each pool in each forest type was calculated by taking the square root of the total pool variance and multiplying by 1.645. There was essentially no difference in soil organic carbon in high and low carbon forest classes, so initial SOC for both initial forest classes were recalculated as a single initial class.

The results for all pools are presented in VM0015 Table 23. The results after adjusting for uncertainty are presented in VM0015 Table 25. They are identical because the half width of the 90% confidence interval for the total carbon stock in each initial forest class was less than 10%.

VM0015 Table 23 Carbon Stocks Per Hectare of Initial Forest Classes icl Existing in the Project Area and Leakage Belt – Estimated

Pool	Initial forest class icl	

[57] https://en.wikipedia.org/wiki/Stratified_sampling

	Name	High Carbon Forest				
	ID_{cl}	i1				
	Average carbon stock per hectare ± 90% CI					
	Cab_{icl}		Cbb_{icl}		$Ctot_{icl}$	
	C stock tCO_2e/ha	± 90% tCO_2e/ha	C stock tCO_2e/ha	± 90% tCO_2e/ha	C stock tCO2e/ha	± 90% tCO2e/ha
2022	142.99	11.97	54.58	4.53	197.57	12.8
2023	142.99	11.97	54.58	4.53	197.57	12.8
2024	142.99	11.97	54.58	4.53	197.57	12.8
2025	142.99	11.97	54.58	4.53	197.57	12.8
2026	142.99	11.97	54.58	4.53	197.57	12.8
2027	142.99	11.97	54.58	4.53	197.57	12.8
2028	142.99	11.97	54.58	4.53	197.57	12.8

Project year t	Initial forest class icl					
	Name	Low Carbon Forest				
	ID_{cl}	i2				
	Average carbon stock per hectare ± 90% CI					
	Cab_{icl}		Cbb_{icl}		$Ctot_{icl}$	
	C stock tCO_2e/ha	± 90% tCO_2e/ha	C stock tCO_2e/ha	± 90% tCO_2e/ha	C stock tCO2e/ha	± 90% tCO2e/ha
2022	75.77	10.07	34.22	3.85	109.99	10.78
2023	75.77	10.07	34.22	3.85	109.99	10.78
2024	75.77	10.07	34.22	3.85	109.99	10.78
2025	75.77	10.07	34.22	3.85	109.99	10.78

2026	75.77	10.07	34.22	3.85	109.99	10.78
2027	75.77	10.07	34.22	3.85	109.99	10.78
2028	75.77	10.07	34.22	3.85	109.99	10.78

VM0015 Table 25 Carbon Stocks Per Hectare of Initial Forest Classes icl Existing in the Project Area and Leakage Belt – Values After Discounting for Uncertainty

Project year t	Initial forest class icl					
	Name	High Carbon Forest				
	ID_{cl}	i1				
	Average carbon stock per hectare ± 90% CI					
	Cab_{icl}		Cbb_{icl}		$Ctot_{icl}$	
	C stock tCO_2e/ha	± 90% tCO_2e/ha	C stock tCO_2e/ha	± 90% tCO_2e/ha	C stock tCO2e/ha	± 90% tCO2e/ha
2022	142.99	11.97	54.58	4.53	197.57	12.8
2023	142.99	11.97	54.58	4.53	197.57	12.8
2024	142.99	11.97	54.58	4.53	197.57	12.8
2025	142.99	11.97	54.58	4.53	197.57	12.8
2026	142.99	11.97	54.58	4.53	197.57	12.8
2027	142.99	11.97	54.58	4.53	197.57	12.8
2028	142.99	11.97	54.58	4.53	197.57	12.8
Note	No discount applied since total uncertainty is less than 10%					

Project year t	Initial forest class icl	
	Name	Low Carbon Forest
	ID_{cl}	i2
	Average carbon stock per hectare ± 90% CI	

	Cab_{icl}		Cbb_{icl}		$Ctot_{icl}$	
	C stock tCO_2e/ha	± 90% tCO_2e/ha	C stock tCO_2e/ha	± 90% tCO_2e/ha	C stock tCO2e/ha	± 90% tCO2e/ha
2022	75.77	10.07	34.22	3.85	109.99	10.78
2023	75.77	10.07	34.22	3.85	109.99	10.78
2024	75.77	10.07	34.22	3.85	109.99	10.78
2025	75.77	10.07	34.22	3.85	109.99	10.78
2026	75.77	10.07	34.22	3.85	109.99	10.78
2027	75.77	10.07	34.22	3.85	109.99	10.78
2028	75.77	10.07	34.22	3.85	109.99	10.78
Note	No discount applied since total uncertainty is less than 10%					

Post Deforestation Carbon Stock Analysis

Post-deforestation woody pool stocks were calculated as a single sampling area stratified by years since deforestation. Pool averages and standard deviations for each year were calculated using a pivot table. The uncertainty for each pool for each year was also calculated in excel using the appropriate t-statistic depending on the numbers of samples in each year. Then the long-term average of each pool was calculated by averaging the annual estimates. The 90% confidence interval of the long-term averages for each pool were calculated using the pooled standard errors of each year (Equation 17). The results are presented in VM0015 Table 26.

Equation 17 90% Confidence Interval for the 20-year average post-deforestation pool carbon stock

$$CI_{20years} = 1.645 \times \sqrt{\frac{1}{n^2}\sum_{i=1}^{n}(SE_i^2)}$$

Where

$CI_{20years}$ = half width of the 90% confidence interval for the 20-year average of the pool

n = number of deforestation age classes (20)

SE_i = standard error of the pool estimates for deforestation age class i

VM0015 Table 26 Long-Term (20-Year) Average Carbon Stocks Per Hectare of Post-Deforestation LU/LC Classes Present in the Reference Region.

Project year t	Post deforestation class fcl					
	Name	Post deforestation				
	ID_{fcl}	f3				
	Average carbon stock per hectare ± 90% CI					
	Cab_{fcl}		Cbb_{fcl}		$Ctot_{fcl}$	
	C stock tCO_2e/ha	± 90% tCO_2e/ha	C stock tCO_2e/ha	± 90% tCO_2e/ha	C stock tCO_2e/ha	± 90% tCO_2e/ha
t*	6.09	8.96	1.65	2.43	7.74	9.28
t*+1	27.84	37.92	7.55	10.28	35.39	39.29
t*+2	7.13	7.22	1.93	1.96	9.06	7.48
t*+3	2.38	3.12	0.51	0.78	2.89	3.22
t*+4	16.12	25.46	4.37	6.9	20.49	26.38
t*+5	9.41	15.9	2.54	4.32	11.95	16.48
t*+6	9.11	10.21	2	2.94	11.11	10.62
t*+7	4.48	10.54	1.21	2.86	5.69	10.92
t*+8	7.84	17.22	2.12	4.67	9.96	17.84
t*+9	8.25	18.62	2.24	5.05	10.49	19.29
t*+10	9.85	19.2	2.67	5.2	12.52	19.89
t*+11	0.54	1.27	0.15	0.34	0.69	1.31
t*+12	7.9	12.55	1.84	3.41	9.74	13.01
t*+13	6.18	11.09	1.24	1.93	7.42	11.26
t*+14	1.69	2.45	0.46	0.66	2.15	2.54
t*+15	6.03	5.63	1.63	1.53	7.66	5.83

t*+16	18.87	17.14	4.17	3.48	23.04	17.49
t*+17	12.1	24.23	3.28	6.57	15.38	25.1
t*+18	20.18	45.82	5.47	12.42	25.65	47.47
t*+19	31.56	41.78	7.07	8.47	38.63	42.63
Average	10.68	3.38	2.7	0.85	13.38	3.49
Average to be used in project area calculations	14.06		3.55			
Average to be used in leakage belt calculations	7.3		1.85			

VM0015 Table 27 Long-Term (20-Year) Area-Weighted Average Carbon Stock Per Zone

Zone		Post-deforestation LU/LC classes fcl				Average weighted long-term (20-year) average carbon stocks per zone z
		Name	Post-deforestation			
		IDfcl	f3			
IDz	Name			C stock (t CO_2e/ha)		
		Cab_{fcl}		Cbb_{fcl}	$Ctot_z$	90% CI
1	Zone1	10.68		2.7	13.38	3.49

Calculation of Emissions Factors

Emissions factors were calculated for each initial forest class (icl) and the singe post-deforestation class (fcl) as per VM0015:

1. For above-ground biomass:

    a. Initial forest classes (icl): immediate release of 100 percent of the carbon stock (as estimated in Table 25) is assumed to happen during year t = t* (year when deforestation occurs).

b. Post-deforestation classes (fcl): linear increase from 0 t CO_2e/ha in year t = t* to 100 percent of the long-term (20-year) average carbon stock (as estimated in VM0015 Table 27 after adjusting for uncertainty) in year t = t*+ 9 is assumed to happen in the 10-year period following deforestation (i.e., 1/10th of the final carbon stock is accumulated each year).

2. For below-ground biomass:

a. Initial forest classes (icl): an annual release of 1/10th of the initial carbon stock (as estimated in Table 25) is assumed to happen each year between t = t* and t = t*+ 9.

b. Post-deforestation classes (fcl): linear increase from 0 t CO_2e/ha in year t = t* to 100 percent of the long-term (20-year) average carbon stock (as estimated in VM0015 Table 27 after adjusting for uncertainty) in year t = t*+ 9 is assumed to happen in the 10-year period following deforestation (i.e., 1/10th of the final carbon stock is accumulated each year).

The results for each icl and the single fcl for the project area and leakage belt calculations are reported in the following versions of VM0015 Table 33. Version 1.2 of the methodology requires that baseline stock changes be estimated for the entire reference region, but doesn't specify which uncertainty adjustment, if any, should be applied to those calculations. Therefore, for post deforestation stock changes for reference region, the unadjusted values from VM0015 Table 27 were used.

