Ntakata Mountains REDD Project

Project Title	Ntakata Mountains REDD Project
Version	3.0
Date of Issue	5th June 2020
Project Location	United Republic of Tanzania, Tanganyika District
Project Proponent(s)	Carbon Tanzania (CT, Ltd.) Marc Baker, Director of Operations Email: marc@carbontanzania.com Tel: +255 (0) 784 448 761
Prepared By	TerraCarbon, LLC. David Shoch, Amanda Bradley, Rebecca Dickson and Ben Rifkin Email: davidshoch@terracarbon.com Tel: +1 434 326 1144
Validation Body	VVB ID: 048 Contact: Mr. Venkat info@epicsustainability.com epicsustainability@gmail.com vishnu@epicsustainability.com Location: No. 41, Anugraha 1st Cross Road, Sundarnagar, Near BEL Circle, Bangalore – 560054, India Website: www.epicsustainability.com
Project Lifetime	19 May 2017 – 19 May 2047; 30 year lifetime
GHG Accounting Period	19 May 2017 – 19 May 2037; 20 years
History of CCB Status	Not applicable

Gold Level Criteria	GL1 – Climate Change Adaptation Benefits All relevant GL1 requirements are completed in Section 3.4 by addressing aspects of positive climate change adaptation benefits that are attributable to the project activities. GL2 – Exceptional Community Benefits All relevant GL2 requirements are completed in Section 4.4 by addressing aspects of positive community benefits that are attributable to the project activities. GL3 – Exceptional Biodiversity Benefits All relevant GL3 requirements are completed in Section 5.4 by addressing aspects of positive biodiversity benefits that are attributable to the project activities.
Expected Verification Schedule	Once every 5 years or less, starting in 2019

Table of Contents

1 Summary of Project Benefits 4
1.1 Unique Project Benefits 4
1.2 Standardized Benefit Metrics 4
2 General 7
2.1 Project Goals, Design and Long-Term Viability 7
2.3 Stakeholder Engagement 20
2.4 Management Capacity 24
2.5 Legal Status and Property Rights 26
3 Climate 30
3.1 Application of Methodology 30
3.2 Quantification of GHG Emission Reductions and Removals 39
3.3 Monitoring 83
3.4 Optional Criterion: Climate Change Adaptation Benefits 115
4 Community 117
4.1 Without-Project Community Scenario 117
4.2 Net Positive Community Impacts 120
4.3 Other Stakeholder Impacts 122
4.4 Community Impact Monitoring 123
4.5 Optional Criterion: Exceptional Community Benefits 123
5 Biodiversity 128
5.1 Without-Project Biodiversity Scenario 128
5.2 Net Positive Biodiversity Impacts 130
5.3 Offsite Biodiversity Impacts 137
5.4 Biodiversity Impact Monitoring 138
5.5 Optional Criterion: Exceptional Biodiversity Benefits 138
Appendices 141
Appendix 1: Stakeholder Identification Table 141
Appendix 2: Project Risks Table 145
Appendix 3: Approved Village Land Use Plans 147

1 SUMMARY OF PROJECT BENEFITS

1.1 Unique Project Benefits

Outcome or Impact Estimated by the End of Project Lifetime	Section Reference
1) Village Land Use Plans (VLUPs) developed	2.1.1
2) Protection of habitat suitable for Chimpanzees	5.2.1

1.2 Standardized Benefit Metrics

Category	Metric	Estimated by the End of Project Lifetime	Section Reference
GHG emission reductions or removals	Net estimated emission removals in the project area, measured against the without-project scenario[1]	5,727,542 tCO^2-e	3.2
	Net estimated emission reductions in the project area, measured against the without-project scenario	5,727,542 tCO^2-e	3.2
Forest[2] cover	For REDD[3] projects: Estimated number of hectares of reduced forest loss in the project area measured against the without-project scenario	66,325 ha over first 10 years (assuming 80% effectiveness of the project in stopping deforestation)	3.2
	For ARR[4] projects: Estimated number of hectares of forest cover increased in the project area measured against the without-project scenario	N/A	-
Improved land mana	Number of hectares of existing production forest land in which IFM[5] practices are expected to occur as a	N/A	-

[1] Measured at end of 10-year crediting period.
[2] 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*)
[3] 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*)
[4] 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*)
[5] 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*)

Category	Metric	Estimated by the End of Project Lifetime	Section Reference
	result of project activities, measured against the without-project scenario		
	Number of hectares of non-forest land in which improved land management practices are expected to occur as a result of project activities, measured against the without-project scenario	19,324	3.2
Training	Total number of community members who are expected to have improved skills and/or knowledge resulting from training provided as part of project activities	15,000	4.2.1
	Number of female community members who are expected to have improved skills and/or knowledge resulting from training as part of project activities	7,500	4.2.1
Employment	Total number of people expected to be employed in project activities,[6] expressed as number of full-time employees[7]	200	4.2.1
	Number of women expected to be employed as a result of project activities, expressed as number of full-time employees	50	4.2.1
Livelihoods	Total number of people expected to have improved livelihoods[8] or income generated as a result of project activities	20,000	4.2.1
	Number of women expected to have improved livelihoods or income generated as a result of project activities	10,000	4.2.1
Health	Total number of people for whom health services are expected to improve as a result of project activities, measured against the without-project scenario	40,000	4.2.1

[6] 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.
[7] 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 the UN System of National Accounts (1993) paragraphs 17.14[15.102];[17.28])
[8] 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.

Category	Metric	Estimated by the End of Project Lifetime	Section Reference
	Number of women for whom health services are expected to improve as a result of project activities, measured against the without-project scenario	20,000	4.2.1
Education	Total number of people for whom access to, or quality of, education is expected to improve as result of project activities, measured against the without-project scenario	10,000	4.2.1
	Number of women and girls for whom access to, or quality of, education is expected to improve as result of project activities, measured against the without-project scenario	5,000	4.2.1
Water	Total number of people who are expected to experience increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	0	-
	Number of women who are expected to experience increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	0	-
Well-being	Total number of community members whose well-being[9] is expected to improve as a result of project activities	40,000	4.2.1
	Number of women whose well-being is expected to improve as a result of project activities	20,000	4.2.1
Biodiversity conservation	Expected change in the number of hectares managed significantly better by the project for biodiversity conservation,[10] measured against the without-project scenario	204,807 ha	5.2.1
	Expected number of globally Critically Endangered or Endangered species[11] benefiting from reduced	15	5.1.2

[9] 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, Livelihoods, Health, Education and Water), and may also include other benefits such as strengthened legal rights to resources, increased food security, conservation of access to areas of cultural significance, etc.
[10] Managed for 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, e.g. enhancing the status of endangered species
[11] Per IUCN's Red List of Threatened Species

Category	Metric	Estimated by the End of Project Lifetime	Section Reference
	threats as a result of project activities,[12] measured against the without-project scenario		

2 GENERAL

2.1 Project Goals, Design and Long-Term Viability

2.1.1 Summary Description of the Project (G1.2)

The Ntakata REDD project was initiated in May 2017 by Carbon Tanzania, a registered Tanzanian company headquartered in Arusha. The overall aim of the project is to engage and support local communities in the protection of their village forest reserves in order to contribute to the conservation of important wildlife habitat and to mitigate climate change. The project is located in Tanganyika District, in Western Tanzania, an area experiencing dramatic landscape changes over the past decade, with detrimental effects on forests and critically important species such as chimpanzee. Chimpanzees rely on large expanses of forest to maintain their 'fusion fission' social patterns whereby troops split up and form new groups on a regular basis. Sufficient forest habitat and corridors to facilitate movement throughout the landscape are vital. Threats to these forest habitats include slash and burn agriculture undertaken by a steady influx of migrants from all parts of Tanzania as well as from across the country's Western border. In addition, grazing by pastoralists, mining, and the development of new infrastructure (e.g. roads) negatively impact the forest, with consequences for water resources and livelihoods as well as for wildlife conservation.

Carbon Tanzania, in partnership with the District Government, has identified 8 villages to collaborate with, and the Village Land Use Plans (VLUPs) of these villages form the basis for identifying the forest landscapes to be protected under the project. These VLUPs have been prepared through a participatory process and are legally binding documents forming a key input for village development planning. However, the implementation of these plans is substantially under-resourced; this is where the Ntakata REDD project plays an important role in channelling carbon finance to support patrolling by Village Game Scouts (VGS) and other activities to enhance sustainability of the resources.

An equally important goal is to work in partnership with local communities in order to have positive impacts on their livelihoods. Carbon Tanzania works with the Village Governments as the primary interface, thus utilizing existing governance structures. Carbon Tanzania (CT) will train and provide compensation to Village Game Scouts (VGS) to conduct regular patrols of the forest. Additionally, overall governance in the landscape is improved through support to the Village Government in the form of training and contributions to the village development budget. Other livelihood-related interventions include training and demonstration of climate smart agriculture techniques and reproductive health services, among others.

As a result of the implementation of a range of project activities, the Ntakata REDD project is estimated to generate approximately 572,754 tCO2e (average per year over the 10-year crediting period, see section 2.1.17.) in GHG emissions reductions on an average annual basis.

[12] In the absence of direct population or occupancy measures, measurement of reduced threats may be used as evidence of benefit

2.1.2 Project Scale

The project is expected to generate more than 300,000 t CO2e emissions reductions per year on average and is thereby defined as a large project.

Project Scale	
Project	
Large project	X

2.1.3 Project Proponent (G1.1)

Organization name	Carbon Tanzania (CT, Ltd.)
Contact person	Marc Baker
Title	Director of Operations
Address	PO Box 425 Arusha, Tanzania
Telephone	+255 (0) 784 448 761
Email	marc@carbontanzania.com

2.1.4 Other Entities Involved in the Project

Organization name	TerraCarbon LLC
Contact person	David Shoch
Title	Director, Forestry and Technical Services
Address	5901 N. Sheridan Road Peoria, Illinois 61614
Telephone	+1 (309) 693 9303
Email	david.shoch@terracarbon.com

Organization name	Tanganyika District Government
Contact person	Salehe Mbwana Mhando
Title	District Commissioner
Address	P.O. Box 103 Mpanda Katavi Tanzania
Telephone	+255 754 498 752
Email	salehembwana3@gmail.com

Organization name	Mpanda District Government
Contact person	Elisha Mengele
Title	District Natural Resource Officer
Address	P.O. Box 74 Mpanda Katavi Tanzania
Telephone	+255 765 075 431
Email	ymengele@yahoo.com

Organization name	The Nature Conservancy (TNC) (Tuungane)
Contact person	Lukindo Hiza
Title	Program Director
Address	PO Box 894 Kigoma
Telephone	+255 789 179 365
Email	Lukindo.hiza@TNC.ORG

Organization name	The Greater Mahale Ecosystem Research and Conservation
Contact person	Alex Piel
Title	Dr.
Address	http://gmerc.org/
Telephone	+447557915813
Email	sokwemtu@gmerc.org

2.1.5 Physical Parameters (G1.3)

The project area is located between S05.55' - 06.30' and E30.10''- 30.50' with an altitude range from 800m-2000m. The soil Eluvial, Laterised (depleted of soluble substances) red and is predominantly sandy clay loam (ultisols) with good drainage[13]. habitat is typical of the Zambezian (miombo) Woodland Ecoregion characterised by Brachystegia and Julbernardia spp that provides high-quality habitat for a variety of species, including chimpanzees, savanna elephants and zebras. The project area is bordered by Mahale Mountain National Park (MMNP) to the west along Lake Tanganyika. There are two clear seasons across the region, with a wet season from November to April, and a dry season from May to October. Average rainfall is 1800mm/year with temperatures ranging from 18 C to 32 C depending on altitude and time of year. The topography of the region is characterized by broad but steep hills of miombo woodland broken up by thin strips of gallery forest, typically in valley bottoms. There are also patches of seasonally inundated swamps, wooded grasslands, rocky outcrops and expansive tracts of

[13] Soil Atlas of Tanzania. A.S, Hathout, 1983.

bamboo woodlands, especially along the eastern border of Mahale Mountains National Park. The Greater Mahale Ecosystem is framed by Lake Tanganyika in the west and by major rivers – Malagarasi in the north, Ugalla in the east – as well as smaller riverine systems that flow into Lake Tanganyika. All land within the project area us under village land use plans, the legal designation for land planning in Tanzania. The general categories of land use designation are Makazi / Kilimo (village area and farming), Malisho (grazing) and Hifadhi (reserve).

2.1.6 Social Parameters (G1.3)

The project is located in Tanganyika district (Mwese and Katuma Wards) and includes eight villages, namely (in alphabetical order) Bujombe, Kagunga, Kapanga, Katuma, Lugonesi, Lwega, Mpembe, and Mwese with a total population of approximately 16,990 according to the Tanzania National Census of 2012, however the villages self-report a total population figure of 38,211, which is likely more accurate. The eight villages are further divided into a number of sub-villages. A diversity of ethnicities resides in the area, including people of the following tribes: Bende, Fipa, Sukuma, etc. While these are distinct tribes with their own languages and cultural traditions, these groups are all Bantu (a general label for ethnic groups that speak Bantu languages) and speak Swahili as a common and unifying language. Similar to the situation throughout Tanzania, relations between different ethnic groups are generally good. The first villages were formally established in the early 1960s, while an influx of migrants and refugees from neighbouring Rwanda in the 1990s led to rapid growth in population and the establishment of new villages in the area. Some sub-villages in the area retain the refugee camp number as their name.

Under legally-binding village land use plans, each village has allocated land and resources to different uses. All plans include an area of forest for long-term protection and management. These forest areas, ranging in size, in the case of the project villages, from 112 to 38,324 hectares together form the carbon project's forest area. (See Appendix 3)

Villagers in the area primarily depend on farming and animal husbandry as the primary livelihood activities, while income may be supplemented by small businesses, beekeeping, and charcoal production. Most people in the communities claim to own their own land; however, formal land titles are very uncommon/non-existent. While individual parcel boundaries are generally well accepted, some villages are faced with numerous issues of conflict over agricultural and grazing land between neighbours and with new migrants. A diverse array of crops is produced including rice, maize, cassava and sesame. Some of the crops are kept for household consumption, while the rest are sold to the market.

Cattle raising is practiced primarily by the Sukuma ethnic group. It is also quite common in the villages to raise goats, chickens, and sometimes donkeys. Grazing areas have been set aside in each village for the purposes of livestock raising.

While villagers generally have access to land and resources, there is significant food insecurity in the area, with villagers claiming that 5 – 10% of the population does not have adequate food to eat throughout the year. The most vulnerable tend to be the elderly, disabled, and women-headed households. Each village has gone through a process to identify the poorest households and these are subsequently eligible for government assistance through the Tanzania Social Action Fund (TASAF).

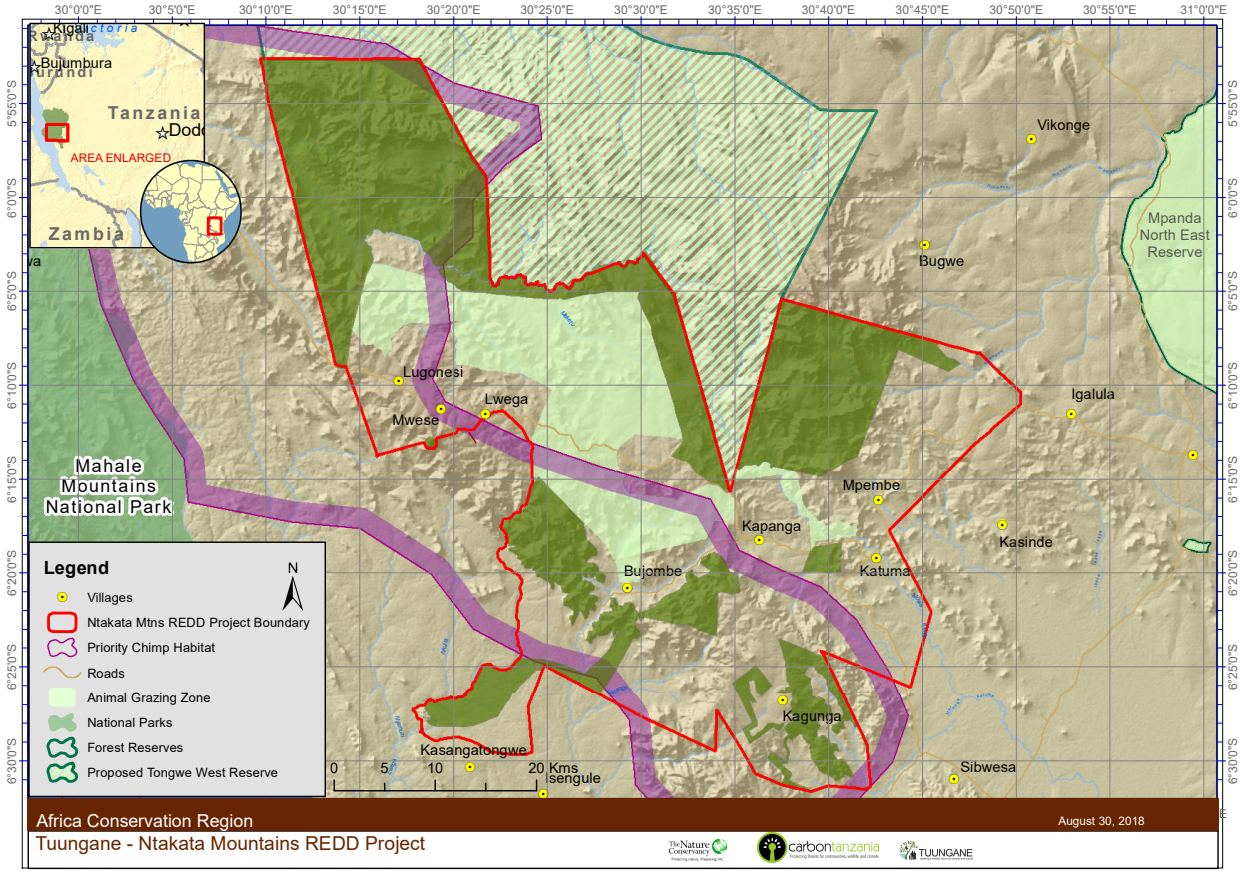
The village land use plans also recognize other important land uses such as residential land, spiritual sites, cemeteries, forest plantations, wildlife corridors, and water sources.

Educational opportunities in the villages are limited. Each village has its own primary school and both boys and girls commonly attend; however, there are only two secondary schools in the area. Higher

education requires traveling out of the village to live elsewhere and therefore few students are able to continue their education. The literacy rates in the village are quite high (71%).

Gender issues and the situation of women in the village have not been studied in-depth and statistics are not yet available; however, project surveys revealed some gender bias. For example, women make up a smaller proportion of the village committee members and are less vocal in meetings. They are perceived to be less able to perform the duties of a village game scout (VGC), but on the other hand, more honest and capable in managing money. In seemingly exceptional cases, a few women hold leadership positions, such as the Village Executive Officer (VEO) in Bujombe, Katuma, Mwese, and the Ward Executive Officer of Mwese.

2.1.7 Project Zone Map (G1.4-7, G1.13, CM1.2, B1.2)



2.1.8 Stakeholder Identification (G1.5)

The impetus for locating the project in the Tanganyika district of Katavi Region was due to the importance of the landscape for chimpanzee conservation. The goal of protecting chimpanzees and their habitat was an underlying motivation for Carbon Tanzania in initiating the project. The food and shelter provided by the miombo woodlands are critical to the survival of chimps in the landscape. Their 'fusion-fission' behaviour requires sufficient area and connectivity for groups to periodically divide and regroup.

At the same time, the project would not have moved forward unless the local stakeholders were enthusiastic and expressly invited Carbon Tanzania to pursue it. Until recently, the project villages were

part of Mpanda district, but in July 2015 the district was divided up and the project villages are now located in the newly designated Tanganyika district. Carbon Tanzania started the process of stakeholder identification by consulting the district governments of both Mpanda and Tanganyika. These district governments in turn, provided an introduction for Carbon Tanzania to other relevant stakeholders including the ward offices, village committees in the eight villages, and the district forestry office and district land office.

Carbon Tanzania recognized the importance of working within existing governance structures and of understanding and respecting the rights of the local stakeholders, particularly in regards to their rights to manage natural resources. Village land use plans are at the core of natural resources management in the landscape, and they have resulted from a participatory process involving a wide range of stakeholders at the local level, including vulnerable and marginalized groups. The project reinforces these legally binding plans by providing the resources and capacity necessary to implement them. With the full support of the district, Carbon Tanzania conducted introductory meetings to the project with all of the village governing committees in February and June 2017. The elected members of these committees represent the entire village through the system of sub-villages. As a result of the positive response from all the village committees, project preparations moved into full swing.

2.1.9 Stakeholder Descriptions (G1.6, G1.13)

See Appendix 1

2.1.10 Sectoral Scope and Project Type

Project Scope 14: Agriculture, Forest and other Land Use (AFOLU)

Project Category: Reducing Emissions from Deforestation and Degradation (REDD)

Type of Activity: Avoided Unplanned Deforestation (AUDD)

Grouped project: No

This project is being registered under the Verified Carbon Standard (VCS) and Climate, Community & Biodiversity Alliance (CCBA) Standard as a Reducing Emissions from Deforestation and Degradation (REDD) project. It has been developed in compliance with the Verified Carbon Standard[14], Version 3.7 and VCS AFOLU Requirements[15], and Climate, Community & Biodiversity Standards, Version 3.1[16]. The project will reduce emissions from unplanned deforestation.

[14] VCS. 2017 VCS Standard. Version 3.7, 21 June 2017. Verified Carbon Standard, Washington, D.C.
[15] VCS. 2017 Agriculture, Forestry and Other Land Use (AFOLU) Requirements. Version 3.6, 21 June 2013. Verified Carbon Standard, Washington, D.C.
[16] CCBS. 2017 Climate, Community & Biodiversity Standards, 3rd Edition. Version 3.1, 21 June 2017. Verified Carbon Standard, Washington, D.C.

2.1.11 Project Activities and Theory of Change (G1.8)

Project Activities and Theory of Change

Activity description	Expected climate, community, and/or biodiversity			Relevance to project's objectives
	Outputs (short term)	Outcomes (medium term)	Impacts (long term)	
1. Increase the local capacity and resources for effective forest management	- *Village committees receive training in good governance project management.* - *The number of VGS is increased to an average of 6 per village* - *VGS receive monthly stipends, uniforms and start up kits which includes boots and GPS* - *An extra 14 VGS participate in the intensive 3-month training course on forest law enforcement at Pasiansi Institute.* - *16 VGS are trained on forest inventory.* - *Fire management is included in village forest reserves* - *Train Community members and leaders on Good Governance of Natural resources and Gender equity.* - *Governance training to build accountability and transparency to resource allocations, planning and budget management*	- *VGS patrols are conducted regularly and in a professional, manner.* - *The problem of new settlement within the forest is effectively controlled.* - *Increasing number of VGS provides for greater support to the village government.* - *Fire management is developed* - *Community members and leaders have a detailed understanding and prioritise natural resource management* - *Village governments are democratic, transparent and representative and recognise gender equality*	- *Illegal activities within forest areas are virtually eliminated.* - *Forest boundaries are respected.* - *Degraded areas are restored to better quality forest* - *Habitat suitability and landscape connectivity for Chimpanzee improves*	*Improved forest management has a direct positive effect on carbon stocks and sequestration.*

Activity description	Expected climate, community, and/or biodiversity			Relevance to project's objectives
	Outputs (short term)	Outcomes (medium term)	Impacts (long term)	
2. Improve local livelihoods for villagers, including for marginalized and vulnerable groups	- *Provide carbon revenues to support village development (e.g. health, education)* - *Provide technical support for tree plantations* - *Land use planning identifies areas for legal farming allowing for communities to better plan resource use* - *Land use planning identifies areas for grazing allowing communities to better plan resource use* - *Provide training and matching grants to Community Conservation Banks (Cocoba) in each village to enable micro-finance for enterprise development* - *Provide training on entrepreneurship to women's groups and young mothers*	- *School facilities are improved* - *Health facilities are improved* - *The number of those classified as poor in the villages decreases* - *Agriculture is conducted in areas designated by the villages* - *New businesses (including women-owned) are established in each village*	- *Food insecurity in the villages is virtually eliminated* - *Average household income increases*	*The project aims to improve local livelihoods, so the impacts are directly relevant to this objective. In addition, since livelihoods improvements will be related to results-based payments, the importance of forest protection will be reinforced and widely supported*
3. Provide quality reproductive health	- *Conduct counselling on reproductive health* - *Support training of trainers on reproductive health issues*	- *Couples are aware of reproductive health choices and have access to options*	- *Women's reproductive health improves (e.g. fewer STDs, problems in childbirth)*	*The Population, Health, and Environment (PHE) approach to community development states improved health care, particularly family planning and reproductive health help communities conserve and manage natural resources. Local and district infrastructure exist to address primary health and disease prevention, so the project focuses on reproductive health through project partner and reproductive health expert organization Tuungane, as healthier women and families reduce pressure on forests.*

2.1.12 Sustainable Development

Tanzania's National Development Vision of 2025 outlines the country's commitment to sustainable development. It includes goals related to 'high quality livelihood', and 'good governance and the rule of law'. Further it states: "It is also envisaged that fast growth will be pursued while effectively reversing current adverse trends in the loss and degradation of environmental resources (such as forests, fisheries, fresh water, climate, soils, biodiversity) and in the accumulation of hazardous substances."

The Ntakata REDD project contributes directly to these goals in the target area. Carbon revenues will support village development plans, thereby reducing poverty and improving health and education services in the participating villages. Food self-sufficiency will be increased, and school enrolment will increase. With more resources for education, illiteracy will be reduced. Reproductive health and infant mortality will also be positively impacted by the project interventions. The project will also contribute to improved 'rule of law' through regular forest patrols, and resources and capacity development for local governance structures.

In addition, Tanzania has defined a number of national policies related to forest conservation and addressing climate change. These include the National Climate Change Strategy (2012) and the Zanzibar Climate Change Strategy (2014), the National Forestry Policy (1998), the National Environmental Policy (1997); the Zanzibar Environmental Policy (2013); the National Environmental Action Plan (2012 – 2017); the National REDD+ Strategy and Action Plan (2013) and the National Environment Management Act (2004). Tanzania has also defined its nationally determined contributions (NDCs) under the UNFCCC Paris Climate Agreement. Tanzania's goal is stated as follows:

> Tanzania will reduce greenhouse gas emissions economy wide between 10-20% by 2030 relative to the BAU scenario of 138 - 153 Million tonnes of carbon dioxide equivalent (MtCO2e)- gross emissions, depending on the baseline efficiency improvements, consistent with its sustainable development agenda.

Tanzania, with low emissions and relatively high forest cover (48.1m ha), as a 'net sink', has recognized the importance of forests in reaching this goal. Tanzania's NDC emphasizes a participatory approach with the up-scaling of participatory forest management programmes, the coordinated implementation of actions under forest polices and the national REDD+ programme, and the strengthened protection and conservation of natural forests.

The Ntakata REDD project contributes directly to achieving Tanzania's climate and forestry objectives as articulated in the NDC and other national policies. Through improved forest management in the ecosystem, the project reduces emissions using a participatory approach.

The project also improves the capacity to analyse and report the results of interventions, with attention also to gender-disaggregated data. These skills are relevant to national level reporting - such as the 5-year review of the Development Vision and the Biennial Update Report (BUR) to the UNFCCC to track the country's progress towards its development goals.