VM0015 Table 33 Emission Factors for High Carbon Forest Class (i1) (Method 1)

Year after deforestation		$\Delta Cab_{icl,t}$	$\Delta Cbb_{icl,t}$
1	t*	-142.99	-5.458
2	t*+1		-5.458
3	t*+2		-5.458
4	t*+3		-5.458
5	t*+4		-5.458
6	t*+5		-5.458
7	t*+6		-5.458
8	t*+7		-5.458
9	t*+8		-5.458

10	t*+9		-5.458
11	t*+10		
12	t*+11		
13	t*+12		
14	t*+13		
15	t*+14		
16	t*+15		
17	t*+16		
18	t*+17		
19	t*+18		
20	t*+19		
21	t*+20		

VM0015 Table 33 Emission Factors for Low Carbon Forest Class (i2) (Method 1)

Year after deforestation		$\Delta Cab_{icl,t}$	$\Delta Cbb_{icl,t}$
1	t*	-75.77	-3.422
2	t*+1		-3.422
3	t*+2		-3.422
4	t*+3		-3.422
5	t*+4		-3.422
6	t*+5		-3.422
7	t*+6		-3.422
8	t*+7		-3.422
9	t*+8		-3.422
10	t*+9		-3.422

11	t*+10		
12	t*+11		
13	t*+12		
14	t*+13		
15	t*+14		
16	t*+15		
17	t*+16		
18	t*+17		
19	t*+18		
20	t*+19		
21	t*+20		

VM0015 Table 33 Emission Factors for post deforestation class (f3) in reference region (Method 1)

Year after deforestation		$\Delta Cab_{fcl,t}$	$\Delta Cbb_{fcl,t}$
1	t*	1.068	0.27
2	t*+1	1.068	0.27
3	t*+2	1.068	0.27
4	t*+3	1.068	0.27
5	t*+4	1.068	0.27
6	t*+5	1.068	0.27
7	t*+6	1.068	0.27
8	t*+7	1.068	0.27
9	t*+8	1.068	0.27
10	t*+9	1.068	0.27
11	t*+10		

12	t*+11		
13	t*+12		
14	t*+13		
15	t*+14		
16	t*+15		
17	t*+16		
18	t*+17		
19	t*+18		
20	t*+19		
21	t*+20		

VM0015 Table 33 Emission Factors for post deforestation class (f3) in project area (Method 1)

Year after deforestation		$\Delta Cab_{fcl,t}$	$\Delta Cbb_{fcl,t}$
1	t*	1.406	0.355
2	t*+1	1.406	0.355
3	t*+2	1.406	0.355
4	t*+3	1.406	0.355
5	t*+4	1.406	0.355
6	t*+5	1.406	0.355
7	t*+6	1.406	0.355
8	t*+7	1.406	0.355
9	t*+8	1.406	0.355
10	t*+9	1.406	0.355
11	t*+10		
12	t*+11		

13	t*+12		
14	t*+13		
15	t*+14		
16	t*+15		
17	t*+16		
18	t*+17		
19	t*+18		
20	t*+19		
21	t*+20		

VM0015 Table 33 Emission Factors for post deforestation class (f3) in leakage belt (Method 1)

Year after deforestation		$\Delta Cab_{fcl,t}$	$\Delta Cbb_{fcl,t}$
1	t*	0.73	0.185
2	t*+1	0.73	0.185
3	t*+2	0.73	0.185
4	t*+3	0.73	0.185
5	t*+4	0.73	0.185
6	t*+5	0.73	0.185
7	t*+6	0.73	0.185
8	t*+7	0.73	0.185
9	t*+8	0.73	0.185
10	t*+9	0.73	0.185
11	t*+10		
12	t*+11		
13	t*+12		

14	t*+13		
15	t*+14		
16	t*+15		
17	t*+16		
18	t*+17		
19	t*+18		
20	t*+19		
21	t*+20		

Calculation of Baseline Carbon Stock Changes

Baseline carbon stock changes were calculated using VM0015 Equation 10.

VM0015 Equation 10

$$\Delta CBSLPA_t = \sum_{p=1}^{P}\left(\sum_{icl=1}^{icl} ABSLPA_{icl,t} \times \Delta Cp_{icl,t=t*} + \sum_{icl=1}^{icl} ABSLPA_{icl,t-1} \times \Delta Cp_{icl,t=t*+1} + \sum_{icl=1}^{icl} ABSLPA_{icl,t-2} \times \Delta Cp_{icl,t=t*+2} + \ldots \sum_{icl=1}^{icl} ABSLPA_{icl,t-19} \times \Delta Cp_{icl,t=t*+19}\right)$$

Where

$\Delta CBSLPA_t$ = Total baseline carbon stock change within the project area at year *t* (t CO_2e)

$ABSLPA_{icl,t}$ = Area of initial forest class *icl* deforested at time t within the project area in the baseline case (ha)

$ABSLPA_{icl,t-1}$ = Area of initial forest class *icl* deforested at time t-1 within the project area in the baseline case (ha)

$ABSLPA_{icl,t-19}$ = Area of initial forest class *icl* deforested at time t-19 within the project area in the baseline case (ha)

$\Delta Cp_{icl,t=t*}$ = Average emission factor for carbon pool *p* in initial forest class icl applicable at time *t* (t CO_2e/ha)

$\Delta Cp_{icl,t=t*+1}$ = Average emission factor for carbon pool *p* in initial forest class icl applicable at time *t* (t CO_2e/ha)

$\Delta Cp_{icl,t=t*+19}$	=	Average emission factor for carbon pool *p* in initial forest class icl applicable at time *t* (t CO_2e/ha)
Icl	=	1, 2, 3, …, *Icl* initial (pre-deforestation) forest classes (dimensionless)
z	=	1, 2, 3, …, *Z* zones (dimensionless)
p	=	1, 2, 3, …, *P* carbon pools included in the baseline (dimensionless)
t	=	1, 2, 3, …, *T*, a year of the proposed project crediting period (dimensionless)
*t**	=	Year in which area $ABSLPA_{icl,t}$ is deforested in the baseline case

To simply accounting during this baseline validity period, continued baseline, and project stock changes in project years 11-19 associated with baseline and observed deforestation during project years 2-10 were calculated separately. Due to higher deforestation at the end of the first baseline validity period, project stock changes exceeded the baseline stock changes by 5369 t CO_2e. This amount was conservatively subtracted from the emissions reductions reported in the 2013-2022 monitoring report and thus does not need to be accounted for during this baseline validity period.

VM0015 Table 35 Baseline Carbon Stock Change for AGB in the Reference Region (Method 1)

Carbon Stock Changes in the Aboveground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Aboveground Biomass of Initial Forest Classes in the Reference Region		Carbon Stock Changes in Aboveground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Aboveground Biomass of Post-deforestation Zones in the Reference Region		Total Net Carbon Stock Change in Aboveground Biomass of Post-deforestation Zones in the Reference Region	
ID_{icl}>	1	2	$\Delta Cab\ BSLRR_{icl,t}$ Annual	$\Delta Cab\ BSLRR_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cab\ BSLRR_{z,t}$ Annual	$\Delta Cab\ BSLRR_{z}$ Cumulative	$\Delta Cab\ BSLRR_{t}$ Annual	$\Delta Cab\ BSLRR$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-8,655,896	-2,542,928	-11,198,824	-11,198,824	2022	100,495	100,495	100,495	-11,098,330	-11,098,330
2023	-12,389,812	-3,639,878	-16,029,690	-27,228,514	2023	244,340	244,340	344,835	-15,785,350	-26,883,679
2024	-12,389,812	-3,639,878	-16,029,690	-43,258,204	2024	388,185	388,185	733,020	-15,641,504	-42,525,184
2025	-12,389,812	-3,639,878	-16,029,690	-59,287,893	2025	532,031	532,031	1,265,050	-15,497,659	-58,022,843
2026	-12,389,812	-3,639,878	-16,029,690	-75,317,583	2026	675,876	675,876	1,940,926	-15,353,814	-73,376,657
2027	-12,389,812	-3,639,878	-16,029,690	-91,347,273	2027	819,721	819,721	2,760,647	-15,209,969	-88,586,625
2028	-3,757,566	-1,103,897	-4,861,463	-96,208,736	2028	863,346	863,346	3,623,994	-3,998,117	-92,584,742

VM0015 Table 35 Baseline Carbon Stock Change for BGB in the Reference Region (Method 1)

Carbon Stock Changes in the Belowground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Belowground Biomass of Initial Forest Classes in the Reference Region		Carbon Stock Changes in Belowground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Belowground Biomass of Post- deforestation Zones in the Reference Region		Total Net Carbon Stock Change in Belowground Biomass of Post-deforestation Zones in the Reference Region	
ID_{icl}>	1	2	$\Delta Cbb\ BSLRR_{icl,t}$ Annual	$\Delta Cbb\ BSLRR_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cbb\ BSLRR_{z,t}$ Annual	$\Delta Cbb\ BSLRR_{z}$ Cumulative	$\Delta Cbb\ BSLRR_{t}$ Annual	$\Delta Cbb\ BSLRR$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-330,400	-114,846	-445,246	-445,246	2022	25,406	25,406	25,406	-419,840	-419,840
2023	-803,325	-279,234	-1,082,559	-1,527,805	2023	61,771	61,771	87,177	-1,020,788	-1,440,628
2024	-1,276,251	-443,622	-1,719,872	-3,247,678	2024	98,137	98,137	185,314	-1,621,736	-3,062,364
2025	-1,749,176	-608,010	-2,357,185	-5,604,863	2025	134,502	134,502	319,816	-2,222,683	-5,285,047
2026	-2,222,101	-772,397	-2,994,499	-8,599,362	2026	170,867	170,867	490,684	-2,823,631	-8,108,678
2027	-2,695,027	-936,785	-3,631,812	-12,231,174	2027	207,233	207,233	697,916	-3,424,579	-11,533,257
2028	-2,838,455	-986,640	-3,825,095	-16,056,269	2028	218,262	218,262	916,178	-3,606,833	-15,140,091

VM0015 Table 36 Baseline Carbon Stock Change for AGB in the Project Area (Method 1)