2.1.13 Implementation Schedule (G1.9)

Date	Milestone(s) in the project's development and implementation
February 2016	District personnel conduct introductory meetings with project villages to ensure free prior and informed consent is given for Carbon Tanzania to visit project villages
April 2017	Final land use plans are completed for Bujombe and Kapanga villages
May 2017	First 8 Village Game Scouts (VGS) complete training at Pasiani and return to villages to begin support of village land use plans
May 19 2017	**Start of project GHG accounting period.** **Signing of MOU between Carbon Tanzania, The Nature Conservancy and Pathfinder 19th May 2017. Implementation of protection measures on villages land use plans that lead to GHG emission reductions.**
May 19 2017	Start of biodiversity monitoring activities
February 2017	Project introductory meetings in: Mpembe, Mwese, Lwega, Katuma.
June 2017	Project introductory meetings in: Lugonesi, Kagunga, Bujombe, Kapanga.
October 2017	Forest inventory (including training of VGS)
October 2018	Village contracts signed
November 2018	Carbon Champions program in all project villages
April 2019	Submission of PD to VCS
May 2019	Presentation of the PD to villages Presentation of BMP to villages Presentation of CMP to villages
June 2019	Project validation and verification initiated
May 2047	End of project GHG crediting period

2.1.14 Project Start Date

The Ntakata REDD project start date is 19th May 2017 based on activities outlined in section 2.1.11 and 2.1.13. of this PD. This date is based on the completion of the final participatory land use plans in April 2017, the completion of the training of village game scouts in May 2017 (see appendix 4.) and the date on which Carbon Tanzania, The Nature Conservancy and Pathfinder signed a Memorandum of Understanding. The signing of this MoU along with these activities all lead to the beginning of implementation of management and protection plans. At this stage all villages had already been involved in an introductory exercise in February 2016 conducted by the District Government (see appendix 4.) and

introductory meetings in February - June 2017 which included training on the REDD project (see appendix 4). (see Section 2.5.3.).

2.1.15 Benefits Assessment and Crediting Period (G1.9)

The Ntakata REDD Project has an initial project crediting period of 30 years, starting on 19th May 2017. The initial project crediting period is set to end on 18th May 2047. The initial baseline period started on 19th May 2017 and is set to continue through 18th May 2027.

2.1.16 Differences in Assessment/Project Crediting Periods (G1.9)

There are no differences between the GHG emissions accounting, climate adaptive capacity and resilience, community, and/or biodiversity assessment periods.

2.1.17 Estimated GHG Emission Reductions or Removals

Throughout this document, the convention is employed that project year refers to the calendar year at the beginning of the annual interval, e.g. project year 2017 refers to the annual interval from 19th May 2017 to 19th May 2018.

Year	Estimated GHG emission reductions or removals (tCO^2e)
2017	445,855
2018	933,749
2019	763,797
2020	702,321
2021	508,074
2022	555,409
2023	445,685
2024	452,275
2025	461,561
2026	458,815
Total estimated ERs	5,727,542
Total number of crediting years	10
Average annual ERs	572,754

2.1.18 Risks to the Project (G1.10)

Project risks, impacts and mitigation measures are detailed in the risk table in Appendix 2. Risks identified include increased mining activity, new major roads, and changes in national REDD+ policy to disallow voluntary market projects.

Project risks are also assessed in detail in the VCS Non-permanence Risk Report, which will be updated periodically as part of the VCS monitoring and verification process. Risks assessed applying the VCS AFOLU Non-permanence Risk Tool relate to risks of reversals of climate benefits but equally to community and biodiversity benefits as the success of the carbon project is integral to financing ongoing community engagements and management and protection activities in the reserve. Further, the risk of un-prevented deforestation that is assessed using the VCS AFOLU Non-permanence Risk Tool in the context of a REDD project, has direct implications to community and biodiversity benefits in terms of availability of natural resources and wildlife habitat. In short, community and biodiversity benefits are subject to the same risks as the carbon project. Continued community engagement is critical to the success of the project, and the risk that this engagement could be lost is addressed through continuing regular consultations and communication with villages and active participation of village carbon champions.

2.1.19 Benefit Permanence (G1.11)

There are two principal strategies to ensure the maintenance and enhancement of the project benefits beyond the project lifetime. The first is capacity development. The project will provide opportunities for learning, and the knowledge and skills gained will last beyond the project cycle. District officers, village committees and VGS will be more capable and efficient in their jobs. They will be able to identify and access new funding sources to continue the forest management work, whether it be from external donors or resources from within the better-off community itself. The forest will also be less degraded with greater potential to provide timber and non-timber forest products on a sustainable basis – a means to offset management costs. The local population will have a greater appreciation of the benefits of sustainably managing forest resources as a result of support to the education of both children and adults through the school system and adult education.

The second strategy relates to how land-use planning will set down long term goals for the land-use and management that will set norms around those lands and allow for the expansion of agricultural and settlement in a sustainable way. While land use plans may be adjusted over time, the forest reserves are set aside for long term protection beyond the lifetime of the project.

The measures discussed above serve to ensure climate, community and biodiversity benefits related to maintenance and protection of forest cover for at least 100 years.

2.1.20 Financial Sustainability (G1.12)

Carbon Tanzania has analysed the anticipated financial health of the project over its lifetime by estimating the flow of revenue from carbon in relation to project expenses. This spread-sheet (see “Ntakata Cash Flow Analysis.xlsx”) demonstrates that the carbon revenues will be sufficient to cover the expenses of the project and to also fund the village development funds, thereby making it possible to achieve the project’s climate, community and biodiversity benefits, given that the risks identified are either not encountered or sufficiently mitigated.

2.1.21 Grouped Projects

This project is not a grouped project.

2.2 Without-project Land Use Scenario and Additionality

2.2.1 Land Use Scenarios without the Project (G2.1)

The baseline scenario is the same as the conditions existing prior to the project initiation (See section 3.1.4 Baseline Scenario). In the absence of the project, the most likely land use scenario would be one of continued migration to the area and deforestation. Uncontrolled migration to the area would lead to further expansion of agriculture, and birth rates would remain relatively high (i.e. 5.8 births per WRA). The under-resourced village committees would continue to struggle to implement land use plans, and incidents of land conflict would increase due to increasing pressure on land. It is estimated that the current rate of deforestation would continue and even possibly accelerate in the absence of the project. Areas of settlement would expand, fires would be more common, and forests would be cleared for agriculture and grazing.

2.2.2 Most-Likely Scenario Justification (G2.1)

The most-likely land use scenario in the absence of the project is justified in Section 3 below using the T-ADD, "VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities," Version 3.0 and the VCS Methodology VM0007 Module BL-UP.

2.2.3 Community and Biodiversity Additionality (G2.2)

The Village Land Act and Forest Act 2002 promotes participatory forest management (PFM) as a means to protect and conserve forest; however, the resources and capacities to implement this law are lacking, particularly in remote areas of the country with limited tourism, as in the case of the project district. The project maximizes financial returns to the villages. Without the flow of carbon revenues to the villages, they are unable to implement the land use plans. These plans reflect the intentions of the villages to manage forests sustainably and protect a designated forest area long into the future; however, the reality is that without resources and capacity for enforcement, villages are unable to stem the tide of immigrants and control destructive activities such as logging, clearing and fires. In some cases, the protected forest area is quite far from the village center (e.g. 8-10 kms). For families that struggle to make a living, the opportunity cost of spending a full day or more away from home to do patrolling, is a very heavy burden. This time can be spent more productively in farming or small business development. Therefore, it is necessary to compensate villagers for their time spent in undertaking project tasks such as patrolling. Even though land use plans are legally enforceable documents under Tanzanian Law, *without the resources and capacity to implement them, they become mere exercises*[17]. Furthermore, under the project, VGS benefit from extensive training in forest law enforcement. This training is legally empowering – those certified have authority to make arrests, confiscate illegally collected forest products, and levy fines. Without this specialized training supported under the project, enforcement is ineffective and 'toothless', encouraging offenders to continue illegal activities. The project also supports the district government to backstop enforcement. Currently, only 3 officers cover the entire district; however, with the project, the district government will have the resources to expand their support.

With the continued loss of forest in the absence of the project, the biodiversity benefits would also be reduced. For example, valuable chimpanzee forest habitat would be lost. Hunting and capture of chimps

[17] IIED_Blomley_2016

for the pet trade, contravening the Wildlife Conservation Act of 2009, also have the potential to increase if forests are not regularly patrolled.

2.2.4 Benefits to be used as Offsets (G2.2)

There are no distinct community and biodiversity benefits intended to be used as offsets.

2.3 Stakeholder Engagement

2.3.1 Stakeholder Access to Project Documents (G3.1)

A copy of the full Project Document (PD) will be provided to each district officer and village committee to review and keep on file for public access. In addition, copies of monitoring reports will be delivered on a regular basis to the district offices and village committees. Since these documents are in English, of which there is limited knowledge in the villages, CT will prepare summaries in Swahili and speak at regular meetings to convey the relevant information in an efficient manner.

2.3.2 Dissemination of Summary Project Documents (G3.1)

Since English knowledge is limited and there is no strong culture of reading in the area, the project team has planned face-to-face meetings to provide a summary of the PD to the project steering committee and other interested villagers. These meetings will be conducted within a short time from the completion of the PD. A shorter document in Swahili has been prepared and will be circulated to summarize the most relevant sections of the PD for villagers. Similarly, summaries of monitoring results and annual reports will be prepared and explained in regular bi-annual project meetings and shared with all stakeholders. The procedure for these meetings is shown in appendix 1.

2.3.3 Informational Meetings with Stakeholders (G3.1)

Information on the project has been provided to the village committees on several occasions prior to project validation. These meetings were conducted in Swahili and attended by most of the 25 members of the village committees. Official meeting minutes were recorded. During these meetings, the project team has explained the project background as well as the roles and responsibilities of the villages if they are to engage. Risks such as the possible failure to sell credits, have been mentioned and discussed. The project team welcomes any questions or comments on the project, and there is ample time to share and exchange ideas. In addition to the village development committee meetings, CT has also attended and presented in the village general assemblies which bring together more members of the community. The general assembly meetings are publicized by word-of-mouth at the sub-village level, so that all families are made aware of the time and place of the meeting. The table in Section 2.5.3 summarizes the informational meetings and consultations that have been conducted and minutes or summary reports are on file.

2.3.4 Community Costs, Risks, and Benefits (G3.2)

The project team has discussed the costs, risks, and potential benefits of the project candidly with the Village Governments in all the target villages, during the project introductory meetings. Most information is conveyed in these face-to-face meetings, but CT has also prepared a leaflet on the project and its background. Numerous copies have been distributed to the Village Governments over the course of introducing the project. The risks discussed include the risk of not being able to sell carbon credits, thus

reducing revenues to support project activities. CT has emphasized its commitment to sell the project credits, along with its track record in having done so for other similar projects; however, CT has been candid in explaining that the global market forces affecting carbon credit prices and sales are beyond the company's control.

The project has also developed the strategy of 'carbon champions' to share and gather information. There will be one or two champions selected in each village based on interest and capabilities, also taking into account gender balance. These champions will be given additional training about the project and they in turn will be asked to spread key messages throughout the villages. These champions will also be able to convey information from project participants back to the project team.

In discussing potential benefits, CT has described the other projects it has initiated, including the Yaeda project which has already delivered financial returns to the community. However, CT is also careful not to unduly raise expectations. CT has also explained the correlation between financial flows and overall effectiveness in protecting the forest in the project area. If one or two communities fail to protect the forest, for example, then revenues to all communities could be affected. CT has also explained that some of the project revenues must be spent on project running costs, including salaries, transportation, marketing, validation and verification costs. It has also been explained that payments to communities will be based on results and correlated with a base amount and the area of the forest protected.

2.3.5 Information to Stakeholders on Validation and Verification Process (G3.3)

As mentioned, the validation and verification processes have been explained in the face-to-face meetings in each village. Villagers are encouraged to speak openly and candidly to the project auditors. Information on the validation and verification process has also been included in the project summary that has been circulated to the Village Governments. Face-to-face meetings are the most effective way of sharing information in the villages. The Village Governments are responsible to carry the key information on the project validation and verification to the sub-villages, according to the village governance structure. Oral communication does not depend on literacy levels, so those with lower education are not excluded. Meetings are organized at convenient times so that women can participate. The carbon champions also share information on the validation and verification process door-to-door. Generally, it is easier for women to meet at home since they are busy without household tasks. Peak harvest season is also avoided to ensure good participation.

2.3.6 Site Visit Information and Opportunities to Communicate with Auditor (G3.3)

The communities will be informed about the visit of the auditor through the Village Government. The day and time of the meeting will be clearly communicated by CT to the Village Government at least one week before arrival. The Village Government will be asked to inform all villagers about the audit and to remind them again of the visit one day before. Depending on the request of the auditor, meetings may be arranged with each Village Government or sub-village representative. It is also possible for the auditor to travel door to door to gather information and feedback on the community perspective in a more informal manner. A member(s) of the CT team may accompany the auditor if desired to assist in any clarifications; however, it is also possible for the auditor to make the visit with the assistance of a local government official or Village Government representative.

2.3.7 Stakeholder Consultations (G3.4)

The project is centered on the village land use plans (VLUP) that were formulated based on a participatory process, based on the local governance structures, including the sub-villages, and representatives including 'mwenyekiti ya kitongoji' (chairman of sub village) or 'mjumbe' (member of village government). These plans define the land use for different areas in the village, for instance, the forest reserve area, the farming area, wildlife corridor, settlements, plantation and pasture. The VLUP also defines the strategies for managing these areas. The Ntakata REDD project adopts these plans as part of the overall project scheme, so there is full integration of community views and priorities in the project design. Besides the planning of land use, communities have also made input on how the project will support development in the village. During village meetings with the project team, they have raised various suggestions for how financial flows from carbon revenues could be used most effectively in their village. For instance, in Mwese, village representatives prioritized housing for teachers, nurses, and doctors. The Ntakata REDD project is designed in such a way that each village can set its own priorities and spending plan according to the perceived needs and consensus among the committee.

2.3.8 Continued Consultation and Adaptive Management (G3.4)

The CT team and its partners, including Tuungane, will be in the project landscape on a regular basis. Staff are based in the district and travel on a weekly basis to the villages in the project site. This regular contact is complemented by more formal quarterly Village Government meetings in each village, where the REDD project will feature on the agenda. The discussions in these meetings are documented in minutes and decisions may be taken to address project issues or suggest improvements to the project strategy. CT values the regular input from villagers through this formal mechanism, as well as through more informal channels such as text messaging groups and face-to-face discussions. CT will conduct an internal annual review of the project to adapt the strategy to changing circumstances, while still maintaining the overall goals of carbon emissions reductions and livelihood improvement.

2.3.9 Stakeholder Consultation Channels (G3.5)

The communities in the project area have been informed and consulted adequately on the project, and they have given their clear consent for its implementation. Meetings to introduce and discuss the project with the Village Governments in each village have taken place on several occasions. Village Government members are elected and have a responsibility to convey the information to the sub-village level. Copies of leaflets in Swahili explaining the project have also been printed and distributed in each village, as will be the project summary. CT has encouraged Village Governments to carry through this responsibility, and while it is not feasible to verify communication on the project with every household, some spot checks reveal that the community at large is well informed. For example, in Mwese the Village Government confirmed that they had spoken to villagers in all 5 sub-villages about the project. They reported having discussed the potential project benefits and the need to mobilize people to protect the forest.

2.3.10 Stakeholder Participation in Decision-Making and Implementation (G3.6)

In order to ensure that the project has been effectively communicated with all communities, including disadvantaged groups, and that they have been given an opportunity to participate, CT has taken some steps. First, face-to-face meetings have been organized to present the opportunities to participate in the project, and CT has encouraged equal opportunities for all members. For example, while women might not be normally considered for the work of Village Game Scout (VGS) due to gender perceptions, CT has suggested to the Village Governments that this work could be carried out by women as well as by men. In

addition, the project adopts existing governance structures as a means to implement the project. These structures are democratic and culturally accepted in the communities.

2.3.11 Anti-Discrimination Assurance (G3.7)

Carbon Tanzania has company policies to prevent discrimination and outline a course of action, should it occur. The human resource (HR) policy provides a clear statement on discrimination relating to gender, religion or sexual discrimination. Discrimination is considered a level A misconduct under the HR policy. Where discrimination occurs within the company, partner organisations or within project areas (project participants), actions are outlined in the grievance policy to ensure that any discrimination is dealt with by the senior management. All company employees and field partners sign a code of conduct with CT that includes anti-discrimination.

2.3.12 Feedback and Grievance Redress Procedure (G3.8)

Carbon Tanzania has a clear grievance redress mechanism which is outlined in the company grievance policy. The grievance policy is also part of the files kept at the Village Government office. The policy defines a grievance and its scope and outlines both an informal and formal procedure for managing grievances. Under the informal procedure, an affected person first discusses with a director or another member of the management team. The director will attempt to resolve the grievance on an informal basis, taking advice if necessary, from other parties. The director and affected person will work together to resolve the problem. If the grievance is against a director, the grievance will be forwarded to another member of the management team. If a grievance cannot be resolved via informal discussions, the formal procedure may then be used. The formal procedure requests the grievance to be in written form (or if not possible, by telephone to the director or senior manager). An investigation is arranged within 1 week (7 days) to gather additional information, followed by a grievance hearing. The hearing should occur within 10 working days of the investigation being completed. Should the grievance be against a member of management or director a third party can be brought to represent the party at the hearing. Additional details, including the contact numbers of the directors, are included in the grievance policy, available in both English and Swahili.

2.3.13 Accessibility of the Feedback and Grievance Redress Procedure (G3.8)

The CT Grievance policy for employees, partners, and community members is available in both English and Swahili and a copy is available in each Village's Government office. In addition, the grievance policy is described briefly in the project summary that is disseminated throughout the project area. The carbon champions have disseminated information specifically on the grievance policy as part of their awareness raising efforts and they are available to help project participants raise grievances if needed.

2.3.14 Worker Training (G3.9)

There are opportunities for community members to participate in orientations and training to gain new knowledge and skills in relation to the project. Carbon Tanzania has already conducted several meetings with the Village Governments to orient members to the project and to share knowledge on key concepts such as REDD, carbon markets, and sustainable forest management. In addition, CT has conducted a training and practical exercises on forest inventories and there are plans for certification trainings for VGS. Little turnover is expected since outmigration from the community is limited and learning and employment opportunities are highly valued, and thus rarely given up.

2.3.15 Community Employment Opportunities (G3.10)

All members of the community are eligible to apply for open positions and their applications will be assessed fairly and without bias. The Village Governments are requested to ensure that women and other marginalized groups are informed about new opportunities and encouraged to apply.

2.3.16 Relevant Laws and Regulations Related to Worker's Rights (G3.11)

Tanzania overhauled its employment and labor laws in 2004 when it enacted the Employment and Labor Relations Act, Act No. 6 of 2004 ("the Employment Act") and the Labor Institutions Act, Act No. 7 of 2004 ("Labor Institutions Act"). The Employment Act provides for labor standards, rights and duties, together with the Labor Institutions Act constitute the main governmental instruments to deal with worker's rights. In 2007, additional legislation was added to facilitate the enforcement of labor rights and standards stipulated in the Employment Act. One of the most significant of these is the Employment and Labor Relations (Code of Good Practice) Rules, G.N. No. 42 of 2007. CT is organizationally committed through internal policy to following these laws. All employees receive a briefing on laws and worker's rights in Tanzania and receive a copy of the CT company policy documents.

2.3.17 Occupational Safety Assessment (G3.12)

The risks of employment or involvement in the project are well within a normal range and CT has taken measures to inform workers of possible risks and to minimize these risks. Risks during the project activities include vehicle accidents, insect or snake bites, as well as conflict-related violence during enforcement operations. Workers are informed about these risks during orientation. Risks are minimized by promoting driver safety, avoiding travel by public bus whenever possible, providing appropriate equipment, ensuring use of tents / mosquito nets for fieldwork, and giving training to deal peacefully and effectively with conflict, including training on arrest procedures for Village Game Scouts

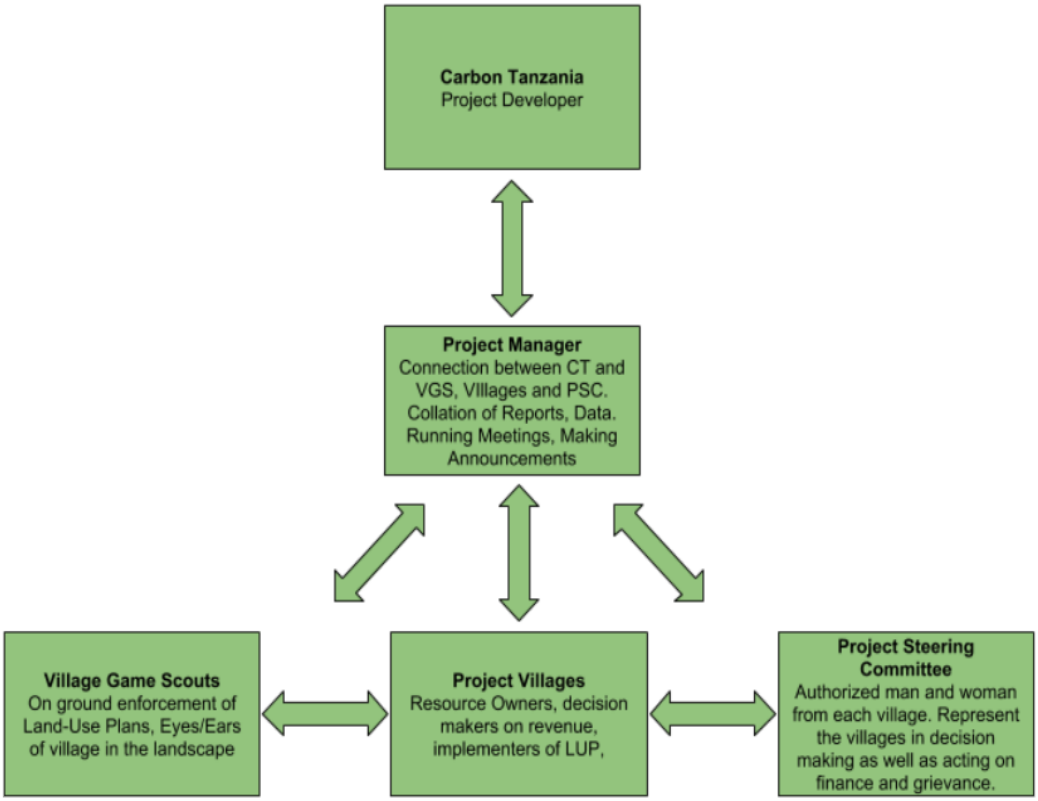
2.4 Management Capacity

2.4.1 Project Governance Structures (G4.1)

The main partners of the project are Carbon Tanzania, the Tuungane program (composed of The Nature Conservancy and Pathfinder), the Greater Mahale Ecosystem Research and Conservation project – along with the district, ward, and relevant village governments in Tanganyika district and the relevant departments of the Mpanda district government (forestry). Carbon Tanzania has the role and responsibility to manage and coordinate the operations of the REDD project in collaboration with other partners. The other NGOs support different thematic areas: rural development, health, and conservation while the local government structure supports overall implementation and connection and communication to the grassroots level.

2.4.2 Required Technical Skills (G4.2)

The project requires a range of key technical skills for successful implementation. These skills include project management, marketing, community engagement, natural resources conservation, biodiversity assessment, provision of health services, rural development, and carbon measure and monitoring. Curriculum vitae of project personnel are available to show skills in these areas.



Project governance structure

2.4.3 Management Team Experience (G4.2)

The members of the project management team possess the key technical skills required to implement the project. These skills include project management, credit marketing, community development, reproductive health, conservation and biodiversity assessment, forest law enforcement, and community engagement and facilitation. The key management team staff already have experience in developing and implementing two other forest carbon projects in Tanzania including the Yaeda Valley REDD Project and the Makame Savannah REDD Project. Please refer to the curriculum vitae of key project staff for additional details on staff experience.

2.4.4 Project Management Partnerships/Team Development (G4.2)

TerraCarbon LLC has been contracted to provide services on carbon measurement and monitoring in the initial start-up phase, while building the team's own capacity in this area. TerraCarbon has also provided support in the preparation of the Project Document. TerraCarbon is a world leader in the development of VCS REDD projects.

2.4.5 Financial Health of Implementing Organization(s) (G4.3)

Carbon Tanzania is an established company with a sound financial basis for operations over the project lifetime. Annual audit reports and financial statements are available upon request by the auditors.

2.4.6 Avoidance of Corruption and Other Unethical Behavior (G4.3)

Carbon Tanzania and its partners are not involved in or complicit in any form of corruption. The policies of the company (HR Policy) explicitly state a zero-tolerance policy for corruption under gross misconduct

2.4.7 Commercially Sensitive Information (*Rules* 3.5.13 – 3.5.14)

There is no commercially sensitive information that has been excluded from the public version of the project document. Only internal financial records are kept confidential.

2.5 Legal Status and Property Rights

2.5.1 Statutory and Customary Property Rights (G5.1)

The Village Land Use Plans (VLUPs) in each village provide the basis for understanding tenure rights in the project zone, including both statutory and customary user rights. These plans include designations for a variety of land use categories including farming areas (Kilimo Nchikavu), forest reserves (Msitu wa Hifadhi wa Kijiji), spiritual sites (Eneo la Matambiko), wildlife corridors (Ushoroba), and pastures (Eneo la Malisho), among others. Under the Village Land Act, these plans are legally enforceable. While villagers generally do not possess formal titles to their land, there are agreements, sometimes verbal, and sometimes written, for the transfer of land from one family or individual to another. There is general agreement and respect for the land use designations in the village land use plans. (See Appendix 3)

Though there is variation between villages with regards to access and use rights, most forest reserves are protected, at least in theory. In Mwese, people are forbidden from going to the forest to avoid contaminating water supplies. Villagers tend to collect firewood from nearby farms rather than going as far as the reserve forests. In Lwega, villagers need to seek permission before installing a honey box in the forest.

2.5.2 Recognition of Property Rights (G5.1)

Under the Land Act, number 4 and the Village Land Act, number 5 (1999), villagers were granted equal rights to access, use and control land, corresponding to vast areas of mainland Tanzania. However, despite this progressive law, there are many land conflicts throughout the country due to the fact that very few villages have clear land use plans, this leads to increasing conflicts between farmers and pastoralists as land pressures increases. While these conflicts do not affect the project area directly, they can create discord within the community and exert an indirect influence on the solidarity of the community and therefore the project's effectiveness. Carbon Tanzania aims to have a positive impact on this situation through support to the Village Government in terms of capacity building and financial resources to deal with tenure-related issues. Within the local governance system, the Village Land Council and Land Adjudication Committees are specifically tasked to deal with disputes, and they will receive technical and financial support to resolve disputes.

2.5.3 Free, Prior and Informed Consent (G5.2)

As stated, the designation of the project area is based on the Village Land Use Plans (VLUPs) that were developed under a participatory process in consultation with multiple stakeholders. There are no overlapping claims in these areas, and communities have given their free prior and informed consent for the project to be implemented in the village forest reserves. This consent is based on a series of

informational consultation meetings by the District Government on behalf of Carbon Tanzania in February 2016 (see appendix 4) followed by an educational program to all villages in February 2017 (see appendix 4). Several meetings followed based on carbon baseline and more detailed introductions to the project activities and discuss the potential risks and benefits, culminating in the project contracts with each of the eight villages signed in October 2018. These contracts are negotiated and finalized by the Village Government that, as an elected committee, has the authority to act on behalf of the villagers to make the agreement. The table below lists the consultation meetings leading to consent to the project.

Consultation Meetings

Location	Date	Stakeholders	Topics
Tanganyika District and potential project villages	February 2016	All project villages and District Government	District visits all project villages to introduce the concepts of the REDD project. This was done on behalf of Carbon Tanzania by the District natural resource authority.
Tanganyika District	June 2016	District Government	Introduction to project and discussion of potential next steps for development.
District/ Project Villages	Feb 2017	District/ Projects Villages	Introduction of project to project villages using the project / update report to district.
District/ Project Villages	October 2018	District/ Projects Villages	Explanation of baseline survey, request of permission to conduct baseline survey, conducting of baseline survey (in each village individually)
District/ Project Villages	July 2018	District/ Projects Villages	preliminary results of baseline survey, explanations of general terms of potential future contract (in each village individually)
District/ Project Villages	Sept 2018	District/ Projects Villages	Full contract read through and explanation (in each village individually) Group signing of contract

2.5.4 Property Rights Protection (G5.3)

The project activities do not involve any involuntary removal or relocation of property rights holders from their lands. The previous land use planning activities involving multiple stakeholders have already used participatory processes to designate village forest reserves where settlement and agricultural activities are not permitted. There have been no cases of relocation of habitation or legitimate user rights in the project area. In the case that claims for land or user rights occur within the project area, they will be resolved according to the legal procedures and will involve the appropriate government authorities.

2.5.5 Illegal Activity Identification (G5.4)

The illegal activities that could affect the project's impacts include logging and clearing of forest – including by setting fires - in the project area (village forest reserves) and illegal hunting of wildlife. All of these issues are addressed directly by the project's core activity: the employing and training of Village Game Scouts (VGS) who patrol the village forest reserves. The schedule of the VGS patrols is unpredictable in order to increase their effectiveness with an element of surprise. Their role is further facilitated by the complementary village development activities such as climate smart agriculture, educational support, and reproductive health services, which reduce pressure on forests.

2.5.6 Ongoing Disputes (G5.5)

There are no ongoing or historical disputes between stakeholders over land ownership or resource use within the project area. The participatory land use planning process which started in Mwese in 2011 and ended in Bujombe in 2017 ensured all stakeholders where engaged in the planning of all land and resource ownership.

2.5.7 National and Local Laws (G5.6)

The following table lists the most relevant laws and regulations and describes the project's compliance with each one.

Year	Law/Regulation	Compliance
1967	Land Acquisitions Act	Provides a basis for land governance in the project area
1999	Land Act, number 4 & Village Land Act number 5	Provides the basis for the communities to control and make decisions on the land in the project area.
2002	Forest Act	This act defines village forest land reserves upon which the project area is based.
2002	Contract Act	Provides the basis for the contractual agreement between the villages and Carbon Tanzania
2004	Employment and Labor Relations Act	Sets standards that the project follows in employing its staff
2004	Prevention and Combatting of Corruption	Sets standards to prevent corruption which the project adheres to in its zero-tolerance policy.
2009	Wildlife Conservation Act	Provides a basis for protection of wildlife and enforcement activities in the project area.
2017	Employment and Labor Relations (General) Regulations	Sets standards that the project follows in employing its staff.

2.5.8 Approvals (G5.7)

Carbon Tanzania has approval from the appropriate authorities to implement the project. Carbon Tanzania has reached agreement and signed a contract with representatives from each of the eight project villages (October 2018). This contract is signed by the Executive Officers and the Village Chairperson of the Village Government on behalf of each project village. The Tanganyika District Commissioner has also signed as the witness to the contract. The contract specifies also the timeframe of the project. In addition, Carbon Tanzania has signed a Memorandum of understanding with Tuungane and Tuungane has an MOU with the Tanganyika District (19th May 2017).

2.5.9 Project Ownership (G5.8)

Carbon Tanzania is the owner of the project based on the contracts and MOUs mentioned in section 2.5.8. in agreement with Section 3.11.1 Version 3. 6) An enforceable and irrevocable agreement with the holder of the statutory, property or contractual right in the land, vegetation or conservational or management process that generates GHG emission reductions or removals which vests project ownership in the project proponent. In Tanzania, there is currently no specific legislation governing carbon rights.

2.5.10 Management of Double Counting Risk (G5.9)

The Ntakata Mountains REDD project does not seek to generate any other form of environmental or social credit nor does it intend to do so. Version 3 Standard section 3.11.2. refers rules for double counting under national emission trading programs which are covered in section 2.5.11 as Tanzania has no national emission trading program.

2.5.11 Emissions Trading Programs and Other Binding Limits

The Ntakata Mountains REDD project is not subject to binding emissions limits or emission trading programs.

2.5.12 Other Forms of Environmental Credit

The Ntakata Mountains REDD project has not nor does it intend to create non-VCS/CCB GHG emissions reductions or any another form of environmental credit. This includes, but is not limited to, biodiversity credits, species banking, water certificates, and nutrient certificates.[18]

2.5.13 Participation under Other GHG Programs

The Ntakata Mountains REDD project has not been registered, nor is it seeking registration under any other GHG programs other than VCS and CCB.

2.5.14 Projects Rejected by Other GHG Programs

The Ntakata Mountains REDD project has not been rejected by any other GHG programs.

[18] Forest Trends, “Our Initiatives,” http://www.forest-trends.org/#

2.5.15 Double Counting (G5.9)

Tanzania is not currently participating in any national REDD+ markets where a compliance mechanism, or formal jurisdictional reporting framework in operation, could lead to double counting. Double counting would therefore be limited to the voluntary markets. The Ntakata Mountains REDD project has not been registered, nor is seeking registration, under any other GHG programs hence double counting is not an issue for this project.

3 CLIMATE

3.1 Application of Methodology

3.1.1 Title and Reference of Methodology

The Ntakata REDD Project is utilizing the Avoided Deforestation Partners' VCS REDD Methodology, entitled, "VM0007: REDD Methodology Modules (REDD-MF)." The only eligible activity as part of this project is avoiding unplanned deforestation, hence only modules related to unplanned deforestation are required. This project is eligible as an avoiding unplanned deforestation project because the forest land is expected to be converted to non-forest land in the baseline case and the land is not legally authorized and documented to be converted to non-forest or a managed tree plantation. The specific modules applied to the project are listed below.

REDD-MF, REDD Methodology Framework Version 1.5

Carbon Pool Modules:

CP-AB, "VMD0001 Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools," Version 1.1

CP-D, "VMD0002 Estimation of carbon stocks in the dead-wood pool," Version 1.0

CP-W, "VMD0005 Estimation of carbon stocks in the long-term wood products pool," Version 1.1

Baseline Modules:

BL-UP, "VMD0007 Estimation of baseline carbon stock changes and greenhouse gas emissions from unplanned deforestation," Version 3.2

Leakage Modules:

LK-ASU, "VMD0010 Estimation of emissions from activity shifting for avoided unplanned deforestation," Version 1.1

LK-ME, "VMD0011 Estimation of emissions from market effects" Version 1.0

Monitoring Module:

M-MON, "VMD0015 Methods for monitoring of greenhouse gas emissions and removals," Version 2.1,

Miscellaneous Modules:

X –STR, “VMD0016 Methods for stratification of the project area,” Version 1.1

X-UNC, “VMD0017 Estimation of uncertainty for REDD project activities,” Version 2.1

Tools:

T-SIG, CDM tool “Tool for testing significance of GHG emissions in A/R CDM project activities,” Version 1.0

T-ADD, “VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities,” Version 3.0

T-BAR, “Tool for AFOLU non-permanence risk analysis and buffer determination,” Version 3.3

Use of modules, REDD-MF, M-MON, T-ADD, T-BAR, X-UNC, and X–STR, is always mandatory when using the VM0007 methodology. Further use of modules, BL-UP and LK-ASU, is mandatory in the case of projects focusing on unplanned deforestation. Use of the module T-SIG determines whether GHG emissions by sources and/or decreases in carbon pools are insignificant. Finally, CP-AB is mandatory in all cases and while CP-D is optional as the dead wood pool is greater in the project scenario than the baseline scenario, it has been included.

3.1.2 Applicability of Methodology

The above modules are applicable as demonstrated below.

REDD-MF, REDD Methodology Framework

Table 3.1. Applicability Conditions and Demonstration for the REDD Methodology Framework Module.

Applicability Condition	Demonstration
Land in the project area has qualified as forest at least 10 years before the project start date.	The project area complies with this condition with complete forest cover demonstrated for the year 2007 by the imagery classification used for development of the baseline.
If land within the project area is peatland and emissions from the soil carbon pool are deemed significant, the relevant WRC modules (see Table 1) must be applied alongside other relevant modules.	No lands within the project area is classified as a peatland.
Baseline deforestation and baseline forest degradation in the project area fall within one or more of the following categories: Unplanned deforestation (VCS category AUDD); Planned deforestation (VCS category APD); Degradation through extraction of wood for fuel (fuelwood and charcoal production) (VCS category AUDD).	Baseline deforestation in the project area falls within the unplanned deforestation category, as the agents of deforestation are small scale farmers who do not have permission to convert forest in the project area to cropland.

Leakage avoidance activities must not include: • Agricultural lands that are flooded to increase production (e.g., paddy rice); • Intensifying livestock production through use of feed-lots6 and/or manure lagoons.	Leakage avoidance activities do not include flooding agricultural land or creating feed-lots or manure lagoons.
All land areas registered under the CDM or under any other carbon trading scheme (both voluntary and compliance-orientated) must be transparently reported and excluded from the project area. The exclusion of land in the project area from any other carbon trading scheme shall be monitored over time and reported in the monitoring reports.	The Ntakata REDD project is not registered in any carbon trading scheme or program.

BL-UP, "VMD0007 Estimation of Baseline Carbon Stock Changes and Greenhouse Gas Emissions from Unplanned Deforestation"

Table 3.2. Applicability Conditions and Justifications for the VMD0007 Module.

Applicability Condition	**Justification**
Baseline agents of deforestation shall: (i) clear the land for settlements, crop production (agriculturalist) or ranching, where such clearing for crop production or ranching does not amount to large scale industrial agriculture activities; (ii) have no documented and uncontested legal right to deforest the land for these purposes; and (iii) are either resident in the reference region or immigrants. Under any other condition this framework shall not be used.	The baseline agents of deforestation clear the land for cropland. These small-scale farmers have no legal right to use or deforest the land. These agents of deforestation are from nearby communities and in some cases immigrant actors looking for land to convert for agricultural uses.
Where, pre-project, unsustainable fuelwood collection is occurring within the project boundaries modules BL-DFW and LK-DFW shall be used to determine potential leakage.	There is no shortage of fuelwood in the area surrounding the project area. As such, it is unlikely that fuelwood is collected from the project area and fuelwood is much more likely to be collected in areas closer to where communities live rather than in the project area.

M-MON, "VMD0015 Methods for Monitoring of Greenhouse Gas Emissions and Removals"

Table 3.3. Applicability Conditions and Justifications for the VMD0015 Module.

Applicability Condition	**Justification**
Emissions from logging may be omitted if it can be demonstrated the emissions are de minimis using T-SIG.	Logging emissions have been omitted as no commercial timber harvest occurs in the baseline or with project case.

If emissions from logging are not omitted as de minimis, logging may only take place within forest management areas that possess and maintain a Forest Stewardship Council (FSC) certificate for the years when the selective logging occurs.	Not applicable
Logging operations may only conduct selective logging that maintains a land cover that meets the definition of forest within the project boundary.	Not applicable
All trees cut for timber extraction during logging operations must have a DBH greater than 30 cm.	Not applicable
During logging operations, only the bole/log of the felled tree may be removed. The top/crown of the tree must remain within the forested area.	Not applicable
The logging practices cannot include the piling and/or burning of logging slash	Not applicable
Volume of timber harvested must be measured and monitored.	Not applicable

3.1.3 Project Boundary

Sources of GHG Emissions Associated with the Baseline, Project and Leakage

GHG emission sources included in the project boundary are listed in Table 3.4. Justifications are provided when excluded from the project boundaries.

Table 3.4. GHG Emission Sources Included in the Project Boundary.

Source	Gas	Included	Justification/ Explanation
Biomass burning	CO_2	No	CO_2 emissions are already considered in carbon stock changes.
	CH_4	Yes	CH_4 and N_2O emissions are included in the baseline and with-project case where fires occur as part of the deforestation process.
	N_2O	Yes	
Fossil Fuel Combustion	CO_2	No	Emissions from fossil fuel combustion in the baseline and project case are minimal. As per methodology module E-FCC "Fossil fuel combustion in all situations is an optional emission source."
	CH_4	No	Emissions are small and negligible.
	N_2O	No	
Use of fertilizers	CO_2	No	Excluded. No increase in fertilizer use is contemplated in the project
	CH_4	No	

			case as part of leakage mitigation or any other activity.
	N_2O	No	Excluded. No increase in fertilizer use is contemplated in the project case as part of leakage mitigation or any other activity.

Carbon Stock Associated with the Baseline, Project and Leakage

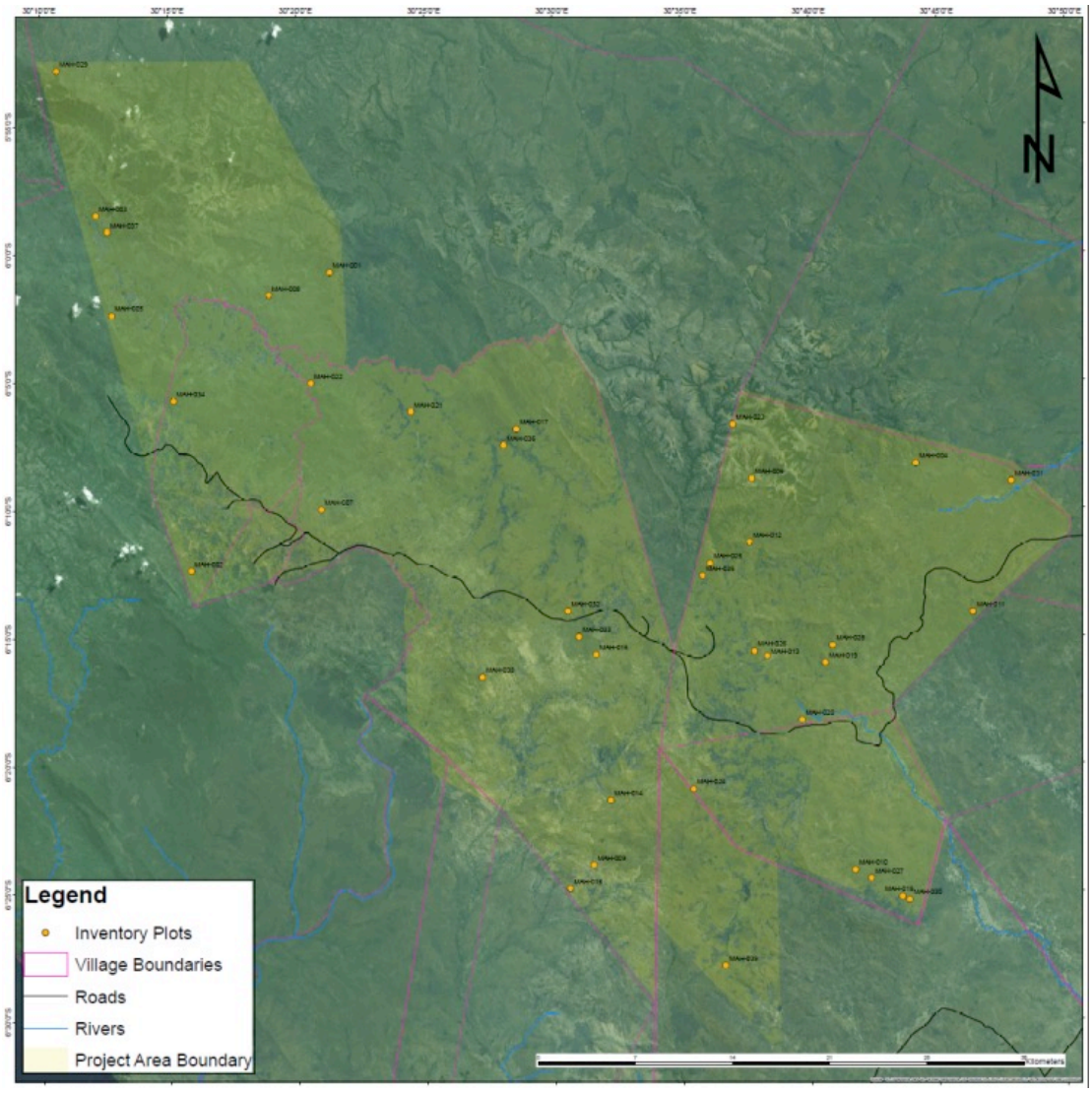
This project will include the following carbon pools (see Table 3.5).

Table 3.5. Carbon Pools Included in the Project Boundary.

Carbon pools	**Included / Excluded**	**Justification / Explanation of Choice**
Aboveground	Included	Mandatory to include. Live tree aboveground biomass, to a minimum 5 cm diameter at breast height (dbh), is included, which is the most significant pool.
Belowground	Included	Included for completeness to account total live tree (aboveground and belowground) biomass.
Dead Wood	Included	The standing dead wood pool, to a minimum 5 cm diameter at breast height (dbh), is included as it can represent a significant component of forest biomass. Lying dead wood has been excluded.
Harvested Wood Products	Included	Some extraction of commercial logs for wood products takes place in the baseline (as part of the forest conversion process) or with project scenarios.
Litter	Excluded	Conservatively omitted, as allowed by methodology.
Soil Organic Carbon	Excluded	Conservatively omitted, as allowed by methodology.
1. As noted in the table above, this project will consider three pools of carbon and the applicable modules include: CP-AB “VMD0001 Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools” and CP-D, “VMD0002 Estimation of carbon stocks in the dead-wood pool”.		

Forest carbon stocks were measured and quantified via field inventory. Locations of permanent sample plots are shown in the map below (Figure 3.1).

Figure 3.1 Ntakata REDD project inventory area and locations of sample clusters.



See section 3.2, below, for a map of the project region including the project area, leakage belt, RRD and RRL.

3.1.4 Baseline Scenario

The steps described below are in accordance with the "Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities", ver. 3.0.

Step 1. Identification of alternative land use scenarios to the proposed VCS AFOLU project activity

Sub-step 1a. Identify credible alternative land use scenarios to the proposed VCS AFOLU project activity

Credible alternative land use scenarios considered include:

Alternative 1: The without-project scenario involves lack of development and implementation of the Village Land Use Plans (VLUPs). With tenure, boundaries and land-use continuing to be poorly-defined in the baseline without-project scenario, project area lands continue to be at risk of intrusion by outsiders and conversion of forest to agriculture. Note this is equivalent to continuation of the pre-project land-use.

Alternative 2: The VLUPs or equivalent are developed and implemented, and village land tenure and resource rights are established and maintained, land use coordinated and forest cover effectively conserved, without the activity being registered as a VCS AFOLU project.

Sub-step 1b. Consistency of credible land use scenarios with enforced mandatory applicable laws and regulations.

The scenarios outlined above are consistent with enforced mandatory applicable laws and regulations. VLUPs were implemented with approval of the Mpanda District Council in accordance with the Village Land Act No. 5 of 1999, the Land Use Planning Act No. 7 of 2007, and the National Environment Management Act No. 20 of 2004.

Sub-step 1c. Selection of the baseline scenario

As per the VCS Additionality tool (VT0001), the baseline scenario is selected and justified applying the methodology, module BL-UP, detailed in Section 3.1.4, and corresponds to Alternative 1 above.

3.1.5. Additionality analysis

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method

No revenue is generated by the project activity outside of carbon revenue. Therefore, a simple cost analysis is applicable.

Sub-step 2b. – Option. Apply simple cost analysis

Total costs associated with project development are provided in the document, “Additionality Cost Analysis.xlsx”. No other revenue is generated by the project outside of GHG credit sales.

Step 3. Barrier analysis

Sub-step 3a. Prevent the implementation of this type of proposed project activity without the revenue from the sale of GHG credits.

The project activity is characterized as implementation of the VLUPs. Implementation of VLUPs can be difficult due to lack of funding options. For example, in the Mbarali District in central Tanzania the district government distributes only about one-third of the amount required to support these projects in a year[19]. Therefore, funding to develop these plans properly depends on outside organizations that can provide alternative funding mechanisms. Without revenue from the VCS-AFOLU project, the proposed project activity would face an insurmountable barrier to implementation.

Sub-step 3b. Do not prevent the implementation of at least one of the alternative land use scenarios.

A lack of funding for VLUPs would not prevent Alternative 1 from occurring. If the VLUPs are not properly financed, it is likely that a lack of enforcement would lead to the continued intrusion of migrants into forested areas. Like most forest land in Tanzania, in recent years, that does not have formal government

[19] Hart, A., Tumsifu, E., Nguni, W., Recha, J., Malley, Z., Masha, R., Buck, B. *Land Use Planning to Support Tanzanian Farmer and Pastoralist Investment.* July 2014.
http://www.landcoalition.org/sites/default/files/documents/resources/participatorylanduseplanning.pdf

protection and proper enforcement or a VLUP in place, the land will likely be cleared for timber and charcoal production and/or used for agricultural activities.

Step 4. Common practice analysis

The project activity, Alternative 2, involving sufficient financing and effective implementation of the VLUPs, is not common practice. The Tanzanian government announced in 2017 that only 1,731 of 12,545 villages had VLUPs in place, accounting for only 13 percent of the nation's villages[20]. Of those in place, the national government has focused on establishment of VLUPs mostly in the Northern region of Tanzania near Arusha and Kilimanjaro[21]. The VCS-AFOLU project will make the implementation of VLUPs in the Greater Mahale Ecosystem feasible and will ultimately contribute to the conservation of forests and improvement of land tenure rights for villages living in and around the project area.

Results of the Additionality Analysis

As demonstrated above, the project activity, without revenue from carbon credits, faces severe financial constraints, and is not a common practice in the region. Therefore, the project is determined to be additional.

3.1.6 Methodology Deviations

The following deviations to the methodology are applied:

The similarities of the project boundaries were assessed using population density rather than settlement density. This methodological deviation is warranted due to inconsistencies in the available data on the location of settlements within Tanzania. Use of population density data still meets the intent of the methodology as both population and settlement density reflect the relative density of resident populations (and level of pressures associated with those populations).

The parameter TOTFOR has not been "limited to forest areas within 5km of roads and rivers suitable for conversion to agriculture / livestock" as specified in the methodology, for lack of relevant data on suitability. As the resulting TOTFOR value is greater, the AVFOR value is also greater. The PROPLB parameter is therefore smaller thus resulting in more leakage outside the leakage belt and hence a conservative estimate. This deviation results in conservative accounting of leakage outside the leakage belt.

The parameter COLB has not been "limited to areas demonstrated to be suitable for agriculture or livestock ranching" as specified in the methodology, for lack of relevant data on suitability.

Parameter UP,SS,i,pool# will be monitored at least once every 10 years, on re-measurement of forest carbon stocks. While module X-UNC requires that monitoring of this parameter occur every < 5 years, this requirement is inconsistent with the VM0007 pools modules, which specify that stock estimates (from

[20] Kolumbia, L. "Land use plans big problem: govt". The Citizen. November 25, 2017. https://www.thecitizen.co.tz/News/Land-use-plans-big-problem--govt/1840340-4201784-11jgqffz/index.html
[21] Hart, A., Tumsifu, E., Nguni, W., Recha, J., Malley, Z., Masha, R., Buck, B. *Land Use Planning to Support Tanzanian Farmer and Pastoralist Investment.* July 2014.
http://www.landcoalition.org/sites/default/files/documents/resources/participatorylanduseplanning.pdf

which uncertainty is calculated) are assumed valid for 10 years. Therefore, a deviation to module X-UNC is applied to permit parameter UP,SS,i,pool# to be monitored every 10 years, putting it into alignment with modules CP-AB and CP-D.

Two deviations are employed in the treatment of wood products to correct errors in the methodology and improve accuracy. In eq. 4 of CP-W, an additional term (incorporating volume-weighted specific gravity of commercial volumes) is applied to convert volume in m^3/ha (from application of 1/BCEF) back to t CO2e/ha (units of output parameter CXB). Also, per current treatment in BL-UP, there is double counting of emissions from wood products because in eq. 24 the entirety of aboveground tree biomass is emitted at the time of deforestation, and in addition, the fraction of aboveground tree biomass entering the wood products pool is steadily emitted over 20 years. Eq. 24 of BL-UP was modified to subtract CWP (fraction of aboveground tree biomass extracted, not immediately emitted and entering wood product pool at time of harvest) from ΔC_{ABtree} to avoid double counting of emissions in the baseline.

To calculate $PROP_{CS}$ for outside leakage belt leakage, mean live aboveground tree biomass t CO2/ha was replaced with mean stem volume m^3/ha. The available national data in the NAFORMA 2015 Report for Tanzania is inaccurate. The aboveground biomass in stem wood is overinflated when multiplied by the appropriate BCEF (selected from the IPCC 2006 Vol 4 Table 4.5), making it ineffective to compare mean live aboveground tree biomass within the project area from the inventory to the national data. Therefore, mean live stem volume was used in its place, dividing mean live aboveground stem volume within the project area by the area weighted average mean live aboveground stem volume in Tanzanian forests based on the provided volumes in the NAFORMA 2015 Report.

In the baseline modeling scenario in section 3.2.1, the landscape factor of slope steepness ratio is not included because it is evident that all slope classes are subject to agricultural conversion. Therefore, the ratio of slope steepness between the PA and the LB/RRD is not important to the determination of the RRD and LB areas. Table 3.5b below illustrates comparable amounts of agricultural activity across all steepness classes in both the PA, RRD, and LB.

Table 3.5b. Area deforested by slope class, showing presence of deforestation for agriculture on all slopes within the PA, RRD, and LB between 2007 and 2017.

Slope Class (%)	Area Deforested (ag conversion) 2007-2017 (km^2)	Total Area (ha)	% Area Deforested
1 to 10	1,171,178.2	15,558,044.8	7.53%
11 to 20	86,741.5	1,213,882.2	7.15%
21 to 30	27,431.1	1,035,667.7	2.65%
31 to 40	13,104.8	215,682.7	6.08%
41 to 50	6,431.4	109,988.7	5.85%
51 to 60	2,950.8	47,413.1	6.22%
61 to 70	1,203.3	17,097.1	7.04%
71 and greater	583.3	7,108.6	8.21%

3.2 Quantification of GHG Emission Reductions and Removals

3.2.1 Baseline Emissions

Development of the project baseline emissions from unplanned deforestation, both rate and location, was conducted in conformance with the VCS modular REDD methodology VM0007, specifically the BL-UP module using the simple historic approach. The simple historic approach is conservative in this case compared to the alternate population driver approach because the population in Tanzania is expanding rapidly, at a national rate of 3.0% per year, according to the World Bank[22]. By applying the simple historic approach the baseline scenario will conservatively exclude the impact of a growing population on the rate of deforestation in the RRD. The project meets the applicability conditions of this module as set out in Section 3.1.2.

Definition of Boundaries

Project boundaries for the development of the baseline include spatial and temporal boundaries from which information on the historical rate of deforestation is extracted and projected into the future. The rate of deforestation is derived from the reference region for rate, while the reference region for location is used in the spatial modeling component of the baseline. Finally, the leakage belt is the area surrounding the project area, where activity shifting leakage (i.e., deforestation which is displaced from the project area due to implementation of the project activities) is most likely to occur.

<u>Spatial Boundaries</u>

<u>Reference Region for Projecting Deforestation Rate</u>

The reference region for rate of deforestation (RRD) has a total area of 6,508,672 hectares[23] and is delineated as shown in Figure 3.1. It excludes the project area and leakage belt, and all non-forested areas at the start of the historical reference period in the year 2007. Further, the reference region has been defined with knowledge of the drivers of unplanned deforestation in the region.

A guiding principle in the delineation of the reference region was, to the extent possible within the requirements of the VM0007 methodology, to reflect political boundaries (districts), to facilitate any eventual alignment with an anticipated Government of Tanzania jurisdictional REDD+ framework.

The main agents of deforestation in the RRD are small scale farmers who intend on establishing croplands through conversion of forest land. The proportion of agriculturalist to ranchers is the same in the RRD as is expected in the project area in the baseline case. Landscape factors (i.e., soil type, vegetation type, elevation, and slope) do not drive agricultural decisions for small scale farmers (see Table 3.6).

In the baseline analysis of landscape factors for the reference region of deforestation and the leakage belt, 100% of soil types and slope classes are demonstrated to be suitable conversion to agriculture, see Table 3.5b and table below.

Soil Type	Area of new NF (2007-17) sq m	Area of full region (no NF removed)sq m	% of total Soil Area
Cambic Arenosols	94,700,878.23	4,679,710,304.74	2.0%

[22] World Bank. 2019. Population growth annual percent – Tanzania. https://data.worldbank.org/indicator/SP.POP.GROW?locations=TZ
[23] The area of the RRD is larger than the minimum required (MREF). The MREF was calculated to be 294,080 ha.