Carbon Stock Changes in the Aboveground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Aboveground Biomass of Initial Forest Classes in the Project Area		Carbon Stock Changes in Aboveground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Aboveground Biomass of Post- deforestation Zones in the Project Area		Total Net Carbon Stock Change in Aboveground Biomass of Post-deforestation Zones in the Project Area	
ID_{icl}>	1	2	$\Delta Cab\ BSLPA_{icl,t}$ Annual	$\Delta Cab\ BSLPA_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cab\ BSLPA_{z,t}$ Annual	$\Delta Cab\ BSLPA_{z}$ Cumulative	$\Delta Cab\ BSLPA_{t}$ Annual	$\Delta Cab\ BSLPA$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-77,718	-13,993	-91,712	-91,712	2022	1,024	1,024	1,024	-90,688	-90,688
2023	-551,047	-70,439	-621,486	-713,198	2023	7,749	7,749	8,773	-613,737	-704,425
2024	-603,662	-76,470	-680,131	-1,393,329	2024	15,104	15,104	23,877	-665,027	-1,369,452
2025	-603,662	-76,470	-680,131	-2,073,460	2025	22,459	22,459	46,336	-657,673	-2,027,124
2026	-603,662	-76,470	-680,131	-2,753,592	2026	29,813	29,813	76,149	-650,318	-2,677,442
2027	-603,662	-76,470	-680,131	-3,433,723	2027	37,168	37,168	113,317	-642,963	-3,320,406
2028	-183,078	-23,192	-206,269	-3,639,992	2028	39,399	39,399	152,716	-166,871	-3,487,276

VM0015 Table 36 Baseline Carbon Stock Change for BGB in the Project Area (Method 1)

Carbon Stock Changes in the Belowground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Belowground Biomass of Initial Forest Classes in the Project Area		Carbon Stock Changes in Belowground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Belowground Biomass of Post- deforestation Zones in the Project Area		Total Net Carbon Stock Change in Belowground Biomass of Post-deforestation Zones in the Project Area	
ID_{icl}>	1	2	$\Delta Cbb\ BSLPA_{icl,t}$ Annual	$\Delta Cbb\ BSLPA_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cbb\ BSLPA_{z,t}$ Annual	$\Delta Cbb\ BSLPA_{z}$ Cumulative	$\Delta Cbb\ BSLPA_{t}$ Annual	$\Delta Cbb\ BSLPA$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-2,967	-632	-3,599	-3,599	2022	259	259	259	-3,340	-3,340
2023	-24,000	-3,813	-27,814	-31,412	2023	1,957	1,957	2,215	-25,857	-29,197
2024	-47,042	-7,267	-54,309	-85,721	2024	3,814	3,814	6,029	-50,496	-79,692
2025	-70,084	-10,720	-80,805	-166,526	2025	5,671	5,671	11,699	-75,134	-154,827
2026	-93,127	-14,174	-107,301	-273,827	2026	7,528	7,528	19,227	-99,773	-254,600
2027	-116,169	-17,628	-133,796	-407,623	2027	9,385	9,385	28,611	-124,412	-379,011
2028	-123,157	-18,675	-141,832	-549,454	2028	9,948	9,948	38,559	-131,884	-510,895

VM0015 Table 37 Baseline Carbon Stock Change for AGB in the Leakage Belt (Method 1)

Carbon Stock Changes in the Aboveground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Aboveground Biomass of Initial Forest Classes in the Leakage Belt		Carbon Stock Changes in Aboveground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Aboveground Biomass of Post- deforestation Zones in the Leakage Belt		Total Net Carbon Stock Change in Aboveground Biomass of Post-deforestation Zones in the Leakage Belt	
ID_{icl}>	1	2	$\Delta Cab\ BSLLK_{icl,t}$ Annual	$\Delta Cab\ BSLLK_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cab\ BSLLK_{z,t}$ Annual	$\Delta Cab\ BSLLK_{z}$ Cumulative	$\Delta Cab\ BSLLK_{t}$ Annual	$\Delta Cab\ BSLLK$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-100,572	-23,243	-123,814	-123,814	2022	737	737	737	-123,077	-123,077
2023	-619,568	-160,251	-779,819	-903,634	2023	5,444	5,444	6,182	-774,375	-897,452
2024	-676,466	-175,442	-851,909	-1,755,543	2024	10,588	10,588	16,770	-841,321	-1,738,773
2025	-676,466	-175,442	-851,909	-2,607,451	2025	15,732	15,732	32,502	-836,177	-2,574,950
2026	-676,466	-175,442	-851,909	-3,459,360	2026	20,876	20,876	53,378	-831,033	-3,405,983
2027	-676,466	-175,442	-851,909	-4,311,269	2027	26,020	26,020	79,397	-825,889	-4,231,872
2028	-205,158	-53,208	-258,366	-4,569,635	2028	27,580	27,580	106,977	-230,786	-4,462,658

VM0015 Table 37 Baseline Carbon Stock Change for BGB in the Leakage Belt (Method 1)

Carbon Stock Changes in the Belowground Biomass per Initial Forest Class icl			Total Carbon Stock Change in Belowground Biomass of Initial Forest Classes in the Leakage Belt		Carbon Stock Changes in Belowground Biomass Per Post deforestation Zone z		Total Carbon Stock Change in Belowground Biomass of Post- deforestation Zones in the Leakage Belt		Total Net Carbon Stock Change in Belowground Biomass of Post-deforestation Zones in the Leakage Belt	
ID_{icl}>	1	2	$\Delta Cbb\ BSLLK_{icl,t}$ Annual	$\Delta Cbb\ BSLLK_{icl}$ Cumulative	ID_{iz}	3	$\Delta Cbb\ BSLLK_{z,t}$ Annual	$\Delta Cbb\ BSLLK_{z}$ Cumulative	$\Delta Cbb\ BSLLK_{t}$ Annual	$\Delta Cbb\ BSLLK$ Cumulative
Name>	High Carbon	Low Carbon			Name>	Post-Deforestation				
Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	Project year t	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-3,839	-1,050	-4,889	-4,889	2022	187	187	187	-4,702	-4,702
2023	-27,488	-8,287	-35,775	-40,664	2023	1,380	1,380	1,567	-34,395	-39,097
2024	-53,309	-16,211	-69,520	-110,184	2024	2,683	2,683	4,250	-66,836	-105,934
2025	-79,130	-24,134	-103,264	-213,448	2025	3,987	3,987	8,237	-99,277	-205,211
2026	-104,951	-32,058	-137,009	-350,457	2026	5,290	5,290	13,527	-131,718	-336,930
2027	-130,772	-39,981	-170,754	-521,210	2027	6,594	6,594	20,121	-164,159	-501,089
2028	-138,603	-42,384	-180,988	-702,198	2028	6,989	6,989	27,111	-173,998	-675,087

6.2 Baseline Non-CO2 Emissions from Forest Fires

Slash and burn is the primary means of clearing land for farms. Slash is often piled before burning to ensure that it all burns, and to increase control over the fire, though in some cases slash is burned where it falls. In general, almost all the above-ground woody biomass is burned before cultivation. Thus, as per the methodology, we calculated baseline non-CO2 emissions from forest fires using VM0015 equations 11-14. $Fburnt_{icl}$ was estimated from the project's disturbance data (Table 24) as being proportionate to the percent of forest disturbances where agriculture was a driver. $Pburnt_{p,icl}$ was conservatively estimated as the difference between starting AGB and uncertainty adjusted long term average post deforestation AGB in each forest class. Parameters are summarized in VM0015 Table 41 and CO_2 equivalents of baseline non-CO2 emissions from the project area are shown VM0015 Table 42.

VM0015 Equation 11

$$EBBtot_{icl,t} = EBBN_2O_{icl,t} + EBBCH_{4icl,t}$$

Where

$EBBtot_{icl,t}$ = Total GHG emissions from biomass burning in forest class *icl* in year *t* (t CO_2e /ha)

$EBBN_2O_{icl,t}$ = N_2O emissions from biomass burning in forest class icl in year *t* (t CO_2e /ha)

$EBBCH_{4icl,t}$ = CH_4 emissions from biomass burning in forest class icl in year *t* (t CO_2e /ha)

VM0015 Equation 12

$$EBBN_2O_{icl,t} = EBBCO_{2icl,t} \times \frac{12}{44} \times NCR \times ER_{N_2O} \times \frac{44}{28} \times GWP_{N_2O}$$

VM0015 Equation 13

$$EBBCH_{4icl,t} = EBBCO_{2icl,t} \times \frac{12}{44} \times ER_{CH_4} \times \frac{16}{12} \times GWP_{CH_4}$$

Where

$EBBCO_{2\ icl,t}$ = Per hectare CO_2 emissions from biomass burning in slash and burn in forest class *icl* in year *t* (t CO_2e /ha)

$EBBN_2O_{icl,t}$ = Per hectare N_2O emissions from biomass burning in slash and burn in forest class *icl* at year *t* (t CO_2e /ha)

$EBBCH_{4\ icl,t}$ = Per hectare CH_4 emissions from biomass burning in slash and burn in forest class *icl* at year *t* (t CO_2e /ha)

NCR = Nitrogen to carbon ratio (IPCC default value = 0.01) (dimensionless)

ER_{N_2O} = Emission ratio for N_2O (IPCC default value = 0.007 from VM0015 v1.2)

ER_{CH_4} = Emission ratio for CH_4 (IPCC default value = 0.012 from VM0015 v1.2)

GWP_{N_2O} = Global Warming Potential for N_2O (IPCC default value = 265 in the 5th assessment report)

GWP_{CH_4} = Global Warming Potential for CH_4 (IPCC default value = 28 in the 5th assessment report)

VM0015 Equation 14

$$EBBCO2_{icl,t} = Fburnt_{icl} \times \sum_{p=1}^{p} \left(C_{p,icl,t} \times Pburnt_{p,icl} \times CE_{p,icl}\right)$$

Where:

$EBBCO2_{icl,t}$ = Per hectare CO2 emissions from biomass burning in forest class *icl* in year *t* (t CO_2e /ha)