Chromic Cambisol	25,478,704.13	437,300,451.11	5.8%
Dystric Calcisol	427,967,852.47	15,529,381,653.37	2.8%
Eutric Fluvisols	96,669,087.49	859,622,143.12	11.2%
Eutric Leptosols	400,447,642.39	5,875,944,837.75	6.8%
Eutric Planosols	354,708,959.10	5,482,707,275.92	6.5%
Eutric Vertisols	134,588,170.30	2,019,660,451.52	6.7%
Ferralic Cambiso	9,271,950,643.49	110,821,479,548.69	8.4%
Fluvic Histosols	106,064,181.22	4,162,955,460.33	2.5%
Haplic Ferrasols	395,060,720.78	5,232,169,128.56	7.6%
Haplic Lixisols	175,759,311.92	5,045,719,300.20	3.5%
Haplic Nitisols	1,035,823,549.87	9,541,444,860.31	10.9%
Haplic Solonetz	324,616,420.66	4,286,681,059.84	7.6%
Lithic Leptosols	45,616,779.30	1,086,408,302.27	4.2%
Rhodic Ferrasols	319,874,510.00	2,772,074,984.93	11.5%

Soil type and steepness of terrain are not good predictors of deforestation in the region as indicated in Table 3.9, which is shown additionally by the model optimized variable selection and accuracy, which is greater than 90% when these factors are excluded.

Maps of the landscape factors, including forest type, soil type, slope, and elevation that were used to help define the reference region and ensure similarity to the project area can be found in the project database. Incorporation of these landscape factors had little effect on delineating the RRD as almost all land in the RRD is suitable for conversion to agricultural land.

Community surveys have been implemented in and around the project area and leakage belt to demonstrate the main agents of deforestation lack the legal rights to use the land, and to estimate the proportion of residents versus immigrants.

Land tenure was also used to help delineate the RRD. Specifically, national parks, game reserves, and forest reserves (where historic enforcement was apparent) were excluded from the RRD as these areas differ from the project area. Comparison of the area covered by landscape factors, transportation networks and human infrastructure are detailed in the Table 3.6 below.

Table 3.6. Criteria for defining the boundary of the RRD and leakage belt.

Factors Assessed	Category	Project Area	Project Area +/- 20%	Leakage Belt	Reference Region for Rate RRD
Vegetation (%)					
	Forest (10% canopy cover)	100.00%	80-100%	100.00%	100.00%
Elevation (%)					
	to 1000	0.00%	0-20%	0.00%	8.14%
	1000-1499	77.15%	57.15- 97.15-%	79.13%	86.28%
	1500-1999	22.85%	2.85- 42.85%	20.79%	5.51%
	2000-2500	0.00%	0-20%	0.08%	0.08%

Slope (%)					
	Gentle (<15%): Steep> 15%)	1.4	See deviation	2.2	12.2
Soil (%)					
	Suitable	100%	100-100	100%	100%
Rivers (m/km^2)					
		93.30	74.64-111.96	81.38	78.33
Roads (m/km^2)					
		46.98	37.59-56.38	38.25	44.41
Settlements/Population (Number of settlments/km^2)					
		0.00	0-0	0.00	0.00

There are no government incentivized land conversion or settlement plans in the RRD which result in planned conversion of forest land.

Reference Region for Projecting Location of Deforestation

The reference region for projecting location of deforestation (RRL) has approximately the same boundary as the RRD, but it excludes all forest reserves because it is expected that conservation of forest reserves will be enforced during the baseline projection period (i.e. will improved from the historic reference period). The RRL has an area of 4,533,253 hectares. In agreement with the methodology, it is a single parcel, contiguous with and including the project area and the leakage belt. Further, it is 29.23% non-forest and 70.57% forest and thus in compliance with the methodological requirements of a minimum of 5% non-forest and a minimum of 50% forest. The area of the RRL is within ±25% of the area of the RRD. As the primary driver of deforestation is subsistence and small-scale farming, access to and availability of land are the most important factors when determining if land is suitable for conversion. Neither, soil suitability, precipitation, elevation, or access to markets play a significant role in the deforestation agent's decision on where to settle and convert land. All conservation lands where the protected status is likely to be enforced have been removed from the RRL.

Figure 3.1. Reference Region for Rate (RRD) and Reference Region for Location (RRL).

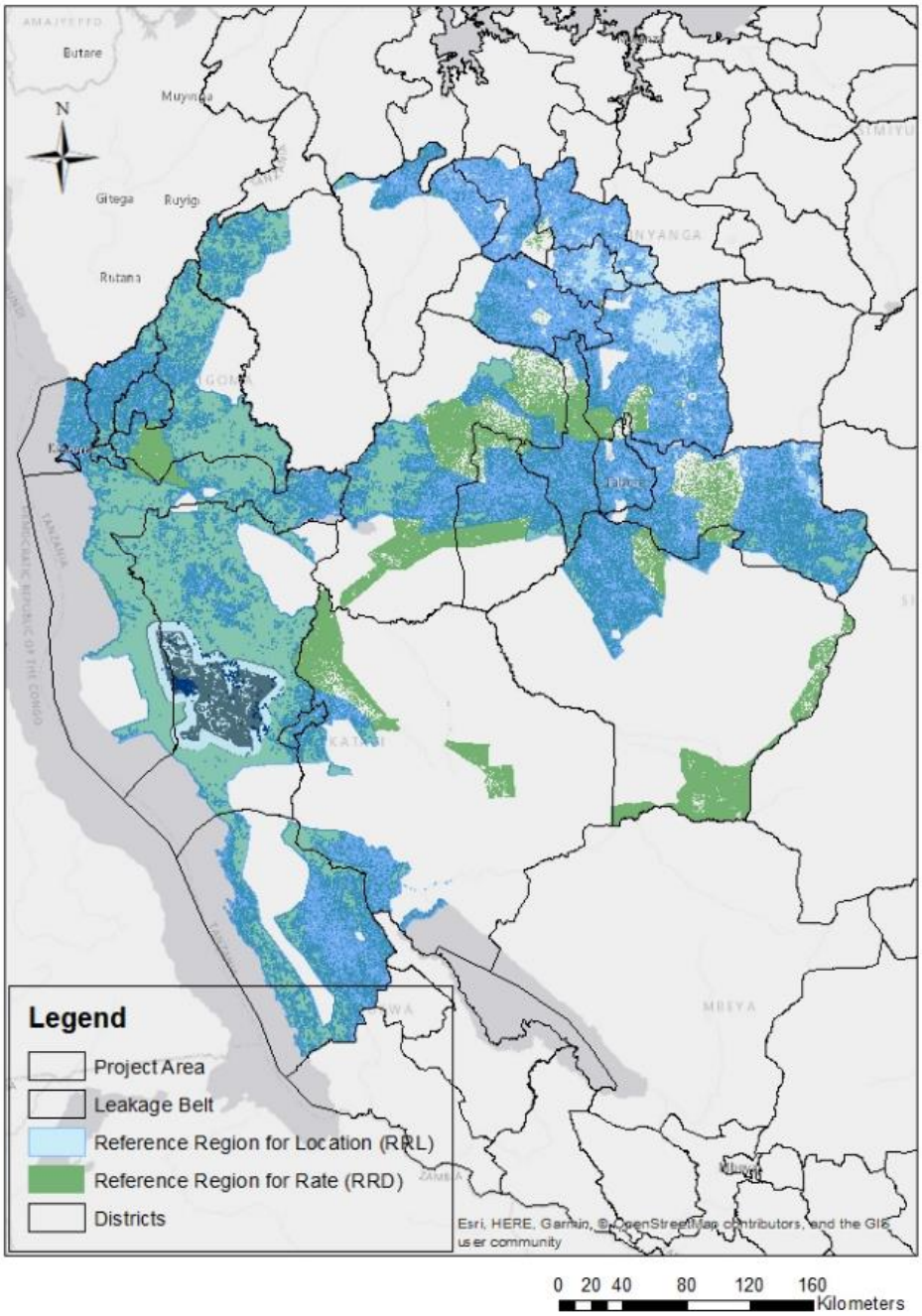
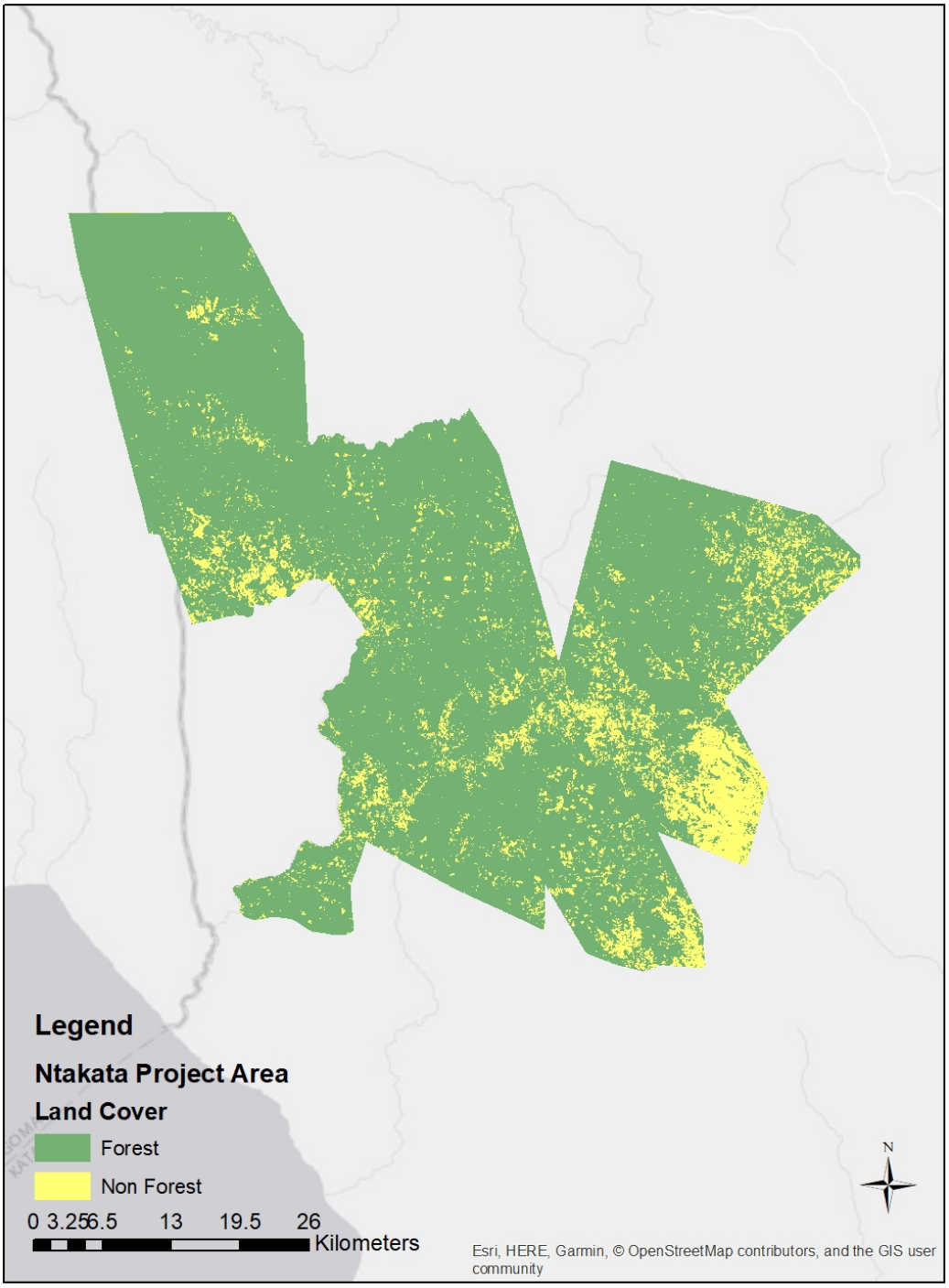


Figure 3.2. 2017 forest/non-forest map, with the non-forest class is in yellow.



Project Area

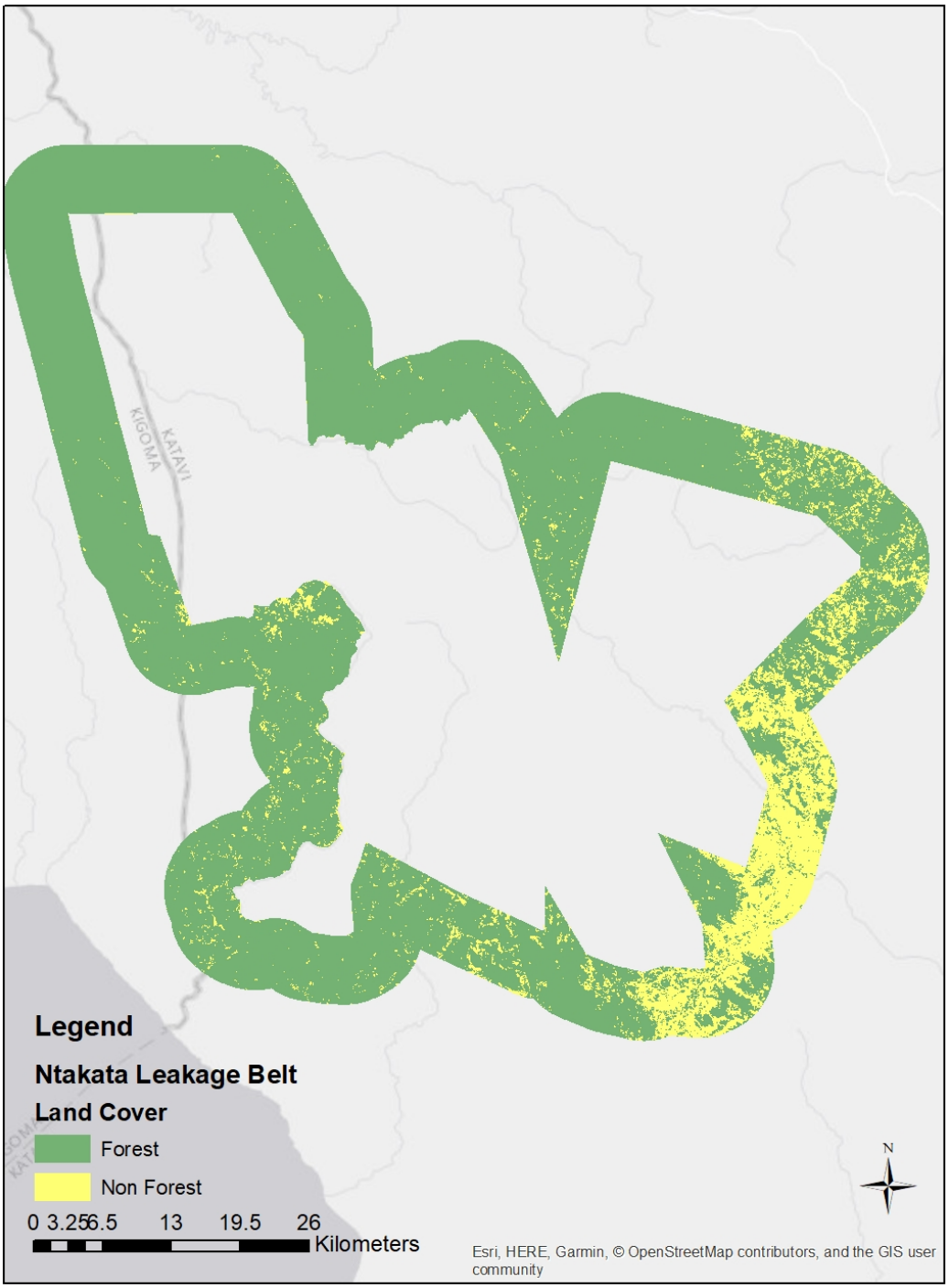
The project area (see Figure 3.3, below) consists of one contiguous parcel of land in the Mpanda and Kigoma District boundaries in western Tanzania, which is under threat of deforestation. The project proponents are undertaking project activities in and around the project area to mitigate deforestation pressures and stop deforestation. The total project area is 204,807 ha and was 100% forested at the start of the project.

Leakage Belt

The leakage belt (see Figure 3.3, below) is the area surrounding, or in the immediate vicinity of, the project area where leakage caused by activity displacement is expected to occur. It meets the following requirements as outlined in the methodology:

- It is the forest area closest to the project area and meets the minimum area requirement (i.e., ≥90% of project area). The leakage belt covers 184,733 hectares, which is greater than 90% of the project area.
- All parts of the leakage belt are accessible and reachable by agents of deforestation.
- The leakage belt is not spatially biased in terms of distance of edge of belt from edge of project area.
- The leakage belt is 100% forest at the start of the project.

Figure 3.3. Leakage Belt Demonstrating Exclusion of Historically Deforested Areas.



Temporal Boundaries

The temporal boundaries of the project are listed below:

- May 19, 2007 to May 18, 2017 - Start date and end date of the historical reference period.
- May 19, 2017 – May 18, 2027 - Start date and end date of the first project baseline period.
- May 19, 2027 - Date at which the project baseline will be revisited. The baseline must be renewed every 10 years from the project start date.

Estimation of Annual Areas of Unplanned Deforestation

The rate of deforestation was derived from an analysis of deforestation occurring within the RRD during the historical reference period, 2007-2017.

Analysis of Historical Deforestation

Landsat TM, ETM and OLI imagery, medium resolution remotely sensed spatial data from the years 2007, 2013, and 2017 were acquired for analysis. A Minimum Mapping Unit (MMU) of 0.36 ha (2 * 2 Landsat pixels or 60 m * 60 m) was used to most closely conform with the Tanzania DNA forest definition minimum area of 0.5 ha. Land cover classifications of forest and non- forest were created for each time step using supervised classification techniques following best practices in remote sensing. Forest cover change between 2007, 2013, and 2017 was assessed from this time series of classified Landsat imagery (data and analysis, including classification accuracy assessment, presented in project database).

An accuracy assessment of the 2017 forest/non-forest map was performed using 100 ground truth points [24] derived from high-resolution imagery in Google Earth (e.g. Quickbird). The Quickbird satellite collects multispectral imagery at 2.4- and 2.8-meter resolutions, and thus meets the requirements of the methodology of < 5-meter resolution for ground-truthing imagery. Distribution of validation points was limited to areas where high resolution imagery was available for corresponding dates to the classification imagery. Within these high-resolution scenes accuracy assessment points were randomly distributed. As availability of high-resolution imagery corresponds to areas of active deforestation and development, it follows that these scenes are a mosaic landscape with patches of forest/non-forest. It is within this mosaic landscape where classification is most likely to be erroneous due to the scale at which deforestation is taking place and the resolution of Landsat which can create the challenge of mixed pixels. As such, the higher concentration of accuracy assessment points within these mosaicked landscapes is not only logical since deforestation is most prevalent here, but it is also where classification errors are more likely, thus increasing the difficulty of attaining the requisite classification accuracy.

All ground-truthing sample points used to assess classification accuracy have been documented in a .kml file and archived. All verification samples gathered from high-resolution imagery were from within 12 months of the classification year. Points were then compared to the forest/non-forest classification for 2017. The accuracy of the 2017 forest/non-forest map was > 90% for both the forest and non-forest class[25]. This meets the minimum map accuracy of 90% for each class as set forth in the methodology.

Estimation of the Annual Areas of Unplanned Baseline Deforestation in the RRD

[24] Congalton (2005) suggests a sample sizes of 50 to 100 assessment points for each map category. Congalton, R. G. 2005. Thematic and Positional Accuracy Assessment of Digital Remotely Sensed Data. 2005 Proceedings of the Seventh Annual Forest Inventory and Analysis Symposium. 2005 October 3–6; Portland, ME.

[25] More detailed results of the accuracy assessment can be found in the project database.

Annual estimates of deforestation within the RRD were derived by calculating the amount of total deforestation within the boundary of the RRD from 2007-2017 and does not include areas deforested prior to 2007 (see Figure 3.1). The resulting area was the amount of deforestation within the RRD in the historical reference period. This area of deforestation was then summarized by year, yielding the results found in Table 3.7.

Table 3.7. Annual Amount of Deforestation in the RRD.

Year	Area of deforestation in RRD (ha/yr)
2007-2013	124,024
2010-2017	146,327
Average	135,176

The mean area deforested across the historical reference period (ABSL,RRD,unplanned,t), located above in Table 3.7, is used for each year in the baseline period.

ABSL,RRD,unplanned,t = 135,175ha

<u>Estimation of Annual Areas of Unplanned Baseline Deforestation in the Project Area</u>

The projected amount of unplanned baseline deforestation in the RRL is estimated using Equation 4 in module BL-UP.

Table 3.8. Projected Area of Unplanned Baseline Deforestation in the RRL.

Parameter	Description	Value	Justification
ABSL,RR,unplanned,t	Projected area of unplanned baseline deforestation in the reference region for location (RRL) in year t; ha	117,046	
ABSL,RRD,unplanned,t	Projected area of unplanned baseline deforestation in RRD in year t; ha	135,175	Derived in Section 3.2.1
PRRL	Ratio of forest area in the RRL at the start of the baseline period to the total area of the RRD; dimensionless	0.866	RRL2007 Forest = 5,635,752 ha

			RRD = 6,508,672 ha

ABSL,RR,unplanned,t = 117,046 ha per year

Location and Quantification of Threat of Unplanned Deforestation

Spatial analysis was conducted with the IDRISI TERRSET software (Eastman 2011), and the Land Change Modeler (LCM) which is an integrated software environment. LCM is a spatially-explicit modeling tool that was used to model the location of deforestation projected in the baseline for both the project area and leakage belt. LCM was developed by Clark Labs in conjunction with the Andes Center of Biodiversity Conservation of Conservation International and has been tested extensively (Clark labs 2007). LCM provides a wide range of tools organized in a series of steps for analyzing land cover change; modeling potential for change; predicting change and validating results. For this analysis, LCM was used to produce a vulnerability map of the project area and leakage belt. Translation of the vulnerability map into a scenario map of deforestation through the project term was conducted with a rank and assign operation. This model meets the criteria of (1) being peer-reviewed, (2) transparent, (3) incorporating spatial datasets used to explain patterns of deforestation, and (4) is capable of projecting the location of future deforestation (Kim 2010, Sangermano et al., 2010, Eastman et al., 2005).[26]

All spatial modeling analysis is performed on the reference region for projecting location of deforestation (RRL). The RRL is defined in section 3.2.1 and encompasses the area surrounding the project area and leakage belt (see Figure 3.1). Information from the reference region is analyzed under a spatially explicit modeling framework to construct future scenarios of how deforestation can be allocated in the reference region. In conformance with the VCS modular REDD methodology VM0007, location analysis was conducted since the initial configuration of the RRL landscape was a frontier configuration.

Preparation of Datasets for Spatial Analysis

Land Cover Maps used for Model Calibration

Land cover maps from 2007, 2013 and 2017 (Figure 3.4 and 3.5) along with GIS coverages of spatial driver variables were analyzed with LCM to produce >50 different candidate vulnerability maps using different combinations of drivers. Remote sensing data used for imagery classification was derived from Landsat imagery as described above.

[26] Kim, O S. 2010. An Assessment of Deforestation Models for Reducing Emissions from Deforestation and Forest Degradation (REDD). *Transactions in GIS*. 14(5): 631-654.
Eastman J R, Van Fossen M E, and Solorzano L A 2005 Transition potential modeling for land cover change. In Maguire D J, Batty, and Goodchild M F (eds), GIS, *Spatial Analysis and Modeling*. Redlands CA, ESRI Press: 357–86.
Sangermano,F. Eastman, J R, and Zhu, V. 2010. Similarity Weighted Instance-based Learning for the Generation of TransitionPotentials in Land Use Change Modeling. *Transactions in GIS*. 14(5): 569–580.f

Figure 3.4. Land cover map of forest/non-forest area of RRD in 2007 used in spatial analysis (2013 not shown).

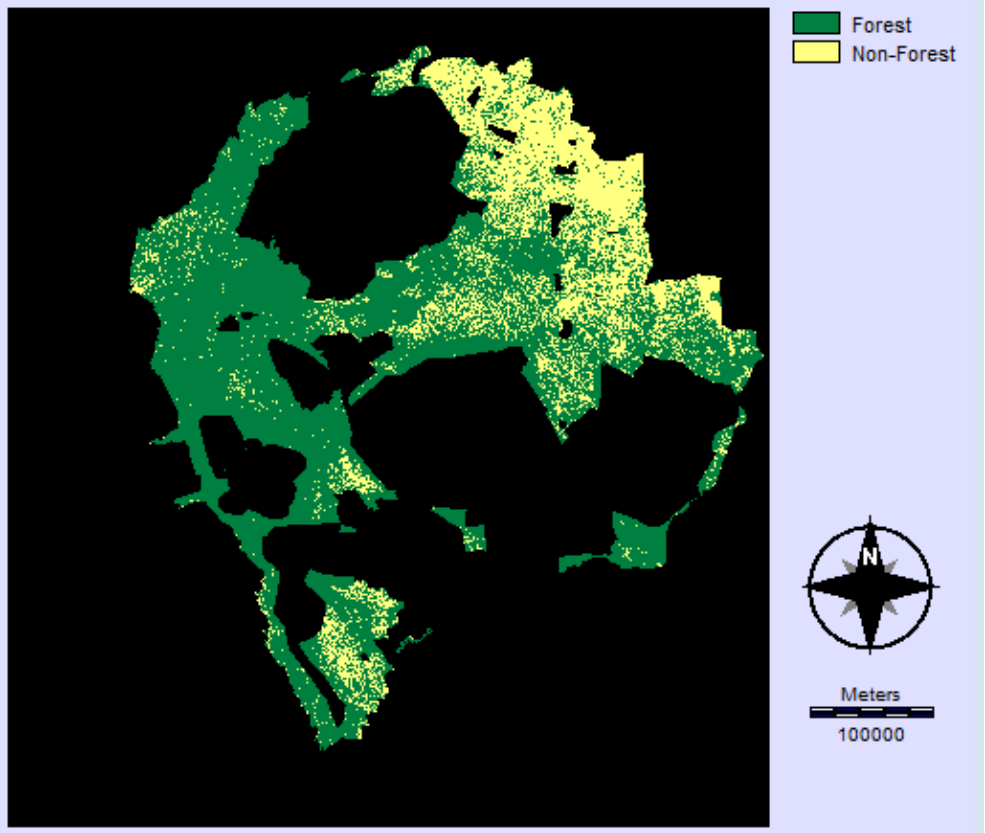
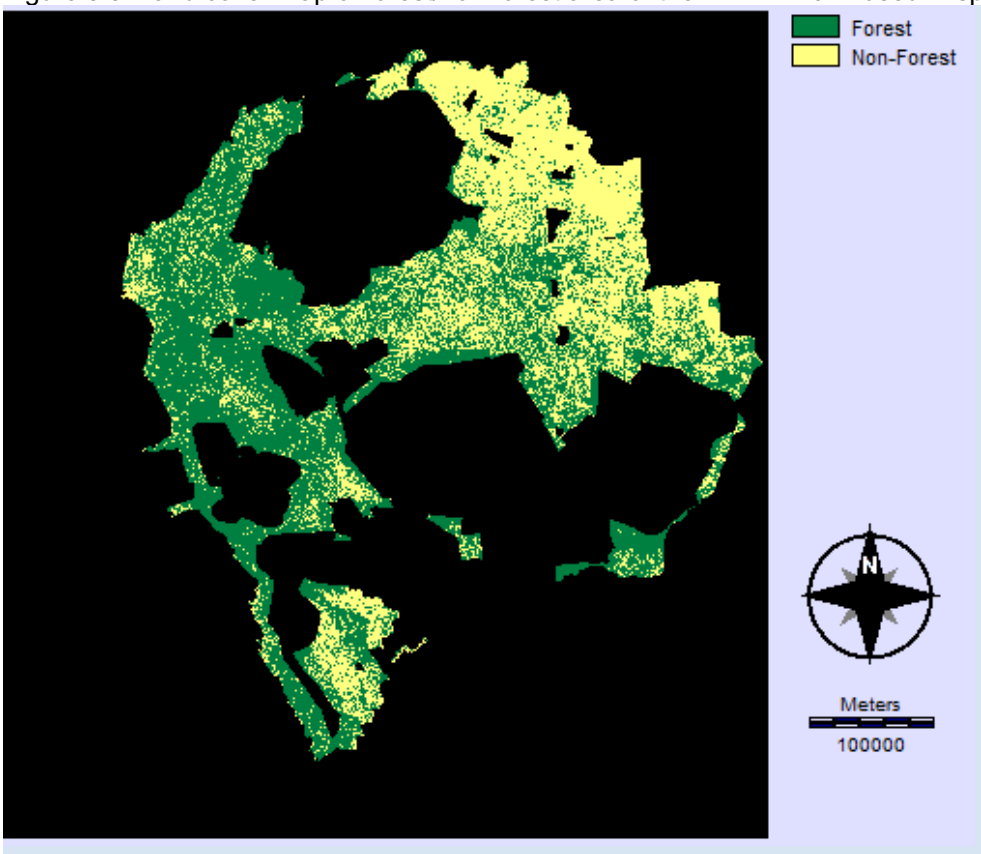


Figure 3.5. Land cover map of forest/non-forest area of the RRD in 2017 used in spatial analysis.



Land cover change modeling requires two phases; calibration and validation. The first time-step, 2007-2013 was used to calibrate the model and the second time-step 2013-2017 was used to validate the model's predictive capacity. For calibration, the classified maps from the first two time points, from 2007 and 2013, were analyzed. Locations that experienced a transition from forest to non-forest ("transition") and locations that do not transition but remained as forest ("persistence") were used to develop and test for relationships with potential driver variables. A large number of training sample locations was randomly chosen from both of these categories. This number may be user-defined, and in this model was set to 5,000 samples. An equal number of randomly selected locations were used to test the predictive capacity of the model within the calibration phase, and inform the adjustment of the weights of the input variables.

Developing a predictive model is an iterative process that requires exploration of the spatial variables that may drive deforestation patterns. Variables that have demonstrated strong correlation with deforestation in the field of land change science are categorized in the methodology into four categories: landscape factors, accessibility factors, anthropogenic factors, actual land tenure and management. All variables must be spatially explicit, and for use in the model must be in raster format. Spatial variable used in the model are called factor maps.

Potential drivers of deforestation were assessed with input from regional experts, literature review and input from other land change modeling efforts. Assessment of factors that should be included in the model is an iterative process that is done by assessing multiple model runs while removing and adding variables selectively. Performance assessment of the combination of factor maps and their predictive capacity is done at multiple stages of the analysis. This results in a general assessment of the model's accuracy and can be used to evaluate if factors have increased or decreased the model's performance. Commonly used transformations for variables were also explored. Although transformations are only

required for logistic regression modeling, where variables must be linearly related to the potential for transition, transformations can improve the performance of other models, especially where there may be strong non-linearities, thus yielding higher accuracy. Distance-based variables were tested to see if transformations improved model accuracy. These transformations included the natural log transformation (ln) which is commonly effective in linearizing distance decay variables, a square root transformation, which can assist in enhancing the importance of small changes in distance, and categorization of distances into classes, which can help to tease out the critical zones of distance-related functions. Factor maps explored in the modeling and included in the final model are listed in Table 3.9.

Table 3.9. Factor Maps that were Incorporated in the Final Spatial Model.

Factors Considered	Description	Included in Final Model
Accessibility Factors	Distance to Roads	Yes
Anthropogenic Factors	Distance to Deforestation	Yes
	Distance to Towns	Yes
	Distance to Forest Edge	Yes
Landscape Factors	Elevation	Yes
	Slope	No
	Soil	No
	Precipitation	No
	Distance to water sources	No
	Vegetation	No
Actual Land Tenure & Management	Distance to Protected Areas	Yes
	Distance to Management Areas	No

Preparation of Risk Maps for Deforestation

Validation of the model is done by comparing the predicted change to actual change for the period from 2013 to 2017. The output of the model is a transition potential map or a “risk map” that expresses the likelihood or potential for a location to transition from forest to deforested on a scale from 0 (minimum potential) to 1 (maximum potential). These values can be ranked in descending order, and this map is used to assign pixels to deforestation.

Quantity of deforestation was estimated in a separate analysis detailed above using average historic rate of deforestation in the RRD. Areas of deforestation were allocated until the quantity of deforestation modeled was exhausted. The procedure was carried out for each year in the baseline, 2017-2027.

Selection of the Most Accurate Deforestation Risk Map

An artificial neural network was used to develop the risk maps, and the following procedures were followed to meet the requirements of model calibration and confirmation from the methodology:

For the calibration period, a minimum of 5,000 samples (pixels) of the “transition” category (forest to non-forest) and 5,000 samples (pixels) of the “persistence” category (locations that do not transition but remain as forest) were randomly selected and used for training and testing. A minimum of 10,000 iterations of the model were run before selecting the best fit model.

Using the above process, multiple risk maps and the corresponding prediction maps were created for the year 2013. Each prediction map is compared to the actual map from 2013 to assess the model's performance. The measure of performance used as mandated by the methodology is the "Figure of Merit" (FOM) that confirms the model prediction in statistical manner (Pontius et al. 2008[27]; Pontius et al. 2007[28]). The FOM is a ratio of the intersection of the observed change (change between the reference maps in time 1 and time 2) and the predicted change (change between the reference map in time 1 and simulated map in time 2) to the union of the observed change and the predicted change. The FOM ranges from 0%, where there is no overlap between observed and predicted change, to 100% where there is a perfect overlap between observed and predicted change. The highest percent FOM and least number of factor maps used for creating the deforestation risk map must be used as the criteria for selecting the most accurate deforestation risk map to be used for predicting future deforestation.

Equation 15 in module BL-UP VMD0007.

$$FOM = \frac{CORRECT}{CORRECT + Err_A + Err_B}$$

Where,

CORRECT	Area correct due to observed change predicted as change; ha
ErrA	Area of error due to observed change predicted as persistence; ha
ErrB	Area of error due to observed persistence predicted as change; ha

The final model was selected from multiple runs, according to the methodology as having the highest FOM value with the fewest number of factor maps with a minimum of one factor map in each of the four categories defined.

FOM 57975 ha / (57975ha + 1311001 ha + 1266126)

%FOM = 31.1%

The minimum threshold for the best fit as measured by the Figure of Merit (FOM) is defined by the net observed change in the reference region for the calibration period of the model (2005-2010). Net observed change is calculated as the total area of change being modeled in reference region during the calibration period as percentage of the total area of the reference region. Net change from 2007-2013 was 744,142.42 hectares out of a total of 6,508,672.19 which is 11.4% of total area. The FOM value therefore meets the minimum threshold.

<u>Mapping of the Locations of Future Deforestation</u>

From the model, a future deforestation risk map was created to assign a likelihood of deforestation to each pixel. Using a rank operation, all forested pixels of the RRL were ranked in descending order, so that the pixel with the highest likelihood of deforestation was assigned a value of 1. Future deforestation was assumed to happen first at the pixel locations with the highest deforestation risk value, so each pixel was allocated to deforestation in rank order for each year according to the annual projections from 2017-2026 ($A_{BSL,RR,unplanned,t}$). This operation resulted in a single map showing the predicted deforestation over

[27] R G Pontius Jr, W Boersma, J-C Castella, K Clarke, T de Nijs, C Dietzel, Z Duan, E Fotsing, N Goldstein, K Kok, E Koomen, C D Lippitt, W McConnell, A Mohd Sood, B Pijanowski, S Pithadia, S Sweeney, T N Trung, A T Veldkamp, and P H Verburg. 2008. Comparing input, output, and validation maps for several models of land change. Annals of Regional Science, 42(1): 11-47.
[28] R G Pontius Jr, R Walker, R Yao-Kumah, E Arima, S Aldrich, M Caldas and D Vergara. 2007. Accuracy assessment for a simulation model of Amazonian deforestation. Annals of Association of American Geographers, 97(4): 677-695.)

the baseline period (Figure 3.5) in the project area and surrounding reference region. Further, the area of baseline deforestation for the project area and leakage belt was summed by strata for each year in the baseline period (Table 3.10 and Table 3.11).

Figure 3.5. Map of the Predicted Deforestation in the Baseline Period from 2017 to 2026.

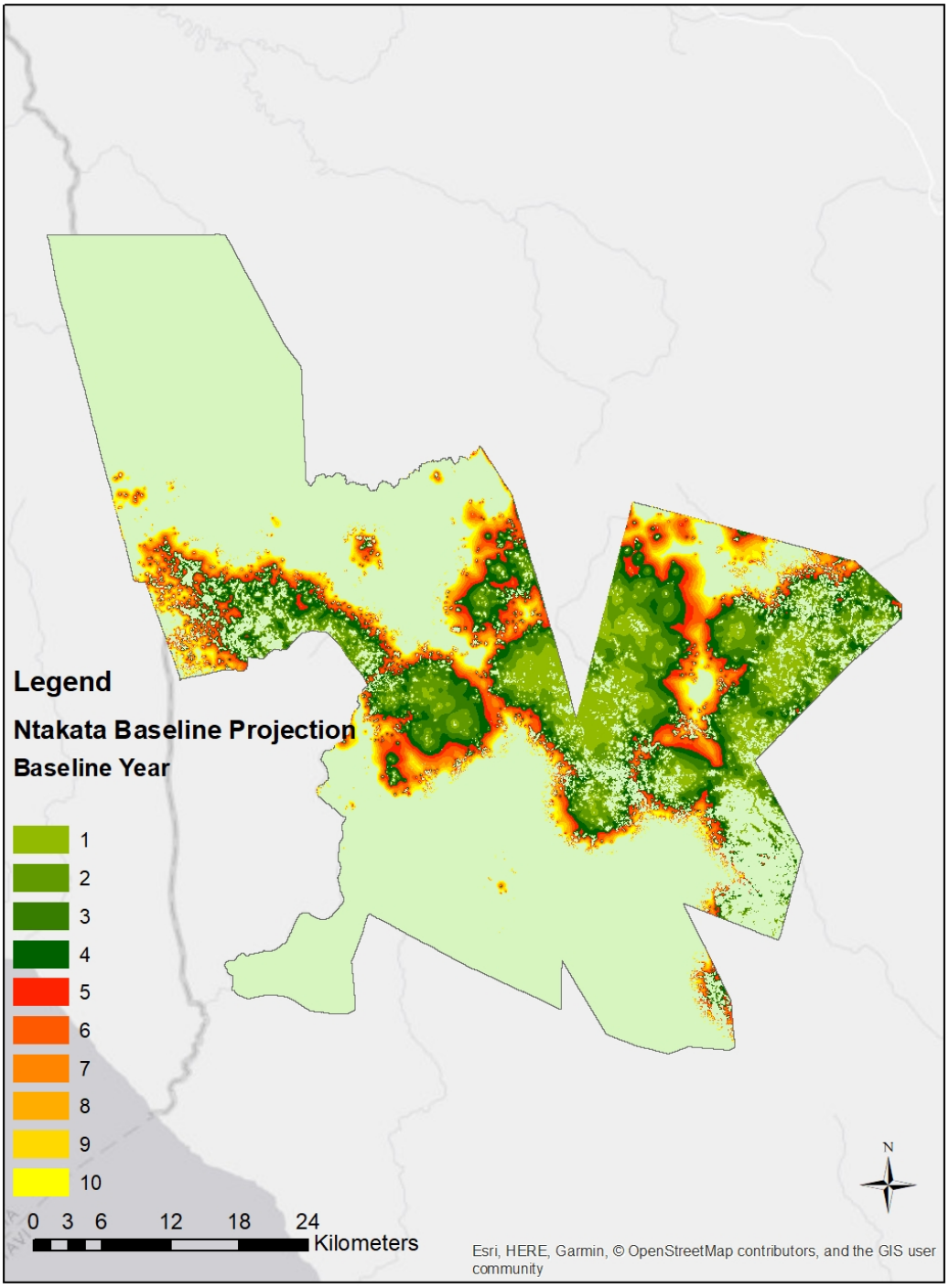


Table 3.10. Amount of Baseline Deforestation (ha) in the Project Area.

Year	Aunplanned,i,t, PA (ha)
2017	11,229.8
2018	14,144.1
2019	13,023.1
2020	11,169.0
2021	6,914.3
2022	7,435.7
2023	4,972.1
2024	4,830.2
2025	4,746.6
2026	4,441.0
Total	82,906.0

Table 3.11. Amount of Baseline Deforestation (ha) in the Leakage Belt.

Year	Aunplanned,i,t, PA (ha)
2017	2,399.0
2018	5,245.1
2019	5,799.7
2020	5,833.3
2021	3,969.7
2022	4,007.3
2023	2,609.1
2024	2,687.5
2025	2,784.0
2026	2,471.9
Total	37,806.4

Image classification

Three years of Landsat imagery were classified, 2007, 2013 and 2017. All images were downloaded from USGS Earth Explorer.

Figure A1. Imagery dates used in classification.

Row	2007	2013		2017	
Path 170					
63	9/26/2007	6/22/2013		9/5/2017	

64	9/26/2007	6/22/2013		9/5/2017	
65	9/26/2007	11/13/2013		9/5/2017	9/21/2017
Path 171					
62	8/24/2007	6/22/2013			8/27/2017
63	7/31/2007	7/15/2013		10/30/2017	8/27/2017
64	7/31/2007	6/29/2013	7/15/2013	10/30/2017	8/27/2017
65	7/31/2007	6/29/2013		10/30/2017	
Path 172					
62	8/7/2007	6/20/2013		8/3/2017	
63	8/7/2007	6/20/2013		8/3/2017	
64	8/7/2007	6/20/2013	8/23/2013	8/3/2017	
65	8/7/2007			8/3/2017	

All imagery is from Landsat 8 Operational Land Imager (OLI), Landsat 7 Enhanced Thematic Mapper Plus (ETM+) or Landsat 4-5 Thematic Mapper (TM). These images are all Tier 1 collection, which indicates that these Landsat scenes have the highest available data quality and are very suitable for time-series analysis. Tier 1 data is Level-1 Precision and Terrain (L1TP) corrected data, so they have well-characterized radiometry and are inter-calibrated across the different Landsat instruments. The 1G product available to users is both radiometrically and geometrically corrected. The correction algorithms employed model the spacecraft and sensor using data generated by onboard computers during imaging events and ground control points and a digital elevation model are also used to improve the overall geometric fidelity. The geometric correction process utilizes both ground control points (GCP) and digital elevation models (DEM) to attain absolute geodetic accuracy. The WGS84 ellipsoid is employed as the Earth model for the Universal Transverse Mercator (UTM) coordinate transformation. Associated with the UTM projection is a unique set of projection parameters that flow from the USGS General Cartographic Transformation Package. The end result is a geometrically rectified product free from distortions related to the sensor (*e.g.*, jitter, view angle effects), satellite (*e.g.,* attitude deviations from nominal), and Earth *(e.g.,* rotation, curvature, relief). The geo-registration (or location accuracy) of Tier 1 scenes is within prescribed image-to-image tolerances of ≦ 12-meter radial root mean square error (RMSE). [29]

When using Level 1G-processed imagery, geometric accuracy should be confirmed, but extra geo-referencing steps are unnecessary.

Processing
All image processing was conducted in TerrSet image processing software version 18.3[30], unless otherwise noted.

Each image was processed using a hard classification clustering technique. Through this process, pixels are grouped according to their spectral similarities and are then identified to land cover classes. Any pixels with no data due to clouds and shadow can be removed and other images can be used to fill these gaps. For each image, the remaining data is processed to identify all forest and non-forest clusters. Using known areas of forest, these cluster groups are identified and clumped. The same process is conducted for non-forest clusters. In some areas, the non-forest category also includes categories that can be difficult to separate due to illumination or similarity to forest (i.e

[29] https://www.usgs.gov/land-resources/nli/landsat/landsat-collection-1
[30] https://clarklabs.org/

secondary forests, swamps and areas that have illumination variability). In these cases, a secondary classification step can be used for clusters that included potential confusion. These areas were processed again through a secondary cluster analysis focused only on these categories and resulted in further dividing confusion classes. Through careful inspection of these new finely distinguished clusters, areas of non-forest were distinguished. In a final processing step, all forest and non-forest groups from each image are then combined.

Ancillary data was included to improve classification performance in some cases. For the year 2017, an additional processing step was added using Sentinel 1 imagery. Sentinel 1 collects C-band synthetic aperture radar imagery[31]. This was added over portions of the region, especially the project area, to add texture and VV band information to the region to improve the classification. Sentinel 1 pre-processing and post-processing was conducted to correct for: Calibration, Acquisition corrective information, Speckle filtering, Geometric and elevation correction, Image stacking, Resampling, GLCM calculation. Overlapping images from 2 close dates were stacked and scattering values were averaged to reduce speckle. Texture values of pixel mean, variance, and contrast were calculated through grey level co-occurrence matrix (GLCM) tool in SNAP (Sentinel application platform). VV and VV variance were classified – lower VV backscatter values were extracted to identify NF areas. This allowed for additional evaluation of the non-forest class.

Quality Assurance/Quality Control
To ensure consistency and quality results, all data sources and analytical procedures are documented and archived (detailed under data archiving).

Accuracy of the classification was assessed by comparing the classification with ground truth points and samples of high-resolution imagery (i.e Quickbird imagery/ Astirum ~5m resolution available on Google Earth and through ESRI ArcMap basemaps). All data collected from ground-truth points are recorded (including GPS coordinates and identified land-use class) and archived. Samples used to assess classification accuracy are well-distributed throughout the classification area (as far as is possible considering availability of high-resolution imagery), with a minimum sampling intensity of 50 points each for the forest and non-forest classes.

2017 Accuracy Assessment

An accuracy assessment of the 2017 forest/non-forest map was performed using 259 ground truthing points using high-resolution Sentinel 2 imagery. Imagery dates are recorded in the shapefile. All points were assessed using 2017 Landsat imagery as well. This allowed for accurate interpretation of the Landsat data set through cross referencing and training with other higher resolution imagery. Distribution of all points is shown in Figure A3. The accuracy assessment table (A2) shows that overall classification accuracy is 93.05%.

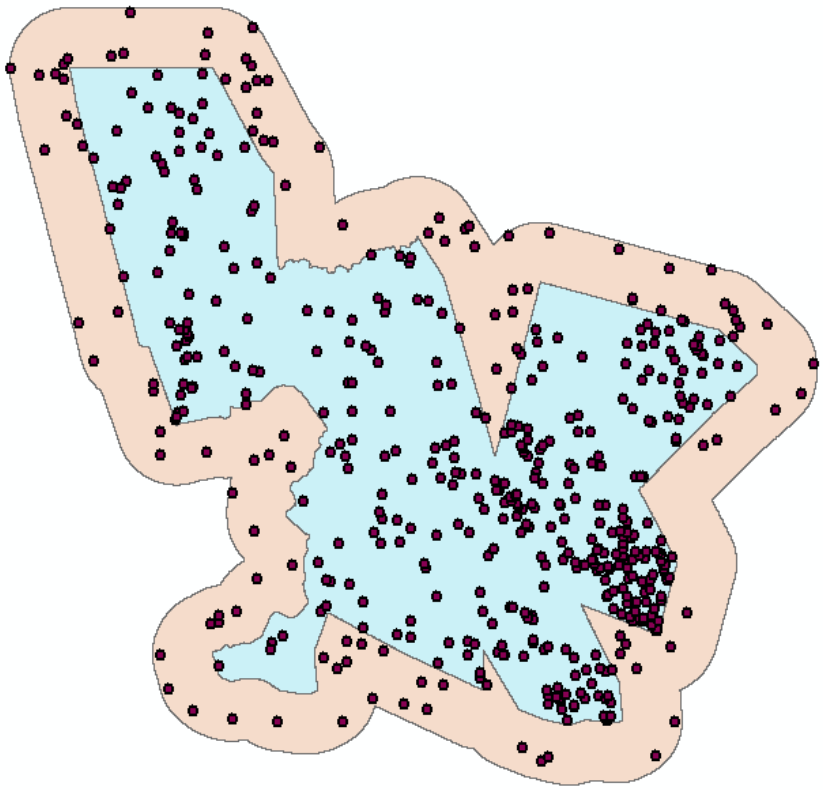
A2. Accuracy Assessment Confusion matrix.

Classification	Land-use class as determined from ground-truth points	Total	Accuracy (%)	Error of Commission (%)
			User's accuracy	

[31] https://sentinel.esa.int/web/sentinel/missions/sentinel-1

	Forest	**Non-forest**		***(# correct/ row total)***	
Forest	247	12	259	95.37%	4.63%
Non-forest	24	235	259	90.73%	9.27%
Total	271	247			
Accuracy (%) ***Producer's accuracy*** ***(# correct/ column total)***	91.14%	95.14%		Overall Accuracy	
Error of Omission (%)	8.86%	4.86%		93.05%	

A3. Distribution of accuracy assessment point throughout the project area and leakage belt.



3.2.2 Project Emissions

Forest carbon stocks were directly measured in a forest inventory of the project area conducted from September to November 2017. Standard operating procedures for field measurements, sample design, analytical methods, including validation of the Mugasha et al. 2013[32] allometric equation for miombo woodland in Tanzania, and all results are detailed in the document "Mahale Forest Inventory Feb2018" which can be found in the project database.

Stratification of the Total Area Subject to Deforestation

The sample design was a simple random sample employing clusters of four fixed 10m-radius plots. Several approaches were tested to post-stratify the inventory, looking at slope, aspect, elevation, Enhanced Vegetation Index (EVI) and distance to nearest population center. None of the factors yielded a strong correlation with biomass stocks and therefore the sample was not post-stratified; see detailed analysis in "Mahale Forest Inventory Feb2018".

[32]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.

Estimation of Carbon Stocks and Carbon Stock Changes

Biomass carbon in live trees was estimated as 162.7 t CO2e/hectare with a 95% confidence interval of 121.7 to 203.7 t CO2e/hectare. Biomass carbon in standing dead wood was estimated as 1.1 t CO2e/hectare with a 95% confidence interval of 0.1 to 2.1 t CO2e/hectare. Total forest biomass carbon was estimated as the sum of the sampled pools live trees and standing dead wood, with average total forest biomass carbon of 163.8 t CO2e/hectare. The carbon stocks are summarized in Table 3.12.

The 95% confidence interval of the onsite forest biomass carbon estimate across all pools is +/- 41.1 t CO2e/hectare or 25.1% of the mean. Thus, we are 95% confident that the average total forest biomass carbon (for the pools sampled) across the inventory area is between 122.7 and 204.9 t CO2e/hectare.

All supporting calculations are provided in the accompanying Excel file “Mahale2017 inventory 1-31-19”.

Table 3.12 Estimation of Carbon Stocks for the Project Area.

Parameter	Description	Value	Justification
$C_{BSL,i}$	Carbon stock in all carbon pools in forest stratum i; t CO_2e ha-1	163.8 t CO_2e ha-1	See forest inventory for calculations.
$C_{AB_tree,i}$	Carbon stock in aboveground tree biomass in stratum i; t CO_2e ha-1	118.3 t CO2e ha-1	See forest inventory for calculations.
$C_{BB_tree,i}$	Carbon stock in belowground tree biomass in stratum i; t CO_2e ha-1	44.5 t CO2e ha-1	See forest inventory for calculations.
$C_{DW,i}$	Carbon stock in dead wood in stratum i; t CO_2e ha-1	1.1 t CO2e ha-1	See forest inventory for calculations.

Stocks of belowground biomass and dead wood are emitted from the year of conversion/deforestation at a linear rate equal to 1/10 of the initial stock annually, for 10 years, calculated based on Equation 23 in module BL-UP VMD0007. Net emissions ($C_{BSL\ -C}$ post) from steady decomposition of these pools are elaborated in Tables 3.13a and 3.13b, below.

Table 3.13a. Emissions from steady decomposition of belowground biomass post deforestation in the project area, Equation 18 module BL-UP VMD0007.

Year	BGB Emissions from Deforestation (t CO2)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2017	351,234	35,123	35,123	35,123	35,123	35,123	35,123	35,123	35,123	35,123	35,123
2018	442,384		44,238	44,238	44,238	44,238	44,238	44,238	44,238	44,238	44,238
2019	407,323			40,732	40,732	40,732	40,732	40,732	40,732	40,732	40,732
2020	349,333				34,933	34,933	34,933	34,933	34,933	34,933	34,933
2021	216,260					21,626	21,626	21,626	21,626	21,626	21,626
2022	232,565						23,257	23,257	23,257	23,257	23,257
2023	155,511							15,551	15,551	15,551	15,551
2024	151,073								15,107	15,107	15,107
2025	148,460									14,846	14,846
2026	138,901										13,890
Total		35,123	79,362	120,094	155,027	176,653	199,910	215,461	230,568	245,414	259,304

Table 3.13b. Emissions from steady decomposition of belowground biomass post deforestation in the leakage belt, Equation 18 module BL-UP VMD0007.

Year	BGB Emissions from Deforestation (t CO2)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2017	75,032	7,503	7,503	7,503	7,503	7,503	7,503	7,503	7,503	7,503	7,503
2018	164,051		16,405	16,405	16,405	16,405	16,405	16,405	16,405	16,405	16,405
2019	181,397			18,140	18,140	18,140	18,140	18,140	18,140	18,140	18,140
2020	182,446				18,245	18,245	18,245	18,245	18,245	18,245	18,245
2021	124,159					12,416	12,416	12,416	12,416	12,416	12,416
2022	125,337						12,534	12,534	12,534	12,534	12,534
2023	81,603							8,160	8,160	8,160	8,160
2024	84,057								8,406	8,406	8,406

2025	87,074									8,707	8,707
2026	77,313										7,731
Total		7,503	23,908	42,048	60,293	72,709	85,242	93,403	101,808	110,516	118,247

Table 3.14a. Emissions from steady decomposition of dead wood post deforestation in the project area, Equation 20 module BL-UP VMD0007

Year	DW Emissions from Deforestation (t CO2)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2017	12,335	1,233	1,233	1,233	1,233	1,233	1,233	1,233	1,233	1,233	1,233
2018	15,536		1,554	1,554	1,554	1,554	1,554	1,554	1,554	1,554	1,554
2019	14,305			1,430	1,430	1,430	1,430	1,430	1,430	1,430	1,430
2020	12,268				1,227	1,227	1,227	1,227	1,227	1,227	1,227
2021	7,595					759	759	759	759	759	759
2022	8,167						817	817	817	817	817
2023	5,461							546	546	546	546
2024	5,306								531	531	531
2025	5,214									521	521
2026	4,878										488
Total		1,233	2,787	4,218	5,444	6,204	7,021	7,567	8,097	8,619	9,106

Table 3.14b. Emissions from steady decomposition of dead wood post deforestation in the leakage belt, Equation 20 module BL-UP VMD0007.

Year	DW Emissions from Deforestation (t CO2)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2017	2,635	264	264	264	264	264	264	264	264	264	264
2018	5,761		576	576	576	576	576	576	576	576	576
2019	6,370			637	637	637	637	637	637	637	637
2020	6,407				641	641	641	641	641	641	641
2021	4,360					436	436	436	436	436	436
2022	4,402						440	440	440	440	440
2023	2,866							287	287	287	287
2024	2,952								295	295	295
2025	3,058									306	306
2026	2,715										272
Total		264	840	1,477	2,117	2,553	2,994	3,280	3,575	3,881	4,153

Harvested Wood Products
Total carbon stocks entering and emitted from the harvested wood products pool over 100 years were calculated using the VCS module CP-W VMD0005. Actual harvest values are not readily available for the project; therefore Option 2 commercial inventory estimation was chosen as the method for estimating these stocks.

To calculate the mean stock of above-ground biomass extracted for commercial wood products, we first derived the value for Pcom. Trees greater than 20 cm DBH[33] and of the following species used for timber in the Miombo woodlands of Tanzania[34] were considered commercial:

Albizia antunesiana
Brachystegia spiciformis
Isoberlinia globiflora
Julbernadia globiflora
Lannea humilis
Pterocarpus angolensis
Swartzia madagascariensis

Total and commercial volumes were estimated applying the equation below:

Stem volume (m3) = volume of a cylinder (Pi * (DBH * (1/100) * 0.5)^2 * MERCHANTABLE STEM HEIGHT) * Form Factor

Where:
DBH (cm) measured in the field
MERCHANTABLE STEM HEIGHT (m), measured in the field or estimated applying a regression derived from a subset of the inventory sample (see “Mahale eq valid 1-15-19.xlsx”)
Form Factor = 0.79 (value for miombo woodlands Katavi region, Mauya et al 201435)

The final Pcom value was then derived as the ratio of commercial volume to total volume of all live inventoried trees.

Parameter C_{XB}, mean stock biomass extracted in t CO2e/ha, was then calculated using equation 4 in module CP-W VMD0005.

=C_{ABtree} * (1 / BCEF) * Pcom * Wood density (0.598 g/cm^3)

Note that a deviation is employed here in eq. 4 of CP-W, with an additional wood density term (volume-weighted average specific gravity of commercial volumes) applied to convert volume in m^3/ha (from application of 1 / BCEF) back to t CO2e/ha (units of output parameter C_{XB}).