$Fburnt_{icl}$ = Proportion of forest area burned during the historical reference period in forest class *icl* (%)

$C_{p,icl,t,}$= Average carbon stock per hectare in carbon pool p burned in forest class *icl* in year *t* (t CO_2e /ha)

$Pburnt_{p,icl}$ = Average proportion of mass burned in carbon pool *p* in forest class *icl* (%)

$CE_{p,icl}$ = Average combustion efficiency of carbon pool *p* in forest class *icl* (dimensionless – used the IPCC default of 50% as per VM0015)

p = Combustible carbon pool (above-ground biomass, dead wood, litter)

icl = 1, 2, 3, …, *Icl* (pre-deforestation) forest classes

t = 1, 2, 3, …, *T*, a year of the proposed project crediting period (dimensionless)

VM0015 Table 41 Parameters Used to Calculate Non-CO_2 Emissions from Forest Fires

Initial Forest Class		Parameters								
		$Fburnt_{icl}$	Cab	$Pburnt_{ab,t}$	$CE_{ab,icl}$	ECO_2-ab	$EBBCO_{2tot}$	$EBBNO_{2icl}$	$EBBCH_{4icl}$	$EBBtot_{icl}$
ID_{cl}	Name	%	t CO_2e/ha	%	%	t CO_2e/ha	t CO_2e/ha	t CO_2e/ha	t CO_2e/ha	t CO_2e/ha
1	HC	95.95%	142.99	90.17%	50%	64.47	61.85	0.49	7.56	8.05

2	LC	95.95%	75.77	81.44%	50%	30.86	29.61	0.43	3.62	4.05

VM0015 Table 42 Baseline Non-CO2 Emissions from Forest Fires in the Project Area

Project year t	Emissions of Non-CO2 Gases from Baseline Forest Fires				Total Baseline Non-CO_2 Emissions from Forest Fires in the Project Area	
	ID_{icl}	= 1	ID_{icl}	= 2		
	$ABSLPA_{icl,t}$	$EBBBSLtot_{icl}$	$ABSLPA_{icl,t}$	$EBBBSLtot_{icl}$	Annual	Cumulative
					$EBBBSLPA_t$	*EBBBSLPA*
	ha	t CO_2e/ha	ha	t CO_2e/ha	t CO_2e	t CO_2e
2,022	544	4,375	185	748	5,123	5,123
2,023	3,854	31,020	930	3,764	34,783	39,906
2,024	4,222	33,981	1,009	4,086	38,067	77,974
2,025	4,222	33,981	1,009	4,086	38,067	116,041
2,026	4,222	33,981	1,009	4,086	38,067	154,108
2,027	4,222	33,981	1,009	4,086	38,067	192,176
2,028	1,280	10,306	306	1,239	11,545	203,721

VM0015 Table 42 Baseline Non-CO2 Emissions from Forest Fires in the Leakage Belt

Project year t	Emissions of Non-CO2 Gases from Baseline Forest Fires				Total Baseline Non-CO_2 Emissions from Forest Fires in the Leakage Belt	
	ID_{icl}	= 1	ID_{icl}	= 2		
	$ABSLLK_{icl,t}$	$EBBBSLtot_{icl}$	$ABSLLK_{icl,t}$	$EBBBSLtot_{icl}$	Annual	Cumulative
					$EBBBSLLK_t$	*EBBBSLLK*
	ha	t CO_2e/ha	ha	t CO_2e/ha	t CO_2e	t CO_2e
2,022	703	5,661	307	1,242	6,903	6,903
2,023	4,333	34,877	2,115	8,563	43,440	50,343
2,024	4,731	38,080	2,315	9,375	47,454	97,797
2,025	4,731	38,080	2,315	9,375	47,454	145,252

2,026	4,731	38,080	2,315	9,375	47,454	192,706
2,027	4,731	38,080	2,315	9,375	47,454	240,160
2,028	1,435	11,549	702	2,843	14,392	254,552

7 PROJECT EMISSIONS

7.1 Ex Ante Estimation of Actual Carbon Stock Changes and Non-CO2 Emissions in the Project Area

The goal of this step is to provide an ex-ante estimate of future carbon stock changes and non-CO2 emissions from forest fires under the project scenario ("actual"). Actual carbon stock changes and GHG emissions are subject to MRV-A, but they are estimated at the beginning of a baseline validity period to assist in guiding optimal implementation of emission reduction measures, and to allow reasonable projections of revenue to be made.

7.1.1 Ex Ante Estimation of Actual Carbon Stock Changes

There are three categories of carbon stock changes that will have some impact on carbon stocks in the project scenario:

1. Planned timber and charcoal harvesting;
2. Planned boundary clearing; and
3. Unplanned deforestation that is unavoidable

Ex Ante Estimation of Actual Carbon Stock Changes due to Planned Activities

Planned harvesting

Project villages have planned harvesting for timber and charcoal during the project. However, these activities predate the project and would have continued in the baseline scenario. They are included in the discussion here to demonstrate that the activities would not significantly impact the project area carbon stocks in either the project or baseline scenarios. Furthermore, while the explanations below show that the baseline level of harvesting would not significantly impact stocks in the baseline scenario, as per the project contracts, the project will help each participating authority adjust their harvesting plans where necessary to ensure that the harvesting does not exceed the mean annual increment for their forests, which will prevent harvesting from unexpectedly increasing to have significant impacts on stocks in the project scenario.

It should also be noted that planned timber harvesting may be introduced to villages forest reserves which VCSL helped establish in Nachingwea, however, the planned harvesting would not exceed baseline harvesting. Any planned harvesting would occur as described below, which includes very conservative assumptions to ensure that harvesting doesn't impact the overall stock of timber trees. However, the even greater constraint on harvesting appears to be cost, as villages almost never manage to harvest and sell their entire quota. This is how timber harvesting is also controlled in the baseline scenario. While village governments are more effective at collecting timber revenue due to their proximity to the forest, the Tanzania Forest Service has road checkpoints all over the country to ensure that royalties are collected on native timber regardless of source. Additionally, transport costs, lack of roads, and the naturally low density of trees suitable for timber harvesting in natural forests limit harvesting. Thus, even in the baseline scenario where there was no village forest reserve or harvesting plans, timber harvesting is limited by costs. The project area disturbance data reported in Table 24 found evidence of timber harvesting in just 0.22% of disturbances by area. The vast majority of cut trees in cut are for farm clearings and in almost all cases, they are simply burned where they fall.

The contracts signed between the project and participating forest owners specify that harvesting should be limited to less than 1% of biomass within the project area forests. To put this in ecological context, the mean annual increment (MAI) of miombo woodlands in Tanzania has been estimated at 1.6 ± 0.2 $m^3\ ha^{-1}\ year^{-1}$ based on NAFORMA national forest inventory data (Manyanda et al., 2020[58]). Converting this to biomass terms using a reasonable mean wood density for Miombo species (0.63 kg/m^3) and a carbon fraction of 0.49 gives an annual increment of approximately 1.8 $tCO_2e\ ha^{-1}\ year^{-1}$ at the central estimate, equivalent to roughly 1.4% of mean standing biomass across the project area. Even at the lower confidence bound of 1.4 $m^3\ ha^{-1}\ year^{-1}$, annual biomass increment equates to approximately 1.2% of standing biomass. However, as explained in more detail below, there is little worry that actual harvesting levels will ever approach even 1%.

Timber

Many of the project villages have timber harvesting plans (quotas) developed using either the Mpingo Conservation and Develop Initiative (MCDI) or MJUMITA's timber harvesting manual, which is based on MCDI's. The MCDI approach to quota setting has been approved by FSC and MCDI has helped 14 villages in Kilwa district obtain FSC certification. The quotas are set every 5 years on a per species basis based on the results of transect data where size class data is gathered for individual species. Then conservative assumptions are applied to estimate a sustainable offtake based not only on the existing stock of harvestable sized trees, but also making sure that there are enough smaller trees that will grow into the harvestable size in the next 5 years. The model assumes a 50-year rotation for the harvestable size class. For instance, if the harvestable size class is 45cm dbh and above, the quota would be set to allow 1/50 of that size class to be harvested if there are sufficient stems in the 22.5 to

[58] Manyanda, B. J., Mugasha, W. A., Nawir, A. A., & Malimbwi, R. E. (2020). Estimates of volume and carbon stock removals in miombo woodlands of mainland Tanzania. International Journal of Forestry Research, 2020, Article 4043965. https://doi.org/10.1155/2020/4043965

45 cm size class to replace the harvestable size class in 50 years accounting for tree mortality in both classes. The model also adjusts for species specific factors like heart rot, which lowers quotas even further. Harvesting is required to be spread out, but this tends to occur even without close supervision because of the low density of species and size classes suitable for timber harvesting in any one area.

To illustrate, the two highest allowable annual cuts reported in the VCSL 2024 CCB survey are from Majonanga village (6,239 m^3) and Nyali village (3,700 m^3). Converting these volumes to equivalent AGB carbon stock using Equation 18, with an assumed average wood density of 0.63 kg/m^3 and a carbon fraction of 0.49, gives annual harvest impacts of 7,164 tCO_2e for Majonanga and 4,188 tCO_2e for Nyali. Dividing these figures by the total AGB of each village's forest reserve — estimated by applying stratum-level AGB values to the areas of high carbon and low carbon forest determined from the stratification map — gives 1,580,682 tCO_2e for Majonanga and 758,276 tCO_2e for Nyali. The allowable annual cuts therefore represent 0.45% and 0.55% of village forest reserve AGB respectively. Nyali has an exceptionally high quota relative to its forest reserve size because its higher-elevation wet Miombo forest supports a disproportionately large number of harvestable-sized trees compared to other villages. Even so, its quota remains well below 1% of standing biomass.