[33] Tanzania Forest Act. 2002.
[34] Mgumia F, Nkonoki J, Safari J. Traditional Uses of Miombo Woodland Tree Species in Sikonge District, Tanzania. International Journal of Natural Resource Ecology and Management. 2017; 2(4): 69-78.
[35] Mauya, E. W., Mugasha, W. A., Zahabu, E., Bollandsås, O. M., & Eid, T. (2014). Models for estimation of tree volume in the miombo woodlands of Tanzania. Southern Forests: a Journal of Forest Science, 76(4), 209-219.

The biomass conversion and expansion factor (BCEF) was sourced from Table 4.5 in Volume 4 of the IPCC 2006 report; the mean stocking volume (m^3) in the project area was 116.97 m^3, corresponding to a BCEF value of 1.8 for humid tropical forest.

The mean stock of biomass entering the wood products pool was calculated with the wood waste factor for developing countries, 0.24.

The fractions of wood products emitted over the first 5 years (SLF) and over 5 to 100 years (OF) were assigned by product class (see Table 15). All calculations for harvested wood are documented in "Mahale2017Inventory_calcs1-15-19.xlsx".

Table 3.15. Fractions for short-term (<5 years) and long-term (5 to 100 years) emissions for each wood product class. All commercial wood products from the project area are assumed to be sawnwood.

Wood Product Class	SLF	OF	Product Class Composition
sawnwood	0.2	0.8	100%
wood-based panels	0.1	0.9	0%
other industrial roundwood	0.3	0.7	0%
paper and paperboard	0.4	0.6	0%
other	1		0%

Table 3.16. The estimated baseline carbon stocks of harvested wood removed from the project area. Pcom represents the proportion of species that would be removed for commercial markets.

Mean ABG t CO2e/ha (Cab)	Pcom	Volume-weighted avg commercial wood density (Mg/m^3)	Mean stock biomass extracted t CO2e/ha (Cxb)	Mean stock biomass entering wood products pool t CO2e/ha Cwp)	Harvested Wood Products to be emitted over 100-years t CO2e/ha (Cwp100)
118.3	12.9%	0.598	5.068	3.852	3.235

Stocks of harvested wood products projected to be emitted over 100-years are emitted from the year of conversion/deforestation at a linear rate equal to 1/20 of the initial stock annually, for 20 years. Emissions are elaborated in Tables 3.17a and 3.17b, below.

Table 3.17a. Emissions from steady decomposition of harvested wood products in the project area, Equation 24 module BL-UP VMD0007.

Year	HWP Emissions from Deforestation (t CO2)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2017	36,334	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817	1,817
2018	45,763		2,288	2,288	2,288	2,288	2,288	2,288	2,288	2,288	2,288

2019	42,136			2,107	2,107	2,107	2,107	2,107	2,107	2,107	2,107
2020	36,137				1,807	1,807	1,807	1,807	1,807	1,807	1,807
2021	22,371					1,119	1,119	1,119	1,119	1,119	1,119
2022	24,058						1,203	1,203	1,203	1,203	1,203
2023	16,087							804	804	804	804
2024	15,628								781	781	781
2025	15,357									768	768
2026	14,369										718
Total		1,817	4,105	6,212	8,018	9,137	10,340	11,144	11,926	12,694	13,412

Table 3.17b. Emissions from steady decomposition of harvested wood products in the leakage belt Equation 24 module BL-UP VMD0007.

Year	HWP Emissions from Deforestation (t CO2)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
2017	7,762	388	388	388	388	388	388	388	388	388	388
2018	16,970		849	849	849	849	849	849	849	849	849
2019	18,765			938	938	938	938	938	938	938	938
2020	18,873				944	944	944	944	944	944	944
2021	12,844					642	642	642	642	642	642
2022	12,966						648	648	648	648	648
2023	8,441							422	422	422	422
2024	8,695								435	435	435
2025	9,007									450	450
2026	7,998										400
Total		388	1,237	2,175	3,119	3,761	4,409	4,831	5,266	5,716	6,116

The sum of baseline carbon stock changes (ΔCTOT) was estimated using Equation 23 in module BL-UP VMD0007. Parameters for use of Equation 23 can be found in Table 3.18.

Table 3.18. Estimation of Sum of Baseline Carbon Stock Changes in the Project Area and Leakage Belt.

Parameter	Description	Value	Justification
ΔC_{TOT}	Sum of the baseline carbon stock change in all pools up to time t*; t CO_2e	See calculations below.	
$\Delta C_{BSL, l, t}$	Sum of baseline forest carbon stock change in areas deforested; t CO_2e	See calculations below.	See calculations below.

C_{POST}	Total post-deforestation carbon stock in areas deforested; t CO_2e	See calculations below.	In the Katavi Rukwa region, not all trees are removed where forests are cleared for grazing or agriculture. In Banda et al 2006 the residual basal area is estimated to be 12 m^2/ha[36]. Regression of BA m^2/ha to live AGB and BGB t CO2/ha were derived from the inventory data in "Mahale2017 inventory 1-31-19.xls" to the determine C-post. From these regressions an estimated 35.29 t CO2/ha live AGB and 13.20 t CO2/ha BGB will remain C-post. Dead wood is assumed not to be a persistent pool in these agro-pastoral systems.
$C_{WP100,\ i}$	Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 00-years from stratum i; t CO_2e	3.2 t CO2-e ha-1	See calculations in "Mahale2017 inventory 1-31-19.xls"
$\Delta C_{AB_tree,\ i}$	Baseline carbon stock change in aboveground tree biomass in stratum i; t CO2-e	See calculations below.	See calculations in "Ntakata_Redd_Calcs2-8-19"
$\Delta C_{BB_tree,\ i}$	Baseline carbon stock change in belowground tree biomass in stratum i; t CO2-e ha-1	See calculations below.	See calculations in "Ntakata_Redd_Calcs2-8-19"
$\Delta C_{DW,i}$	Baseline carbon stock change in dead wood in stratum i: t CO2-e ha-1	See calculations below.	See calculations in "Ntakata_Redd_Calcs2-8-19"
$A_{unplanned,i,t}$	Area of unplanned deforestation in forest stratum i at time t; ha	See calculations below.	See calculations in "Ntakata_Redd_Calcs2-8-19"

[36] Banda, T., Schwartz M., Caro, T. Woody vegetation structure and composition along a protection gradient in a miombo ecosystem of western Tanzania. 2006. Forest Ecology and Management. 230 (179-185). doi:10.1016/j.foreco.2006.04.032

Table 3.19. Calculation of the Total Forest Carbon Stock in Areas Deforested (CBSL) and the Sum of the Baseline Carbon Stock Change in all Pools up to Time t (ΔCTOT) in the Project Area.

Year	**Aunplanned,i,t, PA (ha)**	$CBSL_{AB}$ (t CO2-e)	C $post_{AB}$ (t CO2-e)	$CBSL_{BB}$ -C $post_{BB}$ (t CO2-e)	$CBSL_{DW}$ -C $post_{DW}$ (t CO2-e)	C wp (t CO2-e)	ΔCTOT (t CO2-e)
2017	11,229.8	1,284,740	396,356	35,123	1,233	1,817	926,558
2018	14,144.1	1,618,146	499,215	79,362	2,787	4,105	1,205,184
2019	13,023.1	1,489,901	459,650	120,094	4,218	6,212	1,160,774
2020	11,169.0	1,277,784	394,210	155,027	5,444	8,018	1,052,065
2021	6,914.3	791,031	244,041	176,653	6,204	9,137	738,984
2022	7,435.7	850,674	262,442	199,910	7,021	10,340	805,502
2023	4,972.1	568,825	175,489	215,461	7,567	11,144	627,509
2024	4,830.2	552,593	170,481	230,568	8,097	11,926	632,703
2025	4,746.6	543,033	167,531	245,414	8,619	12,694	642,228
2026	4,441.0	508,070	156,745	259,304	9,106	13,412	633,148
Total	82,906.0	9,484,797	2,926,159	1,716,919	60,296	88,804	8,424,656

Table 3.20. Calculation of the Total Forest Carbon Stock in Areas Deforested (CBSL) and the Sum of the Baseline Carbon Stock Change in all Pools up to Time t (ΔCTOT) in the Leakage Belt.

Year	**Aunplanned,i,t, PA (ha)**	$CBSL_{AB}$ (t CO2-e)	C $post_{AB}$ (t CO2-e)	$CBSL_{BB}$ -C $post_{BB}$ (t CO2-e)	$CBSL_{DW}$ -C $post_{DW}$ (t CO2-e)	C wp (t CO2-e)	ΔCTOT (t CO2-e)
2017	2,399.0	274,452	84,671	7,503	264	388	197,935
2018	5,245.1	600,063	185,126	23,908	840	1,237	440,922
2019	5,799.7	663,510	204,700	42,048	1,477	2,175	504,510
2020	5,833.3	667,350	205,884	60,293	2,117	3,119	526,994
2021	3,969.7	454,147	140,109	72,709	2,553	3,761	393,061
2022	4,007.3	458,455	141,438	85,242	2,994	4,409	409,662
2023	2,609.1	298,487	92,086	93,403	3,280	4,831	307,914
2024	2,687.5	307,464	94,856	101,808	3,575	5,266	323,257
2025	2,784.0	318,497	98,260	110,516	3,881	5,716	340,351
2026	2,471.9	282,793	87,245	118,247	4,153	6,116	324,064
Total	37,806.4	4,325,218	1,334,375	715,676	25,134	37,017	3,768,669

Calculation of Net CO_2 Equivalent Emissions

Net CO_2 emissions in the baseline for the project area and leakage belt are calculated using Equation 26 in module BL-UP VDM0007.

As GHG emissions in the baseline are excluded from the project boundary, the net CO_2 emissions in the baseline is equal to the sum of the baseline carbon stock change in all pools ($\Delta C_{BSL,unplanned} = \Delta C_{TOT}$).
$\Delta C_{BSL,PA,unplanned}$ = 6,247,137 t CO_2e

$\Delta C_{BSL,LK,unplanned}$ = 2,940,461 t CO_2e

Project Emissions

Expected project emissions are estimated ex-ante and apply Equation 1 as found in module M-MON (VMD0015) of Methodology VM0007. Values for individual parameters are justified in Table 3.21 or derived in Tables 3.22, Table 3.24, and Table 3.26. Ex-ante projections of deforestation un-avoided in the project case assume project effectiveness of 80% (i.e., 20% of baseline deforestation occurs in the project case).

Table 3.21. Parameters and Values used to Calculate Annual Ex-Ante Project Emissions.

Parameter	Description	Value	Justification
ΔC_P	Net greenhouse gas emissions within the project area under the project scenario; t CO_2e	See table below for calculations.	
$\Delta C_{P,DefPA,i,t}$	Net carbon stock change as a result of deforestation in the project area in the project case in stratum i at time t; t CO_2e	See table below for calculations.	

$\Delta C_{P,Deg,i,t}$	Net carbon stock change as a result of degradation in the project area in the project case in stratum i at time t; t CO_2e	$\Delta C_{P,Deg,i,t} = 0$	No emissions from degradation are expected to occur due to the prevalence of available fuelwood outside the project area. Forest patrols will further deter degradation activities. Ex-ante degradation is therefore estimated as zero. Emissions resulting from degradation due to selective logging of FSC certified areas (parameter ΔCP,SelLog,i,t) equates to zero as no selective FSC logging occurs in either the baseline or with-project case.
$\Delta C_{P,DistPA,i,t}$	Net carbon stock change as a result of natural disturbance in the project area in the project case in stratum i at time t; t CO_2e	$\Delta C_{P,DistPA,i,t} = 0$	Forests in Mpanda district have a low incidence of natural disturbance and hence no disturbances are likely which result in tree death and CO2 emissions.
$GHG_{P-E,i,t}$	Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum i in year t; t CO_2e	See table below for calculations.	
$\Delta C_{P,Enh,i,t}$	Net carbon stock change as a result of forest growth and sequestration during the project in areas projected to be deforested in the baseline in stratum i at time t; t CO_2e	$\Delta C_{P,Enh,i,t} = 0$	Conservative to exclude.

Table 3.22. Data used to Calculate ΔC_P.

Year	ΔCP,DefPA,i,t (t CO2-e)	ΔCP,Deg,i,t (t CO2-e)	ΔCP,DistPA,i,t (t CO2-e)	GHGP-E,i,t (t CO2-e)	ΔCP,Enh,i,t (t CO2-e)	ΔCP (t CO2-e)

2017	257,657	0	0	14,336	0	271,993
2018	324,523	0	0	18,056	0	342,579
2019	298,803	0	0	16,625	0	315,428
2020	256,263	0	0	14,258	0	270,520
2021	158,643	0	0	8,827	0	167,470
2022	170,604	0	0	9,492	0	180,097
2023	114,079	0	0	6,347	0	120,426
2024	110,824	0	0	6,166	0	116,990
2025	108,907	0	0	6,059	0	114,966
2026	101,895	0	0	5,669	0	107,564

Deforestation in the with-Project Case

The parameters for Equation 3 in module M-MON VMD0015 to calculate the net carbon stock change as a result of deforestation.

Table 3.23. Parameters and Values used to Calculate Annual Ex-Ante Deforestation Emissions.

Parameter	Description	Value	Justification
ΔCP,DefPA,i,t	Net carbon stock change as a result of deforestation in the project case in the project area in stratum i at time t; t CO_2e	See table below for calculations.	See table below for calculations.
ADefPA,u,i,t	Area of recorded deforestation in the project area stratum i converted to land use u at time t; ha	See table below for calculations.	See table below for calculations.
ΔCpools,Def,u,i,t	Net carbon stock changes in all pools in the project case in land use u in stratum i at time t; t CO_2e ha-1	$\Delta C_{pools,Def,u,i,t}$ = 163.8 t CO2e ha-1	This value is the mean stock for the project area. See the forest inventory report for more information on the derivation of this value.

Table 3.24. Data Used to Calculate $\Delta C_{P,DefPA,i,t}$.

Year	ADefPA,u,i,t (ha)	ΔCpools,Def,u,i,t (t CO2-e/ha)	ΔCP,DefPA,i,t (t CO2-e)
2017	2,246.0	114.7	257,657

2018	2,828.8	114.7	324,523
2019	2,604.6	114.7	298,803
2020	2,233.8	114.7	256,263
2021	1,382.9	114.7	158,643
2022	1,487.1	114.7	170,604
2023	994.4	114.7	114,079
2024	966.0	114.7	110,824
2025	949.3	114.7	108,907
2026	888.2	114.7	101,895
ADefPA,u,i,t is derived assuming a project effectiveness of 80% (i.e., 20% of baseline deforestation occurs in the project case).			

GHG Emissions

Greenhouse gas emissions as a result of deforestation activities within the project area (GHGP,E,i,t) and leakage belt are calculated in Table 3.26 using Equation 30 in module M-MON VMD0015. Parameters are found in Table 3.26a and Table 3.26b.

Table 3.25. Parameters and Values Used to Calculate Annual Ex-Ante GHG Emissions.

Parameter	Description	Value	Justification
GHGP,E,i,t	Greenhouse gas emissions as a result of deforestation activities within the project area in the project case in stratum i in year t; t CO_2e	See table below for calculations.	
EBiomassBurn,i,t	Non-CO_2 emissions due to biomass burning in stratum i in year t; t CO_2e	See table below for calculations.	Biomass burning is expected to occur in the with project case.

Table 3.26a. Calculation of $E_{BiomassBurn,i,t.}$ for the project area.

Year	ADefPA,u,i,t (ha)	COMF	E-N2O Biomass Burning (tCO2e)	E-CH4 Biomass Burning (tCO2e)	E-Biomass Burning (tCO2e)	GHGP-E,i,t (t CO2-e)
2017	2246.0	0.45	4,339.9	9,995.7	14,335.6	14,335.6
2018	2828.8	0.45	5,466.1	12,589.7	18,055.8	18,055.8

2019	2604.6	0.45	5,032.9	11,591.9	16,624.8	16,624.8
2020	2233.8	0.45	4,316.4	9,941.6	14,257.9	14,257.9
2021	1382.9	0.45	2,672.1	6,154.5	8,826.6	8,826.6
2022	1487.1	0.45	2,873.6	6,618.5	9,492.1	9,492.1
2023	994.4	0.45	1,921.5	4,425.6	6,347.1	6,347.1
2024	966.0	0.45	1,866.7	4,299.3	6,166.0	6,166.0
2025	949.3	0.45	1,834.4	4,225.0	6,059.3	6,059.3
2026	888.2	0.45	1,716.3	3,953.0	5,669.2	5,669.2

Table 3.26b. Calculation of $E_{BiomassBurn,i,t.}$ for the leakage belt.

Year	ADefLB,u,i,t (ha)	COMF	E-N2O Biomass Burning (tCO2e)	E-CH4 Biomass Burning (tCO2e)	E-Biomass Burning LB (tCO2e)
2017	1347.6	0.45	2,603.9	5,997.4	8,601.3
2018	1697.3	0.45	3,279.7	7,553.8	10,833.5
2019	1562.8	0.45	3,019.7	6,955.1	9,974.9
2020	1340.3	0.45	2,589.8	5,964.9	8,554.8
2021	829.7	0.45	1,603.3	3,692.7	5,296.0
2022	892.3	0.45	1,724.2	3,971.1	5,695.3
2023	596.6	0.45	1,152.9	2,655.4	3,808.3
2024	579.6	0.45	1,120.0	2,579.6	3,699.6
2025	569.6	0.45	1,100.6	2,535.0	3,635.6
2026	532.9	0.45	1,029.8	2,371.8	3,401.5

3.2.3 Leakage

Leakage emissions from displacement of unplanned deforestation are estimated in conformance with the VCS modular REDD methodology VM0007, specifically the LK-ASU module. This module provides for accounting for activity shifting leakage resulting from both local and immigrant deforestation agents.

Leakage due to market effects is restricted to market responses due to project activity impacts on market supply of commercial timber and fuelwood. Agents of deforestation in the project area are mainly pastoralists, not loggers, who would not have the capacity to haul and

commercialize any timber recovered in the process of land clearing activities. Instead, timber and fuelwood are used locally for subsistence use. Additionally, timber markets in Tanzania exist predominantly in coastal regions due to easier access to markets through ports and roads. Therefore, this project will not produce market effects leakage related to timber production. Fuelwood in the project region is predominately collected for subsistence purposes, and not commercially harvested, thus reductions in fuelwood produce no market effects (beyond activity displacement, treated above).

Estimation of Baseline Carbon Stock Changes and Greenhouse Gas Emissions in the Leakage Belt

Activity shifting leakage due to displacement of unplanned deforestation was assessed using a baseline specific to the leakage belt developed following procedures detailed in the Module BL-UP. While details of the baseline are provided in Table 3.20, Table 3.27 below states the baseline estimates for the leakage belt, against which with-project deforestation in the leakage belt will be measured.

Table 3.27. Estimation of Baseline Carbon Stock Changes and Greenhouse Gas Emissions in the Leakage Belt.

Year	ΔCTOT (t CO2-e)
2017	197,935
2018	440,922
2019	504,510
2020	526,994
2021	393,061
2022	409,662
2023	307,914
2024	323,257
2025	340,351
2026	324,064

Estimation of Unplanned Deforestation Displaced from the Project Area to the Leakage Belt

We estimated ex ante leakage in the leakage belt applying a gross approximation of the amount of deforestation anticipated to be displaced from the project area to the leakage belt. We applied a preliminary leakage factor of 15% of baseline emissions in the project area displaced to the leakage belt. Leakage is then calculated as the difference between project and baseline carbon stock changes and greenhouse gas emissions in the leakage belt, as outlined in Equation 1 in LK-ASU VMD0010. Ex-ante estimates of the net CO2 emissions due to unplanned deforestation displaced from the project area to the leakage belt are calculated for each year in the baseline period in Table 3.29.

Table 3.28. Parameters and Values used to Calculate Annual Ex-Ante GHG Emissions in the Leakage Belt.

Parameter	Description	Value	Justification

ΔCLK-ASU-LB	Net CO_2 emissions due to unplanned deforestation displaced from the project area to the leakage belt; t CO_2e	See Table 3.30.	Calculated.
ΔCBSL,LK,unplanned	Net CO_2 emissions in the baseline from unplanned deforestation in the leakage belt; t CO_2e	See Table 3.28.	Derived in Section 3.1.
ΔCP,LB	Net greenhouse gas emissions within the leakage belt in the project case t CO_2e	See Table 3.30.	Ex-ante estimate is calculated by multiplying the estimated baseline carbon stock changes and greenhouse gas emissions for the project area by a factor < 1.0 representing the % of deforestation expected to be displaced into the leakage belt. This result is then added to the estimated baseline for the leakage belt.

Table 3.29. Estimates of the Net CO2 Emissions due to Unplanned Deforestation Displaced from the Project Area to the Leakage Belt.

Year	ΔCBSL,PA,unplanned (t CO2-e)	ΔCP,DefPA,i,t (t CO2-e)	Deforestation emissions expected to be displaced from the project area (t CO2-e)	E-Biomass Burning LB (tCO2e)	ΔCBSL,LK,unplanned (t CO2-e)	ΔCP,LB[1] (t CO2-e)	ΔCLK-ASU-LB (t CO2-e)
2017	998,236	271,993	108,936	8,601	197,935	315,473	117,538
2018	1,295,464	342,579	142,933	10,833	440,922	594,688	153,766
2019	1,243,898	315,428	139,271	9,975	504,510	653,755	149,245
2020	1,123,355	270,520	127,925	8,555	526,994	663,474	136,480
2021	783,117	167,470	92,347	5,296	393,061	490,704	97,643
2022	852,963	180,097	100,930	5,695	409,662	516,287	106,625
2023	659,244	120,426	80,823	3,808	307,914	392,545	84,631
2024	663,533	116,990	81,982	3,700	323,257	408,939	85,681
2025	672,525	114,966	83,634	3,636	340,351	427,620	87,269
2026	661,494	107,564	83,090	3,402	324,064	410,555	86,491

Estimation of Unplanned Deforestation Displaced from the Project Area to Outside the Leakage Belt

We first estimated parameter $PROP_{IMM}$, the proportion of area deforested by population that has migrated into the area in the last 5 years, applying the most current estimate of population growth rate for Mpanda district of 3.2% per year[37]. Assuming the rate was stable over the five years preceding the project start, and conservatively assuming that the entire population increase is attributed to immigration, $PROP_{IMM}$ is estimated to be 14.6%.

The total available national forest area for unplanned deforestation was calculated using Equation 2 in module LK-ASU VMD0010 and the values found in Table 3.31. AVFOR, was calculated to be 48,090,703 ha.

Table 3.30. Parameters and Values used to Calculate the Total Available National Forest Area for Unplanned Deforestation.

Parameter	Description	Value	Justification/Source
AVFOR	Total available national forest area for unplanned deforestation; ha	48,090,703	
TOTFOR	Total available national forest area; ha	48,090,703	page 33 NAFORMA Report
PROTFOR	Total area of fully protected forests nationally; ha	0	Conservatively set to zero
MANFOR	Total area of forests under active management nationally; ha	0	Conservatively set to zero
Ministry of Natural Resources and Tourism, Tanzania Forest Services Agency, Government of Finland, AND FAO. 2015. NAFORMA - National Forest Resources Monitoring and Assessment of Tanzania Mainland - Main Results.			

Next, the ratio (PROPLB) of the forested area of the leakage belt (LBFOR) to the total available national forest area (AVFOR) was calculated.
PROPLB = 184,733 ha / 48,090,703 ha = 0.0065.

[37] See Village Land Use Plans

The area-weighted average live aboveground tree carbon stock for Tanzanian forests (COLB) was calculated using data from NAFORMA[38] as found in Table 3.32. COLB =50.8 t CO2-e ha-1.

Table 3.31. Live Aboveground Biomass Carbon Stocks in Tanzanian Forests.

Vegetation Type	AGB[1] t CO2/ha
Forest	111.8
Woodland	55.1
Bushland	21.8
Area-weighted average	54.7

The area weighted average aboveground tree carbon stock for forests available for unplanned deforestation inside the leakage belt (CLB) referenced the inventory estimate from the project area (comparable forest type), found in Section 3.11.

CLB = 118.3 t CO2e ha-1.

The proportional difference in carbon stocks between areas of forest available for unplanned deforestation both inside and outside the leakage belt (PROPCS) was calculated as PROPCS = 202.0 t CO2-e ha-1 / 118.3 t CO2e ha-1 = 1.708.

The proportional leakage for areas with immigrating populations was calculated using Equation 5 in module LK-ASU VMD0010. The values for the parameters used in this equation can be found in Table 3.33.

Table 3.32. Parameters and Values used to Calculate the Proportional Leakage for Areas with Immigrating Populations.

Parameter	Description	Value	Justification/Source
LKPROP	Proportional leakage for areas with immigrating populations; proportion	0.068	
PROPIMM	Estimated proportion of baseline deforestation	0.146	Estimated above

[38] Values transformed from NAFORMA data. p48 NAFORMA, Ministry of Natural Resources and Tourism, Tanzania Forest Services Agency, Government of Finland, AND FAO. 2015. NAFORMA - National Forest Resources Monitoring and Assessment of Tanzania Mainland - Main Results.

	caused by immigrating population; proportion		
PROPLB	Area of forest available for unplanned deforestation as a proportion of the total national forest area available for unplanned deforestation; proportion	0.0065	Calculated above
PROPCS	The proportional difference in stocks between areas of forest available for unplanned deforestation both inside and outside the Leakage Belt; proportion	0.467	Calculated above

The net leakage outside the leakage belt (ΔCLK-ASU,OLB) is calculated ex-ante using Equation6 in module LK-ASU VMD0010. The values for the parameters used in this equation can be found in Table 3.33. Annual values for ΔCLK-ASU,OLB were calculated in Table 3.34.

The equation below reflects a correction of an inverted order of the first two terms in the equation 6 of LK-ASU.

$$\Delta C_{LK\text{-}ASU,OLB} = \Delta C_{P,LB} - \Delta C_{BSL,LK,unplanned} * LK_{PROP}$$

Table 3.33. Parameters and Values used to Calculate the Net CO2 Emissions due to Unplanned Deforestation Displaced Outside the Leakage Belt.

Parameter	Description	Value	Justification/Source
ΔCLK-ASU,OLB	Net CO_2 emissions due to unplanned deforestation displaced outside the leakage belt; t CO_2e	Calculated in Table 3.35, below.	

ΔCBSL,LK,unplanned	Net CO_2 equivalent emissions in the baseline from unplanned deforestation in the leakage belt; t CO_2e	See Table 3.28.	Calculated above
ΔCP,LB	Net CO_2 equivalent emissions within the leakage belt in the project case; t CO_2e	See Table 3.30.	Calculated above
LKPROP	Proportional leakage for areas with immigrating populations; proportion	0.068	Calculated above

Table 3.34. Calculation of Net CO2 Emissions due to Unplanned Deforestation Displaced Outside the Leakage Belt.

Year	ΔCP,LB (t CO2-e)	ΔCBSL,LK,unplanned (t CO2-e)	LKPROP	ΔCLK-ASU,OLB (t CO2-e)
2017	315,473	197,935	0.068	7,951
2018	594,688	440,922	0.068	10,402
2019	653,755	504,510	0.068	10,096
2020	663,474	526,994	0.068	9,233
2021	490,704	393,061	0.068	6,606
2022	516,287	409,662	0.068	7,213
2023	392,545	307,914	0.068	5,725
2024	408,939	323,257	0.068	5,796
2025	427,620	340,351	0.068	5,904
2026	410,555	324,064	0.068	5,851

Emissions from Leakage Prevention Activities

Leakage prevention measures do not include the use of fertilizers or the burning of biomass. As such, greenhouse gas emissions as a result of leakage of avoided deforestation activities (GHGLK,E) are assumed to be zero.

Estimation of Total Leakage due to the Displacement of Unplanned Deforestation

The total leakage due to the displacement of unplanned deforestation is estimated in Table 3.36 using Equation 16 in module LK-ASU VMD0010. GHG emissions are not included in the project boundary.

Table 3.35. Parameters and Values used to Estimate Total Leakage due to the Displacement of Unplanned Deforestation.