However, in practice, both MCDI villages[59] and MJUMITA villages haven't managed to find enough market to meet their quotas, so actual harvesting is substantially less than what is permitted. MJUMITA data from VCSL project villages in Morogoro from 2020-2022 shows an average annual offtake of 1337 m^3. The offtake is reported in whole tree volumes based on a conversion table that converts from sawn timber to round logs and then a second step where an additional 30% is added to account for the rest of the tree. However, the MJUMITA staff member who collected the data said that Kilosa district often didn't do the second step. Therefore, the total take was recalculated assuming that the data reported for Kilosa only included the first step. The combination of the table conversions and adding 30% is equivalent to a total tree recovery rate of 24% of sawn timber.

In a recent study in Lindi currently in print, researchers found that for 315 Miombo trees harvested for timber, an average of 48.14% was removed as round logs from the forest[60]. Assuming an average recovery from logs to sawn timber of 50% would give a total tree recovery of 24%, matching the current assumptions used by forest authorities.

After recalculating assuming that Kilosa district villages did not add the extra 30% to their whole tree volume estimates, the total average annual harvested tree volume was 1744 m^3. The three most common species targeted in the COFOREST villages, making up more than 90% of the records where the species was reported were Brachystegia bussei, Brachystegia microphylla, and Brachystegia spiciformis. The average density of these three species is 0.63 t/m^3 . Converting from volume to AGB in tCO2e using that density and a carbon fraction of 0.49 gives a total AGB offtake of 1974 t CO_2e.

[59] Frey, Gregory E., Susan Charnley, and Jasper Makala. "Economic viability of community-based forest management for certified timber production in southeastern Tanzania." World Development 144 (2021): 105491.
[60] The average removal figure comes from Dr. Wilson Mugasha who is the second author on the paper.

Equation 18 Conversion of timber volume to equivalent AGB stock consumed

$$eAGB_{tim} = Tim_{m^3} \times wd \times cf \times \frac{44}{12}$$

Where

$eAGB_{tim}$ = equivalent above ground carbon stock required to produce t tons of charcoal (t CO_2e)

Tim_{m^3} = timber volume (m^3)

wd = average timber tree density (kg/m^3)

cf = carbon fraction of biomass (0.49 in this case since all trees harvested are > 10 cm dbh)

The area weighted average AGB in the COFOREST villages forest reserves subjected to this harvesting was 133.9 tCO2e. These village forest reserves covered 108,630 ha. Thus, the AGB total stocks of the reserves is 14,546,494 tCO2e and the harvesting level is equivalent to 0.014% of total stocks per year. Clearly, this level of harvesting, will be more than offset by growth and will not lead to a long-term decrease in stocks.

The same holds true even for a high-volume harvesting village. Mihima village in Lindi reported the highest actual harvested timber volume in the 2024 CCB survey (976 m^3 — more than four times the next highest reported volume and approaching their annual quota of 1,189 m^3). Applying the same conversion methodology described above, this harvesting is equivalent to just 0.11% of the biomass in Mihima's village forest reserve. This confirms that even in the most active harvesting village in the most intensively harvested year on record, impacts on standing biomass remain negligible compared to a MAI of at least 1.2% per year.

The project doesn't not have as detailed of data for the project villages in Lindi region, but each village was asked if they had a harvesting plan and legal harvesting occurring, and what tool was used to establish the quotas. Only 13 of 32 villages reported legal timber harvesting from their VLFR. Nine of the 13 had been supported by MCDI while the other 4 were supported by district forest officers. Assuming[61] that the timber revenue from the previous 3 years from these villages was from species of the same average value as in the COFOREST villages gives an average offtake of 1,657 m^2. Given that a larger percentage of the project forest is in Lindi, this suggests that the timber harvesting rates in Lindi are even lower than in Morogoro, which makes sense given that Lindi is farther from Dar es Salaam, the primary market for native hard woods than Morogoro.

The project will continue to monitor annual timber offtake reports, but there is currently no need to measure the impact of harvesting on carbon stocks and no need to account for emissions because

[61] This is a conservative assumption because Lindi region forests have more high value species like Pterocarpsis and Dalbergia which have royalties 2x of the most harvested species in the COFOREST project.

harvesting in the project scenario will not be greater than the baseline scenario and in both cases, the harvesting will not significantly impact the project area stocks.

Charcoal

Sustainable charcoal production was introduced by the Tanzania Forest Conservation Group and MJUMITA to COFOREST project villages in 2014, with most COFOREST villages in the VCSL project starting production by 2015. The charcoal harvesting is limited to forest management units specified for charcoal harvesting. The original harvesting plan was based on a 24-year rotation. Each harvesting unit was divided into 50x50 meter grids, and the harvesting plan allowed for 1/24th of the squares to be harvested each year.

There are restrictions on what can be harvested in each square. Trees with a dbh of 10cm or less cannot be cut as well as high valuable timber species such as Pterocarpus, Afzelia, and Dalbergia species. Trees along gullies and within 50 meters of a river are also protected from cutting. Additionally, within each grid cell, harvesters must leave at least 3 trees between 10 and 30 cm dbh.

If the villages were harvesting all the squares eligible for harvesting each year, they would degrade carbon stocks within the forest management unit. However, like timber, due to various challenges related to policy and market, the villages have been harvesting far less than their plans would allow. According to the MJUMITA charcoal harvest data, COFOREST project villages in the VCSL project harvested an average of 731 tons of charcoal per year between 2020 and 2022. It should also be noted given that the reported harvesting is well below quota, and village governments can only charge royalties on forest products harvested inside their village forest reserves, there is currently no incentive for them to under report harvesting. In fact, it is believed that some of the charcoal reported by villages as being harvested from the forest management units likely comes from surrounding farmland, which would have been lost anyway during farm clearing rather than their village forest reserve, so the true harvest from within the project area is probably less.

The reported tonnage can be converted back to carbon stocks using the following equation:

Equation 19 Conversion of charcoal to equivalent AGB stock consumed

$$eAGB_{char} = Char_t \times \left(\frac{100}{kef}\right) \times cf \times \frac{44}{12}$$

Where

$eAGB_{char}$ = equivalent above ground carbon stock required to produce t tons of charcoal (t CO_2e)

$Char_t$ = charcoal (tons)

kef = average charcoal kiln efficiency (%)

cf = carbon fraction of biomass (0.49 in this case since all trees harvested are > 10 cm dbh)

The average kiln efficiency is 19.25% +/- 2.3%. This is known because the COFOREST project did a careful study[62] of kiln efficiency in 2015 in COFOREST project villages in Kilosa district.

Applying the equation yields 6821 tCO2e of AGB consumed annually for charcoal production. The forest charcoal forest management units cover 16,485 ha. The area weighted average AGB for the area is 2,178,334 tCO2e. Thus, the current level of harvesting for charcoal is equivalent to 0.31% of stocks annually. This is significantly more proportionately than the intensity of timber harvesting, but still low enough to not cause long term reductions in stocks given the rapid regeneration of charcoal harvesting squares from coppicing and root suckers. The project will continue to monitor charcoal harvesting levels and work with villages to adjust their charcoal harvesting plans to ensure that harvesting levels remain at or below baseline levels.

Planned boundary clearing

The only activity that is strictly a project activity and that could impact carbon stocks is planned boundary clearing. This activity is meant to enhance the protection of the project area by improving the clarity of the project boundaries. The clearing will be repeated as needed to keep a 3-meter-wide cutline along the edges of forest reserves where the edge is not adjacent to another forest reserve or following an existing boundary feature like the forest edge, a road, trail, or river. The cutlines will go around any tree larger than 15cm dbh to limit the impact of the clearing on stocks. This is possible because the gaps between larger trees are generally greater than 3 meters[63].

For ex-ante estimates, experience from the few villages that have started the activity is used. In 2023, 19 villages cleared cutlines equivalent to 233 ha.

The cutlines were overlayed on the 2022 land-cover class map to calculate the proportion of non-forest[64], high carbon forest and low carbon forest intersected by the cutlines. This exaggerates the proportion of cutlines passing through the forests because the lines will pass on the outside of forests when passing along a forest edge, but for the purpose of ex-ante calculations this generates conservative estimates. Note the technically, all non-forest pixels intersected by cutlines are part of the leakage management area but are assessed together with the project area pixels for simplicity.

To estimate the proportions of stocks in each land-cover type affected by cutlines, the VCSL and COFOREST biomass and post-deforestation plots were reanalyzed after filtering out all stems 15 cm and above. For simplicity, it was assumed that all BGB stocks were emitted instantly.

The total forest reserve area demarcated by the 2023 cutlines was 94,161 ha. Thus, the ratio of cutline area to VLFR area in 2023 was 0.0025. It was also assumed that the same ratio will apply to the rest of the project area and that the proportion of land-cover classes intersected by cutlines will also be the same as 2023. The estimated carbon stock decreases are shown in VM0015 Table 43 Ex Ante

[62] https://www.tfcg.org/wp-content/uploads/2018/05/MJUMITA-Charcoal-Kiln-Study-2015-FINAL.pdf
[63] It is often possible to drive through miombo woodland without roads because the spacing between woody stems is so large.
[64] Assumed equal to long term post-deforestation stocks.

Estimated Actual Carbon Stock Decrease Due to Planned Deforestation/Degradation in the Project Area.