Parameter	Description	Value	Justification
ΔCLK-AS,unplanned	Net greenhouse gas emissions due to activity shifting leakage for projects preventing unplanned deforestation Net CO_2 emissions; t CO_2e	See Table 3.37	Calculated
ΔCLK-ASU-OLB	Net CO_2 emissions due to unplanned deforestation displaced outside the leakage belt; t CO_2e	See Table 3.35.	Calculated
ΔCLK-ASU-LB	Net CO_2 emissions due to unplanned deforestation displaced from the project area to the leakage belt; t CO_2e	See Table 3.30.	Calculated

3.2.4 Net GHG Emission Reductions and Removals

Uncertainty is assessed applying module X-UNC.

Uncertainty in the baseline rate, parameter $Uncertainty_{BSL,RATE}$, is equal to zero. Per the X-UNC module, “It is here assumed that there is zero uncertainty in baseline rate of deforestation or degradation where numbers are equal to a long-term average (BL-UP)” as they are for this project.

Total uncertainty in carbon stocks in forest (parameter $Uncertainty_{BSL,SS}$) is equal to uncertainty of the total forest carbon stock estimate. Parameter $Uncertainty_{BSL,SS}$ is calculated to be 25.1% at the 95% confidence level (calculations detailed in Forest Biomass Carbon Inventory Report) for the initial forest inventory.

$Uncertainty_{WRC_BSL,t}$ is zero as this is not a WRC project. Further, $Uncertainty_{REDD_WPS}$ is zero as no ex post estimates of carbon pools or sources will be made. $NER_{REDD+ERROR,t}$* is therefore limited to $Uncertainty_{BSL,SS}$. The results of overall uncertainty calculations are presented below in Table 3.36.

Table 3.36. Summary of uncertainty calculations.

X-UNC Equation Number	5	Part 1, Step 1	6	10
Parameter	$Uncertainty_{BSL,SS}$	$Uncertainty_{BSL,RATE,}$	$Uncertainty_{BSL,t*}$	$NER_{REDD+ERROR,t*}$
Value	25.1%	0.0%	25.1%	25.1%

Estimates of GHG credits eligible for issuance as VCUs were calculated in Table 3.37, below; where

Estimated GHG emission reduction credits =

Baseline emissions, fixed for 10 years at validation minus

Project emissions minus

Leakage minus

Non-permanence Risk Buffer withholding (calculated as a percent of net change in carbon stocks prior to deduction of leakage, see “VCS-Non-Permanence-Risk-Report_Ntakata.docx” and “VCS-Risk-Report-Calculation-Tool-v3.1-Ntakata.xlsx”).

Note that an uncertainty deduction was applied to the baseline minus project emissions.

Table 3.37. Ex-Ante Estimated of Net Emission Reduction Credits.

Years	Estimated baseline emissions or removals (tCO2e)	Estimated with-project emissions or removals (tCO2e)	Estimated with-project emission reductions (tCO2e)	Estimated leakage emissions (tCO2e)	Risk buffer (%)	Deductions for AFOLU pooled buffer account (tCO2e)	NER REDD	Adjusted NER REDD	GHG credits eligible for issuance as VCUs (tCO2e)
2017	998,236	271,993	726,243	125,489	13%	94,412	600,753	540,266	445,855
2018	1,295,464	342,579	952,885	164,169	13%	123,875	1,389,470	1,597,890	933,749
2019	1,243,898	315,428	928,471	159,342	13%	120,701	2,158,599	2,482,388	763,797
2020	1,123,355	270,520	852,834	145,713	13%	110,868	2,865,720	3,295,578	702,321
2021	783,117	167,470	615,647	104,249	13%	80,034	3,377,118	3,883,686	508,074
2022	852,963	180,097	672,866	113,838	13%	87,473	3,936,146	4,526,568	555,409
2023	659,244	120,426	538,818	90,356	13%	70,046	4,384,608	5,042,299	445,685
2024	663,533	116,990	546,544	91,478	13%	71,051	4,839,674	5,565,625	452,275
2025	672,525	114,966	557,559	93,173	13%	72,483	5,304,060	6,099,669	461,561
2026	661,494	107,564	553,930	92,342	13%	72,011	5,765,648	6,630,495	458,815
Total	8,953,829	2,008,032	6,945,797	1,180,149	13%	902,954			5,727,542

Over the first 10-year baseline period, the project area is expected to result in 6,945,797 tons t CO^2e reductions with a buffer pool contribution of 902,954 t CO^2e and a total expected emission reduction of 5,727,542 t CO^2e after accounting for leakage (1,180,149 t CO^2e).

3.3 Monitoring

3.3.1 Data and Parameters Available at Validation

Data / Parameter	$\Delta C_{BSL,PA,unplanned}$
Data unit	t CO_2-e
Description	Net CO_2 emissions in the baseline from unplanned deforestation in the project area
Source of data	Derived in Section 3.2 of PD
Value applied	Set at start of baseline period
Justification of choice of data or description of measurement methods and procedures applied	Derived and justified in Section 3.2 of PD in which baseline is set
Purpose of data	Calculation of baseline emissions
Comments	

Data / Parameter	$\Delta C_{BSL,LK,unplanned}$
Data unit	t CO_2-e
Description	Net CO_2 emissions in the baseline from unplanned deforestation in the leakage belt
Source of data	Derived in Section 3.2 of PD
Value applied	Set at start of baseline period
Justification of choice of data or description of measurement methods and procedures applied	Derived and justified in Section 3.2 of PD in which baseline is set
Purpose of data	Calculation of leakage
Comments	

Data / Parameter	*CF*

Data unit	t C t^{-1} d.m.
Description	Carbon fraction of biomass
Source of data	IPCC 2006GL
Value applied	0.47
Justification of choice of data or description of measurement methods and procedures applied	Global default
Purpose of data	Calculation of baseline emissions
Comments	

Data / Parameter	C_{OLB}
Data unit	t CO_2-e ha^{-1}
Description	Average aboveground tree carbon stock for forests available for unplanned deforestation outside the Leakage Belt
Source of data	Values transformed from NAFORMA data. p48 NAFORMA, Ministry of Natural Resources and Tourism, Tanzania Forest Services Agency, Government of Finland, AND FAO. 2015. NAFORMA - National Forest Resources Monitoring and Assessment of Tanzania Mainland - Main Results.
Value applied	50.8 t CO_2-e ha^{-1}
Justification of choice of data or description of measurement methods and procedures applied	Derived above in Section 3.2 of the PD
Purpose of data	Calculation of leakage
Comments	

Data / Parameter	f_j(X,Y)
Data unit	kg d.m. tree-1

Description	Allometric equation for species j linking measured tree variable(s) to aboveground biomass of living trees.
Source of data	Data resulting from the forest inventory.
Value applied	See forest inventory excel workbook "Mahale2017 inventory.xls"
Justification of choice of data or description of measurement methods and procedures applied	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.
Purpose of data	Calculation of baseline emissions Calculation of project emissions
Comments	Mugasha et al 2013 allometric equations used for both above- and belowground biomass estimation.

Data and Parameters Monitored

Data / Parameter:	$\Delta C_{P,Def,i,t}$
Data unit:	**t CO_2-e**
Description:	**Net carbon stock change as a result of deforestation in the project case in the project area in stratum i at time t**
Source of data:	**Calculated**
Description of measurement methods and procedures to be applied:	**As this parameter was calculated rather than measured, no measurements methods are noted. Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every ≤ 5 years**
Value applied:	

Year	ΔCP,DefPA,i,t (t CO2-e)
2017	257,657
2018	324,523
2019	298,803
2020	256,263
2021	158,643
2022	170,604
2023	114,079
2024	110,824
2025	108,907
2026	101,895

Monitoring equipment:	**None.**
QA/QC procedures to be applied:	**Neither QA/QC procedures nor calibration are relevant for this calculated parameter.**
Purpose of data	**Calculation of project emissions**

Calculation method:	**Equation 3, VMD0015**
Comments	**None**

Data / Parameter:	**ΔCP,DefLB,i,t**
Data unit:	**t CO2-e**
Description:	**Net carbon stock change as a result of deforestation in the project case in the leakage belt in stratum i at time t**
Source of data:	**Calculated**
Description of measurement methods and procedures to be applied:	**As this parameter was calculated rather than measured, no measurements methods are noted.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every < 5 years**
Value applied:	

Year	ΔCP,DefLB,i,t (t CO2-e)
2017	315,473
2018	594,688
2019	653,755
2020	663,474
2021	490,704
2022	516,287
2023	392,545
2024	408,939
2025	427,620
2026	410,555

Monitoring equipment:	**None.**
QA/QC procedures to be applied:	**Neither QA/QC procedures nor calibration are relevant for this calculated parameter.**
Purpose of data	**Calculation of leakage**
Calculation method:	**Equation 4, VMD0015**
Comments	**None**

Data / Parameter:	**ΔCP,DistPA,i,t**
Data unit:	**t CO2-e**
Description:	**Net carbon stock change as a result of natural disturbance in the project case in the project area in stratum i at time t**
Source of data:	**Calculated**
Description of measurement methods and procedures to be applied:	**As this parameter was calculated rather than measured, no measurements methods are noted.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every < 5 years**
Value applied:	

Year	ΔCP,DistPA,i,t (t CO2-e)

	2017	0
	2018	0
	2019	0
	2020	0
	2021	0
	2022	0
	2023	0
	2024	0
	2025	0
	2026	0

Monitoring equipment:	**None.**
QA/QC procedures to be applied:	**Neither QA/QC procedures nor calibration are relevant for this calculated parameter.**
Purpose of data	**Calculation of project emissions**
Calculation method:	**Equation 20, VMD0015**
Comments	**None**

Data / Parameter:	**ADefPA,u,i,t**
Data unit:	**ha**
Description:	**Area of recorded deforestation in the project area stratum i converted to land use u at time t**
Source of data:	**Monitored at each monitoring/verification event through the use of classified satellite imagery**
Description of measurement methods and procedures to be applied:	**Detailed procedures are provided under monitoring plan description.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every < 5 years**
Value applied:	**See Table 3.11**
Monitoring equipment:	**ArcGIS**
QA/QC procedures to be applied:	**Detailed procedures provided under the monitoring plan description**
Purpose of data	**Calculation of project emissions**
Calculation method:	**Not relevant**
Comments	**None**

Data / Parameter:	**ADefLB,u,i,t**
Data unit:	**ha**
Description:	**Area of recorded deforestation in the leakage belt stratum i converted to land use u at time t**
Source of data:	**Monitored at each monitoring/verification event through the use of classified satellite imagery**

Description of measurement methods and procedures to be applied:	**Detailed procedures provided under the monitoring plan description.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every < 5 years**
Value applied:	**See Table 3.12**
Monitoring equipment:	**ArcGIS**
QA/QC procedures to be applied:	**Detailed procedures provided under the monitoring plan description**
Purpose of data	**Calculation of leakage**
Calculation method:	**Not relevant**
Comments	**None**

Data / Parameter:	**ADistPA,q,i,t**
Data unit:	**ha**
Description:	**Area impacted by natural disturbance in post-natural disturbance stratum q in stratum i, at time t**
Source of data:	**Monitored at each monitoring/verification event through the use of classified satellite imagery**
Description of measurement methods and procedures to be applied:	**Detailed procedures provided under the monitoring plan description.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every < 5 years**
Value applied:	

Year	ADistPA,q,i,t
2017	0
2018	0
2019	0
2020	0
2021	0
2022	0
2023	0
2024	0
2025	0
2026	0

Monitoring equipment:	**ArcGIS**
QA/QC procedures to be applied:	**Detailed procedures provided under the monitoring plan description**
Purpose of data	**Calculation of project emissions**
Calculation method:	**Not relevant**
Comments	**None**

Data / Parameter:	$ADegW,i,t$
Data unit:	ha
Description:	Area potentially impacted by degradation processes in stratum i
Source of data:	Delineated based on survey results indicating general area of project potentially accessed and typical depth of penetration of illegal harvest activities from points of access
Description of measurement methods and procedures to be applied:	Detailed procedures provided under the monitoring plan description. Monitoring responsibilities are listed in section 3.3.
Frequency of monitoring/recording:	Repeated each time the PRA indicates a potential for degradation. PRA conducted every < 2 years
Value applied:	0
Monitoring equipment:	None.
QA/QC procedures to be applied:	Detailed procedures provided under the monitoring plan description.
Purpose of data	Calculation of project emissions
Calculation method:	Not relevant
Comments	PRAs indicated no significant degradation

Data / Parameter:	$C_{BSL,i}$
Data unit:	t CO_2-e ha^{-1}
Description:	Carbon stock in all pools in the baseline case in stratum i
Source of data:	Estimated from forest carbon inventory.
Description of measurement methods and procedures to be applied:	Detailed procedures provided under the monitoring plan description Monitoring responsibilities are listed in section 3.3.
Frequency of monitoring/recording:	Every $\leq$ 10 years.
Value applied:	163.8
Monitoring equipment:	dbh tape, measuring tape, GPS, clinometer
QA/QC procedures to be applied:	Detailed procedures provided under the monitoring plan description
Purpose of data	Calculation of baseline emissions Calculation of project emissions
Calculation method:	Use equations as stated in the forest inventory and section 3.3 of the PD.
Comments	None

Data / Parameter:	$C_{P,post,u,i}$
Data unit:	t CO_2-e ha^{-1}
Description:	Carbon stock in all pools in post-deforestation land use *u* in straum *i*
Source of data:	In the Katavi Rukwa region, not all trees are removed in areas forests are cleared for grazing or agriculture. In Banda et al 2006 the residual basal area is estimated to be 12 m^2/ha[39]. Regression of BA m^2/ha to live AGB and BGB t CO2/ha were derived from the inventory data in "Mahale2017 inventory 1-31-19.xls" to determine C-post. From these regressions an estimated 35.29 t CO2/ha live AGB and 13.20 t CO2/ha BGB will remain C-post. Dead wood is assumed not to be a persistent pool in these agro-pastoral systems.
Description of measurement methods and procedures to be applied:	Value will be updated as new relevant published studies become available. Monitoring responsibilities are listed in section 3.3.
Frequency of monitoring/recording:	Every ≤ 10 years.
Value applied:	49.1
Monitoring equipment:	None
QA/QC procedures to be applied:	
Purpose of data	Calculation of baseline emissions Calculation of project emissions
Calculation method:	Equation 5, VMD0015
Comments	None

Data / Parameter:	*BCEF*
Data unit:	Unitless
Description:	Biomass conversion and expansion factor for conversion of commercial wood volume per unit area to total aboveground tree biomass per unit area; note that BCEF as defined here, and in most applications, is not applied on a per stem basis.
Source of data:	The BCEF is found in Table 4.5 of the IPCC 2006 Report Volume 4 Ch 4. Humid tropical forest was selected as the forest type based on the IPCC climatic model that demonstrates that Tanzania is composed of moderate to humid tropical forest.
Description of measurement methods and procedures to be applied:	Value will be updated as new relevant published studies become available. Monitoring responsibilities are listed in section 3.3.
Frequency of monitoring/recording:	Every ≤ 10 years.

[39] Banda, T., Schwartz M., Caro, T. Woody vegetation structure and composition along a protection gradient in a miombo ecosystem of western Tanzania. 2006. Forest Ecology and Management. 230 (179-185). doi:10.1016/j.foreco.2006.04.032

Value applied:	**1.8 (Higher value selected because tops and branches are not considered part of growing stock)**
Monitoring equipment:	**None**
QA/QC procedures to be applied:	
Purpose of data	**Calculation of harvested wood products**
Calculation method:	**Equation 5, VMD0005**
Comments	**None**

Data / Parameter:	$Pcom_i$
Data unit:	**Dimensionless**
Description:	**Commercial volume as a percent of total aboveground volume in stratum *i*.**
Source of data:	**Based on direct inventory data. Trees greater than 20 cm DBH and included in the following list of species used for timber in the Miombo woodlands of Tanzania were considered commercial:** ***Albizia antunesiana*** ***Brachystegia spiciformis*** ***Isoberlinia globiflora*** ***Julbernadia globiflora*** ***Lannea humilis*** ***Pterocarpus angolensis*** ***Swartzia madagascariensis*** **The mean volume m^3/ha of commercial stems / mean aboveground volume m^3/ha**
Description of measurement methods and procedures to be applied:	**Detailed procedures provided under the monitoring plan description.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every $\leq$ 10 years.**
Value applied:	**12.9%**
Monitoring equipment:	**None**
QA/QC procedures to be applied:	
Purpose of data	**Calculation of harvested wood products**
Calculation method:	**Equation 1, VMD0005**
Comments	**Note that application of the commercial percentage of total volume introduces the simplifying assumption (and conservative, as it is only used in the ex-ante baseline calculations) that all commercial stocks are extracted (i.e. perfect efficiency).**

Data / Parameter:	SLF_{ty}

Data unit:	**Dimensionless**
Description:	**SLF = Fraction of wood products that will be emitted to the atmosphere within 5 years of production by class of wood product ty** **Winjum et al. 1998 give the following proportions for wood products with short-term (<5 yr) uses after which they are retired and oxidized (applicable internationally):** **Sawnwood 0.2** **Woodbase panels 0.1** **Other industrial roundwood 0.3** **Paper and Paperboard 0.4** **The methodology makes the assumption that all other classes of wood products, and where wood product class ty is unknown, are 100% oxidized within 5 years.** **Therefore SLF, by wood product class, is equal to:**

Wood Product Class	SLF
Sawnwood	0.2
Woodbase panels	0.1
Other industrial roundwood	0.3
Paper and paperboard	0.4
Other classes of wood products	1.0

Source of data:	**The source of data is the published paper of Winjum et al. 1998**[40]
Description of measurement methods and procedures to be applied:	**Detailed procedures provided under the monitoring plan description.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every ≤ 10 years.**
Value applied:	**0.2**
Monitoring equipment:	**None**
QA/QC procedures to be applied:	
Purpose of data	**Calculation of harvested wood products**
Calculation method:	**Equation 2,4 VMD0005**
Comments	**-**

Data / Parameter:	WW_{ty}
Data unit:	**Dimensionless**
Description:	**WW = Fraction of extracted biomass effectively emitted to the atmosphere during production by class of wood**

[40] Winjum, J.K., Brown, S. and Schlamadinger, B. 1998. Forest harvests and wood products: sources and sinks of atmospheric carbon dioxide. Forest Science 44: 272-284

	product ty Winjum et al. 1998 indicate that the proportion of extracted biomass that is oxidized (burning or decaying) from the production of commodities to be equal to 19% for developed countries, 24% for developing countries. WW is therefore equal to $C_{XB,ty}$ multiplied by 0.19 for developed countries and 0.24 for developing countries.
Source of data:	The source of data is the published paper of Winjum et al. 1998[41]
Description of measurement methods and procedures to be applied:	Parameter values to be updated if new empirically based peer-reviewed findings become available. Monitoring responsibilities are listed in section 3.3.
Frequency of monitoring/recording:	Every ≤ 10 years.
Value applied:	0.24
Monitoring equipment:	None
QA/QC procedures to be applied:	
Purpose of data	Calculation of harvested wood products
Calculation method:	Equation 2,4 VMD0005
Comments	-

Data / Parameter:	A_i
Data unit:	ha
Description:	Total area of stratum *i*
Source of data:	Direct forest inventory
Description of measurement methods and procedures to be applied:	Detailed procedures provided under the monitoring plan description. Monitoring responsibilities are listed in section 3.3.
Frequency of monitoring/recording:	Every ≤ 10 years.
Value applied:	204,807
Monitoring equipment:	None
QA/QC procedures to be applied:	
Purpose of data	Calculation of harvested wood products
Calculation method:	Equation 1 VMD0005
Comments	Ex-ante it shall be assumed that strata area will remain constant.

Data / Parameter:	CDegW,i,t

[41] Winjum, J.K., Brown, S. and Schlamadinger, B. 1998. Forest harvests and wood products: sources and sinks of atmospheric carbon dioxide. Forest Science 44: 272-284

Data unit:	**t CO2-e**
Description:	**Biomass carbon of trees cut and removed through degradation process from plots measured in stratum i at time t**
Source of data:	**Estimated from diameter measurements of cut stumps in sample plots**
Description of measurement methods and procedures to be applied:	**Detailed procedures provided under the monitoring plan description.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every < 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area**
Value applied:	**0**
Monitoring equipment:	**None.**
QA/QC procedures to be applied:	**Detailed procedures provided under the monitoring plan description.**
Purpose of data	**Calculation of project emissions**
Calculation method:	**Equation 8, VMD0015**
Comments	**PRAs indicated no significant degradation**

Data / Parameter:	**APi**
Data unit:	**ha**
Description:	**Total area of degradation sample plots in stratum i**
Source of data:	**Calculated as 3% of ADegW,i,t**
Description of measurement methods and procedures to be applied:	**Detailed procedures provided under the monitoring plan description.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every < 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area**
Value applied:	**To be determined**
Monitoring equipment:	**ArcGIS**
QA/QC procedures to be applied:	**Detailed procedures provided under the monitoring plan description.**
Purpose of data	**Calculation of project emissions**
Calculation method:	**Not relevant**
Comments	**None**

Data / Parameter:	ΔCP,DegW,i,t
Data unit:	t CO2-e
Description:	Net carbon stock changes as a result of degradation in stratum i in the project area at time t
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	As this parameter was calculated rather than measured, no measurements methods are noted. Monitoring responsibilities are listed in section 3.3.
Frequency of monitoring/recording:	Every < 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area
Value applied:	0
Monitoring equipment:	None
QA/QC procedures to be applied:	Neither QA/QC procedures nor calibration are relevant for this calculated parameter.
Purpose of data	Calculation of project emissions
Calculation method:	Equation 8, VMD0015
Comments	PRAs indicated no significant degradation

Data / Parameter:	PROPIMM
Data unit:	Proportion
Description:	Estimated proportion of baseline deforestation caused by immigrating population
Source of data:	Calculated based population growth rate for Mpanda district.
Description of measurement methods and procedures to be applied:	To reference new government population growth data as released. Monitoring responsibilities are listed in section 3.3.
Frequency of monitoring/recording:	Every < 5 years
Value applied:	14.6%
Monitoring equipment:	None
QA/QC procedures to be applied:	Detailed procedures provided under the monitoring plan description
Purpose of data	Calculation of leakage
Calculation method:	Not relevant
Comments	None

Data / Parameter:	TOTFOR
Data unit:	ha
Description:	Total available national forest area
Source of data:	Official data, peer reviewed publications, remotely sensed imagery (coarse scale imagery is appropriate) or cadastral maps and other verifiable sources
Description of measurement methods and procedures to be applied:	Procedures provided below under monitoring plan description. Monitoring responsibilities are listed in section 3.3.
Frequency of monitoring/recording:	Prior to each verification event and at least every 5 years.
Value applied:	48,090,703
Monitoring equipment:	None
QA/QC procedures to be applied:	Detailed procedures provided under the monitoring plan description
Purpose of data	Calculation of leakage
Calculation method:	Not relevant
Comments	Ministry of Natural Resources and Tourism, Tanzania Forest Services Agency, Government of Finland, AND FAO. 2015. NAFORMA - National Forest Resources Monitoring and Assessment of Tanzania Mainland - Main Results.

Data / Parameter:	PROTFOR
Data unit:	ha
Description:	Total area of fully protected forests nationally
Source of data:	Official data, peer reviewed publications and other verifiable sources
Description of measurement methods and procedures to be applied:	Procedures provided below under monitoring plan description. Monitoring responsibilities are listed in section 3.3.
Frequency of monitoring/recording:	Prior to each verification event and at least every 5 years.
Value applied:	0, conservative assumption
Monitoring equipment:	None
QA/QC procedures to be applied:	Detailed procedures provided under the monitoring plan description

Purpose of data	**Calculation of leakage**
Calculation method:	**Not relevant**
Comments	**None**

Data / Parameter:	**MANFOR**
Data unit:	**ha**
Description:	**Total area of forests under active management nationally**
Source of data:	**Official data, peer reviewed publications and other verifiable sources**
Description of measurement methods and procedures to be applied:	**Procedures provided below under monitoring plan description.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Prior to each verification event and at least every 5 years.**
Value applied:	**0, conservative assumption**
Monitoring equipment:	**None**
QA/QC procedures to be applied:	**Detailed procedures provided under the monitoring plan description**
Purpose of data	**Calculation of leakage**
Calculation method:	**Not relevant**
Comments	**None**

Data / Parameter:	**ARRL,forest,t**
Data unit:	**ha**
Description:	**Remaining area of forest in RRL at time t**
Source of data:	**Calculated**
Description of measurement methods and procedures to be applied:	**As this parameter was calculated rather than measured, no measurements methods are noted.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Prior to each verification event and at least every 5 years.**
Value applied:	
Monitoring equipment:	**ArcGIS**
QA/QC procedures to be applied:	**Neither QA/QC procedures nor calibration are relevant for this calculated parameter.**
Purpose of data	**Calculation of project emissions**
Calculation method:	**Calculated as the total area of the RRL minus all non-forested areas.**

Comments	**None**

Data / Parameter:	Aburn,q,i,t.
Data unit:	**ha**
Description:	**Area burnt in post-natural disturbance stratum q in stratum i, at time t;**
Source of data:	**See parameter ADistPA,q,i,t**
Description of measurement methods and procedures to be applied:	**Monitored as part of ADistPA,q,i,t** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every < 5 years**
Value applied:	
Monitoring equipment:	**None.**
QA/QC procedures to be applied:	**Detailed procedures provided under the monitoring plan description**
Purpose of data	**Calculation of project emissions**
Calculation method:	**Aburn,q,i,t.= ADistPA,q,i,t (area burnt in natural disturbance)**
Comments	**None**

Data / Parameter:	dbh
Data unit:	**cm**
Description:	**diameter at breast height**
Source of data:	**Monitored during the course of each forest inventory**
Description of measurement methods and procedures to be applied:	**Detailed procedures provided below in the SOPs. Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every < 10 years**
Value applied:	**See forest inventory excel sheet.**
Monitoring equipment:	**dbh tape, measuring tape,**
QA/QC procedures to be applied:	**Detailed procedures are provided under monitoring plan description.**
Purpose of data	**Calculation of baseline emissions** **Calculation of project emissions**
Calculation method:	**Not relevant**
Comments	**None**

Data / Parameter:	UP,SS,i,pool#
Data unit:	%
Description:	Percentage uncertainty (expressed as 95% confidence interval as a percentage of the mean where appropriate) for carbon stocks and greenhouse gas sources in the with-project case (1,2…n represent different carbon pools and/or GHG sources)
Source of data:	Calculations arising from field measurement data
Description of measurement methods and procedures to be applied:	Uncertainty in pools derived from field measurement with 95% confidence interval calculated as the standard error of the averaged plot measurements in each stratum multiplied by the t value for the 95% confidence level. Monitoring responsibilities are listed in section 3.3.
Frequency of monitoring/recording:	Monitored at least once every 10 years (on re-measurement of forest carbon stocks)
Value applied:	Same as UBSL,SS,i,pool# values below.
Monitoring equipment:	None
QA/QC procedures to be applied:	Neither QA/QC procedures nor calibration are relevant for this calculated parameter.
Purpose of data	Calculation of baseline emissions Calculation of project emissions
Calculation method:	Not relevant
Comments	Same as UBSL,SS,i,pool# values below as forest carbon stock growth was not tracked.