VM0015 Table 43 Ex Ante Estimated Actual Carbon Stock Decrease Due to Planned Deforestation/Degradation in the Project Area

Project year t	Areas of Planned Deforestation / Degradation × Carbon Stock Change (Decrease) in the Project Area						Total Carbon Stock Decrease due to Planned Deforestation / Degradation	
	ID_{cl}	1	ID_{cl}	2	ID_{cl}	3	Annual	Cumulative
	$ADPD_{icl,t}$	$Ctot_{icl,t}$	$ADPD_{icl,t}$	$Ctot_{icl,t}$	$ADPD_{fcl,t}$	$Ctot_{fcl,t}$	$\Delta CPDdPA_t$	$\Delta CPDdPA$
	ha	tCO_2e/ha	ha	tCO_2e/ha	ha	tCO_2e/ha	tCO_2e	tCO_2e
2022	0	45.32	0	32.47	0	5.08	0	0
2023	135	45.32	34	32.47	65	5.08	7,544	7,544
2024	195	45.32	48	32.47	93	5.08	10,881	18,425
2025	195	45.32	48	32.47	93	5.08	10,881	29,306
2026	0	45.32	0	32.47	0	5.08	0	29,306
2027	0	45.32	0	32.47	0	5.08	0	29,306
2028	0	45.32	0	32.47	0	5.08	0	29,306

VM0015 Table 46 Total Ex Ante Carbon Stock Decrease Due to Planned Activities in the Project Area

Project year t	Total Carbon Stock Decrease due to Planned Deforestation / Degradation		Total Carbon Stock Decrease due to Planned Logging Activities		Total Carbon Stock Decrease due to Planned Fuel-wood and Charcoal Activities		Total Carbon Stock Decrease due to Planned Activities	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	$\Delta CPDdPA_t$	$\Delta CPDdPA$	$\Delta CPLdPA_t$	$\Delta CPLdPA$	$\Delta CPFdPA_t$	$\Delta CPFdPA$	$\Delta CPAdPA_t$	$\Delta CPAdPA$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022	0	0	0	0	0	0	0	0

2023	-7,544	-7,544	0	0	0	0	-7,544	-7,544
2024	-10,881	-18,425	0	0	0	0	-10,881	-18,425
2025	-10,881	-29,306	0	0	0	0	-10,881	-29,306
2026	0	-29,306	0	0	0	0	0	-29,306
2027	0	-29,306	0	0	0	0	0	-29,306
2028	0	-29,306	0	0	0	0	0	-29,306

Ex Ante Estimation of Carbon Stock Changes due to Unavoidable Unplanned Deforestation Within the Project Area

Despite being in legally protected forest reserves, the threat level to the project forests is very high. Not all the project activities can be implemented at once and the effectiveness of certain activities will improve with time. For instance, the boundary demarcation activity will take a couple of years to complete. Additionally, many people farm in the village forest reserves knowing full well that they are breaking the rules. Enhanced and more regular patrols will eventually convince such people that clearing farms in the village forest reserve is not worth it. Additionally, as community members come to see the real tangible financial and social benefits of protecting the forest, forest protection will become more effective.

The initial effectiveness is based on experience from the first year of the first project instance. Effectiveness is then expected to increase over 3 years to eventually reach 75% once all project activities are being implemented on a regular basis.

Stock changes from unplanned deforestation in the project scenario is calculated with VM0015 Equation 16

VM0015 Equation 16

$$\Delta CUDdPA_t = \Delta CBSL_t \times (1 - EI)$$

Where

Where:

$\Delta CUDdPA_t$	=	Total ex ante actual carbon stock change due to unavoided unplanned deforestation at year t in the project area (t CO2e)
$\Delta CBSL_t$	=	Total baseline carbon stock change at year t in the project area (t CO2e)
EI	=	Ex ante estimated Effectiveness Index (%)
t	=	1, 2, 3, …, *T*, a year of the proposed project crediting period (dimensionless)

VM0015 Table 47: Ex Ante Estimated Net Carbon Stock Change in the Project Area Under the Project Scenario

Project year t	Total Carbon Stock Decrease due to Planned Activities		Total Carbon Stock Decrease due to Unavoided Unplanned Deforestation		Total Carbon Stock Change in the Project Case	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	$\Delta CPAdPA_t$	$\Delta CPAdPA$	$\Delta CUDdPA_t$	$\Delta CUDdPA$	$\Delta CPSPA_t$	$\Delta CPSPA$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022	0	0	-61,118	-61,118	-61,118	-61,118
2023	-7,544	-7,544	-415,736	-476,854	-423,280	-484,398
2024	-10,881	-18,425	-357,761	-834,615	-368,643	-853,040
2025	-10,881	-29,306	-183,202	-1,017,817	-194,083	-1,047,123
2026	0	-29,306	-187,523	-1,205,340	-187,523	-1,234,646
2027	0	-29,306	-191,844	-1,397,184	-191,844	-1,426,490
2028	0	-29,306	-74,689	-1,471,872	-74,689	-1,501,178

7.1.2 Ex Ante Estimation of Actual Non-CO2 Emissions from Forest Fires

Ex ante emissions from biomass burning are also calculated using the effectiveness index as per VM0015 Equation 17.

VM0015 Equation 17

$$EBBPSPA_t = EBBBSPA_t \times (1 - EI)$$

Where

$EBBPSPA_t$	=	Total ex ante actual non-CO2 emissions from forest fires due to unavoided unplanned deforestation at year t in the project area (t CO2e)
$EBBBSPA_t$	=	Total non-CO2 emissions from forest fires at year t in the project area (t CO2e)
EI	=	Ex ante estimated Effectiveness Index (%)

t = 1, 2, 3, …, *T*, a year of the proposed project crediting period (dimensionless)

VM0015 Table 48 Total Ex Ante Estimated Actual Emissions of Non-CO2 Gases Due to Forest Fires in the Project Area

Project year t	Total Ex Ante Estimated Actual Non-CO_2 emissions from forest fires in the project area	
	EBBPSPA	*EBBPSPA*
	Annual	Cumulative
	tCO_2e	tCO_2e
2,022	3,330	3,330
2,023	22,609	25,939
2,024	19,034	44,973
2,025	9,517	54,490
2,026	9,517	64,006
2,027	9,517	73,523
2,028	2,886	76,410

7.1.3 Total Ex Ante Estimation for the Project Area

VM0015 Table 49 Total Ex Ante Estimated Actual Net Carbon Stock Changes and Emissions of Non-CO2 Gases in the Project Area

Project year t	Total Ex Ante Carbon Stock Decrease due to Planned Activities		Total Ex Ante Carbon Stock Decrease due to Unavoided Unplanned Deforestation		Total Ex Ante Net Carbon Stock Change		Total Ex Ante Estimated Actual Non-CO_2 Emissions from Forest Fires in the Project Area	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	$\Delta CPAdPA_t$	$\Delta CPAdPA$	$\Delta CUDdPA_t$	$\Delta CUDdPA$	$\Delta CPSPA_t$	$\Delta CPSPA$	$EBBPSPA_t$	$EBBPSPA_t$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2,022	0	0	-61,118	-61,118	-61,118	-61,118	3,330	3,330

2,023	-7,544	-7,544	-415,736	-476,854	-423,280	-484,398	22,609	25,939
2,024	-10,881	-18,425	-357,761	-834,615	-368,643	-853,040	19,034	44,973
2,025	-10,881	-29,306	-183,202	-1,017,817	-194,083	-1,047,123	9,517	54,490
2,026	0	-29,306	-187,523	-1,205,340	-187,523	-1,234,646	9,517	64,006
2,027	0	-29,306	-191,844	-1,397,184	-191,844	-1,426,490	9,517	73,523
2,028	0	-29,306	-74,689	-1,471,872	-74,689	-1,501,178	2,886	76,410

7.2 Ex Post Monitoring of Carbon Stock Changes and GHG Emissions Within the Project Area

7.2.1 Monitoring Project Implementation

Monitoring of unavoided unplanned deforestation will follow VMD0055 in anticipation of transition to VM0048. The method is summarized here. For a full description, see VMD0055. Monitoring period activity data is measured within sample plots distributed in a representative manner across the project area and leakage belt. Sample plot interpretation will be based on planet.com basemaps, Sentinel-2, higher resolution imagery in Google Earth when available. Sample plot interpretation will follow the same procedures as in 3.5.

The project sampling frame encompasses both the project area and leakage belt, minus any areas mapped as identified exclusions in the most recent jurisdictional map of identified exclusions. The stratification of the monitoring plots will consider three factors:

1. Forest class (High carbon or low carbon forest)
2. Accounting area (project or leakage belt)
3. Likelihood of observing deforestation

Following VMD0055 requirements, a minimum of 3 strata with different likelihoods of deforestation will be defined. For this project, this will be defined based on the densities from the deforestation risk map and the number of sampling points in each density class will be proportionate to the expected amount of deforestation. The uncertainty of the deforestation estimate will be calculated in the same manner as the uncertainty of the historical deforestation estimate described in section 3.6. Following VM0015 requirements, the number of sample points used will be sufficient such that the half-width of the 90 percent confidence interval does not exceed 20%. As per VCS rules, if the uncertainty exceeds 10%, then an inflation factor will be calculated using Equation 20 and applied to increase the estimate using

Equation 20 Calculation of inflation factor

$$IF_{UDef} = \frac{U\%(A_{UDef})}{100 \times t_{aplha=10\%}} \times t_{alpha=66.67\%}$$

Where

IF_{UDef}	=	Inflation factor for area of unplanned deforestation (%)
$U\%(A_{UDef})$	=	Percentage uncertainty of the estimated area of unplanned deforestation within the project sampling frame over the monitoring period (%)
$t_{alpha=10\%}$	=	Value of the t distribution for a two-sided 90 percent confidence interval (a value of 1.6449 may be used for AD analyses)
$t_{alpha=66.67\%}$	=	Value of the t distribution for a one-sided 66.67% confidence interval (a value of 0.4307 may be used for AD analyses)

Then the estimates of deforestation in the project area and leakage belt are each inflated by multiplying by (1+IF_{UDEF}). The uncertainty adjusted estimates will then be used to construct ex post tables of activity data per stratum in the project area and leakage belt (VM0015 Table 10, VM0015 Table 11); per initial forest class (VM0015 Table 14, VM0015 Table 15) and, per post-deforestation zone z (VM0015 Table 18, VM0015 Table 19). Not that this is a deviation from VM0015 which appears to expect monitoring of the entire reference region. However, since the activity data from the reference region is not used for any purpose in VM0015 and limiting the monitoring sample plots within the leakage belt and project area will increase the accuracy of the estimated change from these areas, this is a justifiable deviation.

7.2.2 Monitoring of Carbon Stock Changes

Given that the average carbon stocks per LU/LC class are not expected to change significantly during the baseline validity period, the project does not anticipate monitoring carbon stocks during this baseline validity period. Emissions from unavoided unplanned deforestation will be calculated using the same emissions factors and the same equations used to calculate baseline emissions and presented in an ex-post version of VM0015 Table 36.

In the unlikely event of forest fires in the portions of the project area which are not fire adapted and where significant carbon stock decreases may have resulted, the project will install new biomass sampling plots to estimate the decrease. The affected areas will be demarcated with hand drawn polygons covering affected areas visible in planet.com basemaps. Then the changes and affected areas will be reported in VM0015 Table 51. The same approach will be used to assess damage from catastrophic events and reported in VM0015 Table 52. Then they are combined in VM0015 Table 53. And then that is combined with the ex-post version of VM0015 Table 46 in VM0015 Table 54.

VM0015 Table 51 Ex Post Actual Carbon Stock Decrease Due to Forest Fires in the Project Area

Project year *t*	Areas Affected by Forest Fires × Carbon Stock Change (Decrease)				Total Carbon Stock Decrease due to Forest Fires	
	ID_{cl}	1	ID_{cl}	2	Annual	Cumulative
	$AUFP_{icl,t}$	$\Delta Ctot_{icl,t}$	$AUFP_{icl,t}$	$\Delta Ctot_{icl,t}$	$\Delta CUFdPA_t$	$\Delta CUFdPA$
	ha	tCO_2e/ha	ha	tCO_2e/ha	tCO_2e	tCO_2e
2022						
....						
T						

VM0015 Table 52 Ex Post Carbon Stock Decrease Due to Catastrophic Events in the Project Area

Project year *t*	Areas Affected by Catastrophic Events × Carbon Stock Change (Decrease)				Total Carbon Stock Decrease due to Catastrophic Events	
	ID_{cl}	1	ID_{cl}	2	Annual	Cumulative
	$ACPA_{icl,t}$	$\Delta Ctot_{icl,t}$	$ACPA_{icl,t}$	$\Delta Ctot_{icl,t}$	$\Delta CUCdPA_t$	$\Delta CUCdPA$
	ha	tCO_2e/ha	ha	tCO_2e/ha	tCO_2e	tCO_2e
2022						
....						
T						

VM0015 Table 53 Total Ex Post Carbon Stock Decrease Due to Forest Fires and Catastrophic Events

Project year *t*	Total Carbon Stock Decrease due to Forest Fires		Total Carbon Stock Decrease due to Catastrophic Events		Total Carbon Stock Decrease due to Forest Fires and Catastrophic Events	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	$\Delta CUFdPA_t$	$\Delta CUFdPA$	$\Delta CUCdPA_t$	$\Delta CUCdPA$	$\Delta CFCdPA_t$	$\Delta CFCdPA$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e

2022						
…						
T						

VM0015 Table 54 Ex Post Estimated Net Carbon Stock Change in the Project Area

Project year *t*	Total Carbon Stock Decrease due to Planned Activities		Total Carbon Stock Decrease due to Fires and Catastrophic Events		Total Ex Post Carbon Stock Change in the Project Case	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	$\Delta CPadPA_t$	$\Delta CPAdPA$	$\Delta CFCdPA_t$	$\Delta CFCdPA$	$\Delta CPSPA_t$	$\Delta CPSPA$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022						
…						
T						

7.2.3 Monitoring Non-CO2 Emissions from Forest Fires

Non-CO2 emissions from forest fires will be calculated for unavoided unplanned deforestation and in the unlikely event of a significant forest fire. This will be reported using VM0015 Table 41 to estimate an ex-post version of VM0015 Table 42.

7.2.4 Total Ex Post Estimated Actual Net Carbon Stock Changes and GHG Emissions in the Project Area

All sources of stock changes and emissions for the project area will be summarized in an ex-post version of VM0015 Table 49.

8 LEAKAGE EMISSIONS

8.1 Ex Ante Estimation of Leakage (Step 8)

Two sources of leakage are considered under VM0015:

1. Decrease in carbon stocks and increase in GHG emissions associated with leakage prevention measures; and

2. Decrease in carbon stocks and increase in GHG emissions associated with activity displacement leakage.

8.1.1 Ex Ante Estimation of Decrease in Carbon Stocks and Increase in GHG Emissions Due to Leakage Prevention Measures

Carbon Stock Changes due to Activities Implemented in Leakage Management Zones

Project activities are listed in the project description. The only project activity which will technically impact the leakage management areas is the planned forest reserve boundary clearing where the boundaries pass through already deforested areas in the leakage management areas. However, this impact was already assessed under planned deforestation in the project area and shown to be insignificant ex-ante. The primary leakage prevention activity includes promoting labor intensive conservation agriculture techniques to improve agricultural productivity and sustainability. These techniques include soil conservation measures and promoting alternatives to the use of burning to clear land. The techniques promoted by the project will slow the loss of carbon stocks in leakage management areas compared to the baseline scenario. The other major leakage prevention activity includes promoting alternative livelihoods through saving and credits schemes, REDD revenue sharing and improving access to secondary school. These activities are not expected to affect carbon stocks in leakage management areas. Thus, in summary, leakage prevention activities have no negative effect on carbon stocks in the leakage management areas.

Ex Ante Estimation of CH4 and N2O Emissions from Grazing Animals

There are no plans to promote grazing animals as part of project interventions. No significant increase in grazing animals is expected under the project scenario.

Total ex ante estimated carbon stock changes and increases in GHG emissions due to leakage prevention measures

The results of section 8.1.2 and 8.1.3 show that there are no anticipated GHG emission increases associated with leakage prevention.

8.1.2 Ex Ante Estimation of Decreases in Carbon Stocks and Increases in GHG emissions due to Activity Displacement Leakage

Ex ante, activity displacement leakage is approximated based on the anticipated combined effectiveness of the proposed leakage prevention measures and project activities.

This is done by multiplying the estimated baseline carbon stock changes for the project area less planned and unavoided unplanned project stock changes by a Displacement Leakage Factor (DLF) representing the percentage of deforestation expected to be displaced outside the project boundary.

Where deforestation agents do not participate in leakage prevention activities and project activities, the DLF is 100 percent. Where leakage prevention activities are implemented, the factor is equal to the proportion of baseline agents estimated to be given the opportunity to participate in leakage prevention activities and project activities. The project expects to give nearly 100% of deforestation agents the opportunity to participate in leakage prevention activities. The benefit sharing system provides benefits to all community members. Furthermore, part of the forest patrol teams work is to inform deforestation agents about and connect them to agricultural extension services. This is initially focused on deforestation agents found deforesting inside the project area, but as deforestation the project area comes under control, the deforestation patrol teams will work to connect deforestation agents in the leakage belts to agricultural extension services. Of the thousands of deforestation agent records in the forest patrol database, so far only one deforestation agent said they were not interested in extension services. Most agents provided their phone numbers to the forest patrol teams so they may be contacted for extension training. Another way the project reduced potential leakage is that the patrols in 2023 focused on educating deforestation agents in the project area rather than evicting them. They were warned that they were in a village forest reserve and that they would be fined for any further clearance and could be evicted after repeated offences. Otherwise, they were allowed to continue to farm any farm they had established in the village forest reserve prior to the first forest patrol to contact them. They were also educated about REDD and the benefits it would bring to the village. Therefore, DLF is conservatively estimated at 15%.

The ex-ante emissions from forest fires (biomass burning) due to activity displacement leakage are calculated by multiplying baseline forest fire emissions in the project area after subtracting emissions from unavoided unplanned deforestation in the PA by the same DLF used to estimate the decrease in carbon stocks.

These sources of stock reduction and emissions are presented in VM0015 Table 61.

VM0015 Table 61 Ex Ante Estimated Leakage due to Activity Displacement

Project year t	Total Ex Ante Estimated Decrease in Carbon Stocks due to Displaced Deforestation		Total Ex Ante Estimated Increase in GHG Emissions due to Displaced Forest Fires	
	Annual	Cumulative	Annual	Cumulative
	$\Delta CADLK_t$	$\Delta CADLK$	$\Delta EADLK_t$	$\Delta EADLK$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022	-4,936	-4,936	269	269
2023	-32,447	-37,384	1,826	2,095

2024	-52,032	-89,416	2,855	4,950
2025	-80,809	-170,224	4,283	9,233
2026	-84,385	-254,609	4,283	13,515
2027	-86,330	-340,939	4,283	17,798
2028	-33,610	-374,549	1,299	19,097

8.1.3 Ex Ante Estimation of Total Leakage

The ex-ante results of all sources of leakage are summarized in Table 62.

VM0015 Table 62 Ex Ante Estimated Total Leakage

Project year *t*	Total Ex Ante GHG Emissions from Increased Grazing Activities		Total Ex Ante Increase in GHG Emissions due to Displaced Forest Fires		Total Ex Ante Decrease in Carbon Stocks due to Displaced Deforestation		Carbon Stock Decrease due to Leakage Prevention Measures		Total Net Carbon Stock Change due to Leakage		Total Net Increase in Emissions due to Leakage	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	$\Delta EgLK_t$	$\Delta EgLK$	$\Delta EADLK_t$	$\Delta EADLK$	$\Delta CADLK_t$	$\Delta CADLK$	$\Delta CLPMLK_t$	$\Delta CLPMLK$	ΔCLK_t	ΔCLK	ΔELK_t	ΔELK
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022	0	0	269	269	-4,936	-4,936	0	0	-4,936	-4,936	5,205	5,205
2023	0	0	1,826	2,095	-32,447	-37,384	0	0	-32,447	-37,384	34,273	39,479
2024	0	0	2,855	4,950	-52,032	-89,416	0	0	-52,032	-89,416	54,887	94,366
2025	0	0	4,283	9,233	-80,809	-170,224	0	0	-80,809	-170,224	85,091	179,457
2026	0	0	4,283	13,515	-84,385	-254,609	0	0	-84,385	-254,609	88,668	268,125
2027	0	0	4,283	17,798	-86,330	-340,939	0	0	-86,330	-340,939	90,612	358,737
2028	0	0	1,299	19,097	-33,610	-374,549	0	0	-33,610	-374,549	34,909	393,646

8.2 Monitoring Leakage

The same two potential sources of leakage considered ex-ante must be monitored ex-post.

8.2.1 Monitoring of Carbon Stock Changes and GHG Emissions Associated With Leakage Prevention Activities

As described in the corresponding ex-ante section, the project leakage prevention activities will increase rather than reduce carbon stocks in leakage management areas and will not create emissions from grazing animals.

8.2.2 Monitoring of Carbon Stock Decreases and Increases in GHG Emissions due to Activity Displacement Leakage

Monitoring of Carbon Stock Changes

Deforestation above the baseline in the leakage belt area is considered activity displacement leakage. The ex-post activity data for the leakage is collected with activity data for the project area as described in section 7.2.1.

This activity data is then used in combination with the emissions factors calculated for the baseline to generate an ex-post version of VM0015 Table 37. The ex-post and baseline stock changes are then compared in VM0015 Table 63 to calculate if any leakage has occurred.

As per VM0015, if strong evidence is collected that deforestation in the leakage belt is attributable to deforestation agents that are not linked to the project areas, the detected deforestation may not be attributed to the project activity nor considered leakage.

VM0015 Table 63 Total Net Baseline Carbon Stock Change in the Leakage Belt (Method 1)

Project year t	Total Ex Ante Net Baseline Carbon Stock Change		Total Ex Post Net Actual Carbon Stock Change		Total Ex Post Leakage	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	$\Delta CBSLLK_t$	$\Delta CBSLLK_t$	$\Delta CBSLLK_t$	$\Delta CBSLLK_t$	$\Delta CBSLLK_t$	$\Delta CBSLLK$
	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-127,779	-127,779				
2023	-808,770	-936,549				
2024	-908,157	-1,844,706				

2025	-935,454	-2,780,161				
2026	-962,752	-3,742,912				
2027	-990,049	-4,732,961				
2028	-404,784	-5,137,745				

Monitoring Increases in GHG Emissions

In the event of any stock changes in excess of baseline, the same parameters used in VM0015 Table 41 will be used to calculate an ex-post version of VM0015 Table 42 for leakage emissions from biomass burning. Leakage emissions from biomass burning is then calculated by comparing the baseline to actual emissions for each year t. When cumulative emissions from biomass burning exceed baseline in year *t*, leakage has occurred.

8.2.3 Total Ex Post Estimated Leakage

The results of all ex-post estimations of leakage will be summarized using an ex-post version of VM0015 Table 62.

9 ESTIMATED GHG EMISSIONS REDUCTIONS

9.1 Ex Ante Total Net GHG Emission Reductions (Step 9)

9.1.1 Significance Assessment

The significance of emissions from the project area and leakage management activities over the entire baseline validity period was assessed ex-ante as per Appendix 2 of VM0015 and is shown in Table 40. Significance is determined by dividing each source by the net GHG ERRs for the baseline validity period from VM0015 Table 64 before deducting leakage emissions.

The results show that the exaggeration of benefits from excluding the deadwood pool and stock changes from project boundary clearing are likely insignificant. This will be confirmed ex-post at the conclusion of each monitoring period. Emissions from biomass burning are also insignificant but must be included because they are included in the baseline.

Table 40 Testing significance of GHG emissions sources

Emissions source in project area or leakage management activity	Emissions or Exaggeration of benefits	Relative contribution per source	Rank	Significance
Unavoided stock changes in AGB and BGB from deforestation in the project area	1,471,872	0.90	1	0.56
Unavoided GHG emissions from biomass burning in the project area	76,410	0.05	2	0.03
Exaggerated benefits from excluding standing deadwood pool	58,076	0.04	3	0.02
Long term stock changes from AGB and BGB due to boundary clearing	29,306	0.02	4	0.01
Total	1,635,664			

9.1.2 Calculation of Ex Ante Total Net GHG Emissions Reductions

The net anthropogenic GHG emission reduction of the proposed AUD project activity is calculated as follows:

VM0015 Equation 19

$$\Delta REDDt = (\Delta CBSLPA_t + EBBBSLPA_t) - (\Delta CPSPA_t + EBBPSPA_t) - (\Delta CLK_t + ELK_t)$$

Where

$\Delta REDDt$ = Ex ante estimated net anthropogenic GHG emission reduction attributable to the AUD project activity at year *t* (t CO_2e)

$\Delta CBSLPA_t$ = Sum of baseline carbon stock changes in the project area at year t (t CO_2e)

Note – the absolute values of $\Delta CBSLPA_t$ must be used in Eq. (19).

$EBBBSLPA_t$ = Sum of baseline emissions from biomass burning in the project area at year *t* (t CO_2e)

$\Delta CPSPA_t$ = Sum of ex ante estimated actual carbon stock changes in the project area at year *t* (t CO_2e)

Note – where $\Delta CPSPA_t$ represents a net increase in carbon stocks, a negative sign before the absolute value of $\Delta CPSPA_t$must be used. Where $\Delta CPSPA_t$represents a net decrease, a positive sign must be used.

$EBBPSPA_t$ = Sum of (ex-ante estimated) actual emissions from biomass burning in the project area at year *t* (t CO_2e)

ΔCLK_t = Sum of ex ante estimated leakage net carbon stock changes at year *t* (t CO_2e)

Note – where the cumulative sum of ΔCLK_t within a baseline validity period is greater than zero, ΔCLK_t must be set to zero.

ELK_t = Sum of ex ante estimated leakage emissions at year t (t CO_2e)

t = 1, 2, 3, …, *T*, a year of the proposed project crediting period (dimensionless)

9.1.3 Calculation of Ex-Ante Verified Carbon Units (VCUs)

The potential number of Verified Carbon Units (VCUs) at year *t* is estimated as follows:

VM0015 Equation 20

$$VCUt = \Delta REDD_t - VBC_t$$

VM0015 Equation 21

$$VBC_t = (\Delta CBSLPA_t - \Delta CPSPA_t) \times RF_t$$

Where

$VCUt$ = Number of potential Verified Carbon Units at year t (t CO_2e)

Note – where VCUt is less than zero, no VCUs will be granted to the proponents of the AUD project activity. VCUs are only granted where the following condition is met:

VM0015 Equation 22

$$\sum_{t=0}^{t} \Delta REDD_t > 0$$

$\Delta REDD_t$ = Ex ante estimated net anthropogenic GHG emission reductions attributable to the AUD project activity at year *t* (t CO_2e)

VBC_t = Number of buffer credits deposited in the VCS AFOLU non-permanence buffer at year *t* (t CO_2e)

$\Delta CBSLPA_t$ = Sum of baseline carbon stock changes in the project area at year *t* (t CO2e)

$\Delta CPSPA_t$ = Sum of ex ante estimated actual carbon stock changes in the project area at year *t* (t CO2e)

RF_t = Risk factor used to calculate buffer credits (%)

Note – RF_t is a risk factor to be determined using the latest version of the VCS AFOLU Non- Permanence Risk Tool.

t = 1, 2, 3, …, *T,* a year of the proposed project crediting period (dimensionless)

Ex-ante results are presented in VM0015 Table 64.

9.2 Ex Post Net GHG Emission Reductions

The calculation of ex post net GHG emission reductions will be like the ex-ante calculation with the only difference that ex post estimated carbon stock changes and GHG emissions must be used in the case of the project scenario and leakage. The ex post estimated net anthropogenic GHG emissions and calculation of Verified Carbon Units (VCUt, and VBCt) will be reported using an ex-post version of VM0015 Table 64.

VM0015 Table 64 Ex Ante Estimated Net GHG Emission Reductions: (ΔREDDt) and Verified Carbon Units (VCUt)

Project year *t*	Baseline Carbon Stock Changes		Baseline GHG Emissions		Ex Ante Project Carbon Stock Changes		Ex Ante Project GHG Emissions		Ex Ante Leakage Carbon Stock Changes		Ex Ante Leakage GHG Emissions		Ex Ante Net Anthropogenic GHG Emission Reductions		Ex Ante VCUs Tradable		Ex Ante Buffer Credits	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	$\Delta CBSLPA_t$	$\Delta CBSLPA$	$EBBBSLPA_t$	$EBBBSLPA$	$\Delta CPSPA_t$	$\Delta CPSPA$	$EBBPSPA_t$	$EBBPSPA$	ΔCLK_t	ΔCLK	ELK_t	ELK	$\Delta REDD_t$	$\Delta REDD$	VCU_t	VCU	VBC_t	VBC
	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e	t CO_2e
2022	-94,028	-94,028	5,123	5,123	-61,118	-61,118	3,330	3,330	-4,936	-4,936	269	269	29,497	29,497	23,753	23,753	5,744	5,744
2023	-639,594	-733,621	34,783	39,906	-423,280	-484,398	22,609	25,939	-32,447	-37,384	1,826	2,095	194,215	223,712	156,457	180,210	37,758	43,503
2024	-715,523	-1,449,144	38,067	77,974	-368,643	-853,040	19,034	44,973	-52,032	-89,416	2,855	4,950	311,027	534,739	250,478	430,688	60,549	104,052
2025	-732,807	-2,181,951	38,067	116,041	-194,083	-1,047,123	9,517	54,490	-80,809	-170,224	4,283	9,233	482,183	1,016,922	388,148	818,835	94,036	198,087
2026	-750,091	-2,932,042	38,067	154,108	-187,523	-1,234,646	9,517	64,006	-84,385	-254,609	4,283	13,515	502,451	1,519,373	404,253	1,223,088	98,198	296,285
2027	-767,375	-3,699,417	38,067	192,176	-191,844	-1,426,490	9,517	73,523	-86,330	-340,939	4,283	17,798	513,469	2,032,843	413,009	1,636,097	100,461	396,746
2028	-298,755	-3,998,172	11,545	203,721	-74,689	-1,501,178	2,886	76,410	-33,610	-374,549	1,299	19,097	197,816	2,230,659	158,705	1,794,802	39,111	435,857