Data / Parameter:	EBSL SS,i, pool#
Data unit:	t CO2-e
Description:	Carbon stock or GHG sources (e.g. trees, dead wood, soil organic carbon, emission from fertilizer addition, emission from biomass burning etc.) in the baseline case
Source of data:	Calculated

Description of measurement methods and procedures to be applied:	**As this parameter was calculated rather than measured, no measurements methods are noted.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every < 10 years.**
Value applied:	
Monitoring equipment:	**None**
QA/QC procedures to be applied:	**Neither QA/QC procedures nor calibration are relevant for this calculated parameter.**
Purpose of data	**Calculation of baseline emissions** **Calculation of project emissions**
Calculation method:	**Not relevant**
Comments	**Baseline stocks and sources are estimated ex-ante for each baseline period**

Data / Parameter:	**UBSL,SS,i,pool#**
Data unit:	**%**
Description:	**Percentage uncertainty (expressed as 95% confidence interval as a percentage of the mean where appropriate) for carbon stocks and greenhouse gas sources in the baseline case (1,2…n represent different carbon pools and/or GHG sources)**
Source of data:	**Calculated**
Description of measurement methods and procedures to be applied:	**As this parameter was calculated rather than measured, no measurements methods are noted.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every < 10 years.**
Value applied:	
Monitoring equipment:	**None**
QA/QC procedures to be applied:	**Neither QA/QC procedures nor calibration are relevant for this calculated parameter.**
Purpose of data	**Calculation of baseline emissions** **Calculation of project emissions**
Calculation method:	**See equation 5 in the X-UNC module.**
Comments	**Baseline stocks and sources are estimated ex-ante for each baseline period**

Data / Parameter:	EBSL SS,i
Data unit:	t CO2-e
Description:	Sum of combined carbon stocks and GHG sources in stratum i multiplied by the area of stratum i (Ai) in the baseline case
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	As this parameter was calculated rather than measured, no measurements methods are noted. Monitoring responsibilities are listed in section 3.3.
Frequency of monitoring/recording:	Every < 10 years.
Value applied:	
Monitoring equipment:	None
QA/QC procedures to be applied:	Neither QA/QC procedures nor calibration are relevant for this calculated parameter.
Purpose of data	Calculation of baseline emissions Calculation of project emissions
Calculation method:	Not relevant
Comments	Baseline stocks and sources are estimated ex-ante for each baseline period

Data / Parameter:	UBSL,SS,i
Data unit:	%
Description:	Percentage uncertainty in the combined carbon stocks and greenhouse gas sources in stratum i in the baseline case
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	As this parameter was calculated rather than measured, no measurements methods are noted. Monitoring responsibilities are listed in section 3.3.
Frequency of monitoring/recording:	Every < 10 years.
Value applied:	
Monitoring equipment:	None

QA/QC procedures to be applied:	**Neither QA/QC procedures nor calibration are relevant for this calculated parameter.**
Purpose of data	**Calculation of baseline emissions** **Calculation of project emissions**
Calculation method:	**See equation 5 in the X-UNC module.**
Comments	**Baseline stocks and sources are estimated ex-ante for each baseline period**

Data / Parameter:	Bi,t
Data unit:	**tonnes d. m. ha-1**
Description:	**Average aboveground biomass stock before burning stratum i,time t**
Source of data:	**Calculated using forest inventory data**
Description of measurement methods and procedures to be applied:	**Detailed forest inventory procedures are provided in the SOPs.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every < 10 years**
Value applied:	**69.3**
Monitoring equipment:	**None**
QA/QC procedures to be applied:	**Detailed procedures are provided below under monitoring plan description.**
Purpose of data	**Calculation of baseline emissions** **Calculation of project emissions** **Calculation of leakage**
Calculation method:	**Use equations in the forest inventory.**
Comments	**Ex-ante Bi,t is the weighted average across all strata**

Data / Parameter:	AGB
Data unit:	**tonnes d. m. ha-1**
Description:	**Aboveground biomass density**
Source of data:	**Calculated using forest inventory data**
Description of measurement methods and procedures to be applied:	**Detailed forest inventory procedures are provided in the SOPs.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every < 10 years**
Value applied:	**118.3**
Monitoring equipment:	**None**

QA/QC procedures to be applied:	**Detailed procedures are provided below under monitoring plan description.**
Purpose of data	**Calculation of baseline emissions** **Calculation of project emissions**
Calculation method:	**Use equations as stated in the forest inventory.**
Comments	**None**

Data / Parameter:	**Asp**
Data unit:	**ha**
Description:	**Area of sample plots in ha**
Source of data:	**Recording and archiving of number and size of sample plots**
Description of measurement methods and procedures to be applied:	**Detailed forest inventory procedures are provided in the SOPs.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every < 10 years**
Value applied:	**See forest inventory report.**
Monitoring equipment:	**None**
QA/QC procedures to be applied:	**Detailed procedures provided under the monitoring plan description**
Purpose of data	**Calculation of baseline emissions** **Calculation of project emissions**
Calculation method:	**Not relevant**
Comments	**None**

Data / Parameter:	**Hsdw**
Data unit:	**m**
Description:	**Height of standing dead tree in m**
Source of data:	**Monitored during the course of each forest inventory**
Description of measurement methods and procedures to be applied:	**Detailed procedures provided below in the SOPs.** **Monitoring responsibilities are listed in section 3.3.**
Frequency of monitoring/recording:	**Every < 10 years**
Value applied:	**See forest inventory excel workbook.**
Monitoring equipment:	**measuring tape, clinometer**
QA/QC procedures to be applied:	**Detailed procedures are provided below under monitoring plan description.**
Purpose of data	**Calculation of baseline emissions**

	Calculation of project emissions
Calculation method:	Not relevant
Comments	None

Data / Parameter:	DDWdc
Data unit:	t d.m. m-3
Description:	Mean wood density of dead wood in the density class (dc) – sound (1),intermediate (2), and rotten (3); t d.m. m-3
Source of data:	Carsan S, Orwa C, Harwood C, Kindt R, Stroebel A, Neufeldt H, and Jamnadass R. 2012. African Wood Density Database. World Agroforestry Centre, Nairobi.42 Zanne, A.E., Lopez-Gonzalez, G.*, Coomes, D.A., Ilic, J., Jansen, S., Lewis, S.L., Miller, R.B., Swenson, N.G., Wiemann, M.C., and Chave, J. 2009. Global wood density database. Dryad. Identifier: http://hdl.handle.net/10255/dryad.235. Williams, M. R. C. M., Ryan, C. M., Rees, R. M., Sambane, E., Fernando, J., & Grace, J. (2008). Carbon sequestration and biodiversity of re-growing miombo woodlands in Mozambique. Forest Ecology and management, 254(2), 145-155. Malimbwi, R. E., Solberg, B., & Luoga, E. (1994). Estimation of biomass and volume in miombo woodland at Kitulangalo Forest Reserve, Tanzania. Journal of Tropical Forest Science, 230-242. Harmon, M. E., Woodall, C. W., Fasth, B., Sexton, J., & Yatkov, M. (2011). Differences between standing and downed dead tree wood density reduction factors: a comparison across decay classes and tree species.
Description of measurement methods and procedures to be applied:	Monitoring responsibilities are listed in section 3.3.
Frequency of monitoring/recording:	Every < 10 years
Value applied:	
Monitoring equipment:	dbh tape, measuring tape
QA/QC procedures to be applied:	Detailed procedures provided under the monitoring plan description
Purpose of data	Calculation of baseline emissions Calculation of project emissions
Calculation method:	Not relevant
Comments	Species-specific oven dry wood densities (in g/ cm^3 green volume) were referenced from the sources above (where

[42] Oven dry wood density estimated from wood density at 12% moisture content using Table 4-6 of the USFS Wood Handbook 2010

	species-specific wood density was not available, average wood density for the genus or another species within the genus was applied), and applied density reduction factors for standing dead hardwoods sourced from Harmon et al. 2011, and interpreted from field-assessed standing dead wood decomposition categories (Mahale Project Standard Operating Procedures, Appendix A).

Data / Parameter:	CP,Dist,q,i
Data unit:	t CO2-e ha-1
Description:	Carbon stock in all pools in post-natural disturbance q in baseline stratum i
Source of data:	Monitored
Description of measurement methods and procedures to be applied:	Procedures provided in section 3.3 of the PD. Monitoring responsibilities are listed in section 3.3.
Frequency of monitoring/recording:	Prior to each verification event and at least every 5 years.
Value applied:	0, conservative assumption
Monitoring equipment:	dbh tape, measuring tape, GPS, clinometer
QA/QC procedures to be applied:	Detailed procedures provided under the monitoring plan description
Purpose of data	Calculation of project emissions
Calculation method:	None
Comments	It can be conservatively assumed that a post-natural disturbance live and dead vegetation stock is equal to zero

Data / Parameter:	Ai
Data unit:	ha
Description:	Total area of stratum i
Source of data:	GIS coverages
Description of measurement methods and procedures to be applied:	N/A
Frequency of monitoring/recording:	Every < 10 years
Value applied:	
Monitoring equipment:	ArcGIS

QA/QC procedures to be applied:	**Detailed procedures provided under the monitoring plan description**
Purpose of data	**Calculation of baseline emissions** **Calculation of project emissions** **Calculation of leakage**
Calculation method:	**N/A**
Comments	**Ex-ante, it shall be assumed that stratum area will remain constant for the baseline period**

3.3.3 Monitoring Plan

This monitoring plan has been developed to be consistent with module VMD0015 of the REDD Methodological Module, "Methods for monitoring of greenhouse gas emissions and removals (M-MON)." This section focuses on establishing procedures for monitoring deforestation, illegal degradation, natural disturbance, and project emissions ex-post in the project area and leakage belt. Further, procedures for updating the forest carbon stocks and revising the baseline are also provided below.

For accounting purposes, the project conservatively assumes stable stocks and no biomass monitoring is conducted in areas undergoing carbon stock enhancement, as permitted in the methodology monitoring module VMD0015, hence $\Delta C_{P,Enh,i,t}$ is set to 0.

Further as no commercial harvest of timber (including FSC selective logging) occurs in the with-project case, the degradation due to selective logging of certified areas will not be monitored, thus parameter $\Delta C_{P,SelLog,i,t}$ is set to 0.

A separate section on quality assurance/quality control and data archiving procedures covers all monitoring tasks.

Organizations responsible for monitoring are listed below in Table 3.46. These organizations are responsible for implementing all aspects of a particular monitoring task, as described in the monitoring sub-sections below.

Estimation of ex-post net carbon stock changes and greenhouse gas emissions

Ex-post net carbon stock changes and greenhouse gas emissions will be calculated after monitoring:

- The net carbon stock change as a result of deforestation in the project area;
- The net carbon stock change as a result of degradation in the project area;
- The net carbon stock change as a result of natural disturbance in the project area; and
- The greenhouse gas emissions as a result of deforestation and degradation activities within the project area.

<u>Monitoring Deforestation and Natural Disturbance</u>

Forest cover change due to deforestation and natural disturbance is monitored through periodic assessment of classified satellite imagery, see below, covering the project area. Emissions ($\Delta C_{P,Def,i,t}$ and $\Delta C_{P,DistPA,i,t}$ for deforestation and natural disturbance, respectively) are estimated by the multiplying areas $A_{DefPA,u,i,t}$ and $A_{DistPA,q,i,t}$,, for deforestation and natural disturbance, respectively, by average forest carbon stock per unit area. Note that $A_{DistPA,q,i,t}$,, is limited to the area where credits have been issued and is identified as the overlap between the delineated area of the disturbance and the summed area of

unplanned deforestation in the project area to the year in which the disturbance occurred. Stock estimates from the initial field inventory completed in 2017, are valid for 10 years (per VM0007). Table 3.40 shows the data and parameters monitored.

Table 3.40. Data and Parameters for Monitoring Deforestation and Natural Disturbance.

Parameter	Description	Units	Source/ Justification of Choice of Data or Description of Measurement Methods
$\Delta C_{P,Def,i,t}$	Net carbon stock change as a result of deforestation in the project case in the project area in stratum i at time t	t CO_2e	Calculated
$\Delta C_{P,DistPA,i,t}$	Net carbon stock change as a result of natural disturbance in the project case in the project area in stratum i at time t	t CO_2e	Calculated
$A_{DefPA,u,i,t}$	Area of recorded deforestation in the project area stratum i converted to land use u at time t	Ha	Monitored for each verification event
$A_{DistPA,q,i,t}$	Area impacted by natural disturbance in post-natural disturbance stratum q in stratum i, at time t	Ha	Monitored for each verification event
$C_{BSL,i}$	Carbon stock in all pools in the baseline case in stratum i	t CO_2e ha^{-1}	Estimated from the forest carbon inventory
ARRL,forest,t	Remaining area of forest in RRL at time t	Ha	Updated prior to each verification event

Changes in forest cover ($A_{DefPA,u,i,t}$ and $A_{DistPA,q,i,t}$) will be monitored using classified Landsat imagery. Landsat 1G imagery products which are both radiometrically and geometrically corrected will be used, and converted to reflectances using the solar elevation angle parameter in the MTL text file and DN Haze parameter which is calculated from the raw imagery. Each image will then be processed separately using hard classification techniques with a combination of supervised and clustering approaches. Areas of known land cover types (forest, bushlands, grasslands, agriculture) will be used to develop training sites for a supervised classification. To reduce cloud and shadow coverage, multiple images from each scene may be combined. All land cover types are combined into forest and non-forest groups for each Landsat scene, and then all scenes are combined to complete coverage of the full reference region. Once all scenes are combined, a mode filtering procedure will be used whereby, a 3 x 3 pixel filter will be used to increase the minimum mapping unit to 0.81 ha. (90m x 90m).

In the case, where this dataset ceases to be available, ex-post deforestation will be determined by classification of remotely sensed imagery and alternate land use change detection procedures.

The project area (and leakage belt boundary), as set in the PD, will serve as the initial “forest cover benchmark map” against which changes in forest cover will be assessed over the interval of the first monitoring period; the entire project area has been demonstrated to meet the forest definition at the beginning of the crediting period. For subsequent monitoring periods, change in forest cover will be assessed against the preceding classified forest cover map marking the beginning of the monitoring

interval. Thus, the forest benchmark map is updated at each monitoring event. The area of remaining forest in the RRL (ARRL,forest,t) is derived by subtracting the nonforested area within the RRL, as found in the forest benchmark map (updated at each monitoring event), from the total area of the RRL.

Monitoring Illegal Degradation

Emissions due to illegal logging will be tracked by conducting surveys in the surrounding areas every two years. Locations surveyed will include villages in the project area and surrounding area.

Surveys will produce information on wood consumers (fuel wood, wood for construction, and charcoal production) in the surroundings areas, as well as general indications on the areas where wood is sourced from and maximum depth of penetration of harvest activities from access points.

In the event that any potential of illegal logging occurring in the project area is detected from the surveys (i.e. ≥ 10% of those interviewed/surveyed believe that degradation may be occurring within the project boundary), temporary sample plots will be allocated and measured in the area of the project indicated by the surveys as a potential source area for illegally-harvested wood. The potential degradation area within the project area ($A_{DegW,i}$) will be delineated based on survey results, incorporating general area information and maximum depth of penetration. Rectangular plots 10 meters by 1 kilometer (1 ha area) will be randomly or systematically allocated in the area, sufficient to produce a 1% sample of the area, and any recently-cut stumps or other indications of illegal harvest will be noted and recorded. Diameter at breast height, or diameter at height of cut, whichever is lower, of cut stumps will be measured.

In the event that the sample plot assessment indicated that illegal logging is occurring in the area, supplemental plots will be allocated to achieve a 3% sample of the area. Biomass will be estimated from measured diameters (conservatively assuming that diameters of stumps cut below breast height are equivalent to diameter at breast height) applying the allometric equations of Mugasha et al. 2013[43] for miombo woodland in Tanzania and otherwise maintain consistency with analytical procedures applied in the original forest inventory report. Emissions due to illegal logging ($\Delta C_{P,DegW,i,t}$) are estimated by multiplying area ($A_{DegW,i}$) by average biomass carbon of trees cut and removed per unit area ($C_{DegW,i,t}$ / AP_i).

The more intensive 3% sample will be carried out once every 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area to produce an estimate of emissions resulting from illegal logging ($\Delta C_{P,DegW,i}$). Estimates of emissions will be annualized (to produce estimates in t CO_2e per year) by dividing the emission for the monitoring interval by the number of years in the interval.

Table 3.41. Data and Parameters for Monitoring Illegal Degradation.

Parameter	Description	Units	Source/ Justification of Choice of Data or Description of Measurement Methods

[43]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.

$A_{DegW,i,t}$	Area potentially impacted by degradation processes in stratum i	Ha	Delineated based on survey results indicating general area of project potentially accessed and typical depth of penetration of illegal harvest activities from points of access
$C_{DegW,i,t}$	Biomass carbon of trees cut and removed through degradation process from plots measured in stratum i at time t	t CO_2e	Estimated from diameter measurements of cut stumps in sample plots
AP_i	Total area of degradation sample plots in stratum i	Ha	Calculated as 3% of $A_{DegW,i,t}$
$\Delta C_{P,DegW,i,t}$	Net carbon stock changes as a result of degradation in stratum i in the project area at time t	t CO_2e	Calculated

Monitoring Project Emissions

With project emissions are calculated as the sum of emission from fossil fuel combustion ($E_{FC,i,t}$) + non-CO_2 emissions due to biomass burning ($E_{BiomassBurn,i,t}$) + direct N_2O emissions as a result of nitrogen application ($N2O_{direct}$-$N_{,i,t}$.). As stipulated in the methodology, fossil fuel combustion in all situations is an optional emission source. Further, no nitrogen is applied on alternative land uses in the with-project case and hence project emissions therefore equal $E_{BiomassBurn}$ and are calculated using the VMD0013, "Estimation of greenhouse gas emissions from biomass burning (E-BB)" of the AD Partners modular REDD Methodology.

Non-CO_2 emissions from biomass burning in the project case include emissions from burning associated with deforestation and burning associate with natural disturbance, i.e. forest fire. It will be conservatively assumed that the total area burnt during the deforestation process is equal to the area deforested, $A_{DefPA,u,i,t}$. Thus, the area used when calculating E-BB is equal to $A_{burn,i,t}$. (area burnt) = $A_{burn,q,i,t}$. (area burnt in natural disturbance) + $A_{DefPA,u,i,t}$ (area burnt via deforestation in project ex post)."

Also, it is conservatively assumed that burning is a part of the forest conversion process in all incidents of deforestation taking place in the leakage belt. Thus, for deforested strata in the leakage belt, parameter $A_{burn,i,t}$ (Area burnt for stratum i at time t; ha) will be set equal to monitored parameter $A_{DefLB,i,t}$ (Area of recorded deforestation in the leakage belt at time t; ha). The T-SIG tool can then be applied, and if parameter $E_{BiomassBurn,t}$ (Greenhouse emissions due to biomass burning as part of deforestation activities in stratum *i* in year *t*) is determined to be insignificant, $E_{BiomassBurn,t}$, can be assumed equal to zero.

Table 3.42. Data and Parameters for Monitoring Emissions from Biomass Burning.

Parameter	Description	Units	Source/ Justification of Choice of Data or Description of Measurement Methods

E BiomassBurn,t	Greenhouse emissions due to biomass burning as part of deforestation activities in stratum i in year t	tCO_2e of each GHG (CH_4, N_2O)	Calculated
Aburn,i,t	Area burnt for stratum i at time t	Ha	Monitored for each verification event
Bi,t	Average aboveground biomass stock before burning stratum i, time t	tonnes d. m. ha-1	Conservatively assumed to be the carbon stock in all pools in the baseline case (CBSL,i).
COMF i	Combustion factor for stratum i; dimensionless	dimensionless	0.45 for primary open tropical forest. Derived from Table 2.6 of IPCC, 2006.
Gg,i	Emission factor for stratum i for gas g	kg t-1 dry matter burnt	GCH_4 = 6.8 g kg-1 and GN_2O = 0.2 g kg-1. Derived from Table 2.5 of IPCC, 2006.
GWPg	Global warming potential for gas g	t CO_2/t gas g	Default values from IPCC SAR: CH_4 = 21; N_2O = 310).

Monitoring of leakage carbon stock changes and greenhouse gas emissions

Leakage by local agents of deforestation is quantified in the leakage belt. The area deforested in the leakage belt ($A_{DefLB,i,t}$) is estimated in the same manner as the area deforested in the with-project case ($A_{DefPA,u,i,t}$) using the procedures outlined above in the monitoring deforestation section. Activity shifting leakage within the leakage belt ($\Delta C_{LK\text{-}ASU\text{-}LB}$) is then calculated as the with project emissions in the leakage belt ($\Delta C_{P,LB}$) minus the baseline emissions in the leakage belt ($\Delta C_{BSL,LK,unplanned}$).

Table 3.43. Data and Parameters for Monitoring Activity Shifting Leakage.

Parameter	Description	Units	Source/ Justification of Choice of Data or Description of Measurement Methods
$\Delta C_{P,LB}$	Net greenhouse gas emissions within the leakage belt in the project case	t CO_2e	Calculated
$A_{DefLB,i,t}$	Area of recorded deforestation in the leakage belt at time t	ha	Monitored for each verification event
$\Delta C_{P,Def,i,t}$	Net carbon stock change as a result of deforestation in the project case in the project area in stratum i at time t	t CO_2e	Calculated

Immigrant leakage is calculated using a series of equations found in the LK-ASU module. Most of the data for calculating immigrant leakage has been derived for the ex-ante estimates (including $\Delta C_{BSL,LK,unplanned}$; AVFOR; TOTFOR; PROTFOR; MANFOR; $PROP_{LB}$; LBFOR; COLB; CLB; $PROP_{CS}$; and

$A_{BSL,PA,unplanned,t)}$ or gathered in the course of monitoring activity shifting leakage within the leakage belt and deforestation in the project area (including A_{DefPA}; $A_{DefLB,i,t}$; and $\Delta C_{P,LB}$).

The monitoring parameters MANFOR, PROTFOR, TOTFOR will be sourced from official data, peer reviewed publications or other verifiable sources and these monitoring parameters will be updated on review of current literature at least every 5 years. Demonstration that managed and protected forests will be protected against deforestation will further be demonstrated, as stipulated in the LK-ASU module.

To determine what proportion of the agents of deforestation have been resident in and around the leakage belt and project area for ≥ 5 years (PROPRES) and the proportion of area deforested by population that has migrated into the area in the last 5 years (PROPIMM), official Government of Tanzania population census data (at the district level) will be referenced, or community surveys implemented in the villages within and surrounding the project area. As it is sensitive to ask explicit questions regarding responsibility for deforestation, "the proportion of area deforested by population that has migrated into the area in the last 5 years" is assumed to be equal to the percentage of recent immigrants among local population with potential access to the project area (i.e. without directly asking if they are deforestation agents). Similarly, the "proportion of baseline deforestation caused by population that has been resident for ≥ 5 years" is assumed to be equal to the percentage of the local population residing in the area longer than 5 years with potential access to the project area.

Table 3.44. Data and Parameters for Monitoring Immigrant Leakage.

Parameter	Description	Units	Source/ Justification of Choice of Data or Description of Measurement Methods
$PROP_{IMM}$	Proportion of area deforested by immigrant agents in the leakage belt and project area	proportion	Monitored prior to each verification event and at least every 5 years
$PROP_{RES}$	Proportion of baseline deforestation caused by population that has been resident for ≥5 years	proportion	Monitored prior to each verification event and at least every 5 years
TOTFOR	Total available national forest area	ha	Monitored prior to each verification event and at least every 5 years
PROTFOR	Total area of fully protected forests nationally	ha	Monitored prior to each verification event and at least every 5 years
MANFOR	Total area of forests under active management nationally	ha	Monitored prior to each verification event and at least every 5 years

Monitoring of actual carbon stock changes and greenhouse gas emissions

Forest carbon stock estimates will be derived from field measurements less than or equal to 10 years old. Aboveground and belowground live tree and dead wood stocks will be re-assessed on or before November 2026. For each stratum, where the re-measured estimate is within the 90% confidence interval

of the t=0 estimate, the t=0 stock estimate takes precedence and is re-employed, and where the re-measured estimate is outside (i.e. greater than or less than) the 90% confidence interval of the t=0 estimate, the new stock estimate takes precedence and is used for the subsequent period.

Sample plots will be randomly located in areas within the project area and measured following standard operating procedures. Biomass will be estimated applying the following allometric equations and otherwise maintain consistency with analytical procedures applied in the original inventory ("Forest biomass carbon inventory for the Mahale Project, Tanzania," 2018).
For live trees, biomass was calculated as a function of diameter at breast height (DBH; in cm) using the predictive model developed by Mugasha et al. 2013[44] for miombo woodland in Tanzania, and validated for the Ntakata project area:

aboveground biomass (kg) = 0.1027*(dbh)^2.4798 (n=167 trees, R-squared=0.95)

belowground biomass (kg) = 0.2113*(dbh)^1.9838 (n=80 trees, R-squared=0.92)

Biomass of standing dead wood in the decomposition class 1 is estimated using the allometric equation for live trees. In decomposition class 2, the estimate of biomass is limited to the main trunk (bole) of the tree, converting volume of the bole to biomass using dead wood density classes. Volume of bole was estimated as the volume of a cone, as specified in the VM0007 module CP-D, "Estimation of carbon stocks in the dead wood pool".

Species-specific oven dry wood densities (in g/ cm^3 green volume) are sourced from the following (where species-specific wood density is not available, average wood density for the genus or another species within the genus was applied):

Carsan S, Orwa C, Harwood C, Kindt R, Stroebel A, Neufeldt H, and Jamnadass R. 2012. African Wood Density Database. World Agroforestry Centre, Nairobi.[45]

Zanne, A.E., Lopez-Gonzalez, G.*, Coomes, D.A., Ilic, J., Jansen, S., Lewis, S.L., Miller, R.B., Swenson, N.G., Wiemann, M.C., and Chave, J. 2009. Global wood density database. Dryad. Identifier: http://hdl.handle.net/10255/dryad.235.

Williams, M. R. C. M., Ryan, C. M., Rees, R. M., Sambane, E., Fernando, J., & Grace, J. (2008). Carbon sequestration and biodiversity of re-growing miombo woodlands in Mozambique. Forest Ecology and management, 254(2), 145-155.

Malimbwi, R. E., Solberg, B., & Luoga, E. (1994). Estimation of biomass and volume in miombo woodland at Kitulangalo Forest Reserve, Tanzania. Journal of Tropical Forest Science, 230-242.

[44]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.
[45] Oven dry wood density estimated from wood density at 12% moisture content using Table 4-6 of the USFS Wood Handbook 2010

Density reduction factors for standing dead hardwoods are sourced from Harmon et al. 2011[46], and interpreted from field-assessed standing dead wood decomposition categories (Mahale Project Standard Operating Procedures, Appendix A) using the framework below (Table).

Table 3.45. Interpretation of standing dead wood density classes (sensu Harmon et al 2011) and standing dead wood decomposition categories (sensu Mahale Project Standard Operating Procedures).

Standing dead wood decomposition category	Description	Hardwood SD density reduction factor (Harmon et al 2011)	Equivalent SD density class (Harmon et al 2011)
rotten	Machete sinks easily into the piece, piece crumbles, substantial signs of wood loss	0.43	4-5, heartwood at base with advanced decay
intermediate	Machete sinks partly into the piece, some signs of wood loss	0.67	2-3, sapwood sloughing
sound	Machete bounces off the piece and rings	0.99	1, intact

Dry mass is converted to carbon using the default carbon fraction of 0.47 t C/t d.m. (as recommended by IPCC[47] Guidelines for National Greenhouse Gas Inventories).

Revision of the Baseline

The baseline will be revised every 10 years from the project start date.

Data collection procedures in regards to revision of the baseline will include participatory rural appraisals and interviews with municipal officials. Deforestation maps will be prepared by classifying remotely sensed imagery. Other datasets used to substantiate aspects of the baseline with be from official government sources, peer reviewed publications, or other reputable sources.

Quality Assurance/Quality Control and Data Archiving Procedures

<u>Monitoring Deforestation, Natural Disturbance, and Leakage</u>

To ensure consistency and quality results, spatial analysts carrying out the imagery processing, interpretation, and change detection procedures will strictly adhere to best practices and good practice guidelines, when using the alternative method for quantifying deforestation. All data sources and analytical procedures will be documented and archived (detailed under data archiving below).

[46] Harmon, M. E., Woodall, C. W., Fasth, B., Sexton, J., & Yatkov, M. (2011). Differences between standing and downed dead tree wood density reduction factors: a comparison across decay classes and tree species.
[47] IPCC 2006 Guidelines for National Greenhouse Gas Inventories. Chapter 4 AFOLU (Agriculture, Forestry and Other Land-use).

Accuracy of the classification will be assessed by comparing the classification with ground-truth points or samples of high-resolution imagery. Any data collected from ground-truth points will be recorded (including GPS coordinates, identified land-use class, and supporting photographic evidence) and archived. Any sample points of high-resolution imagery used to assess classification accuracy will also be archived. Samples used to assess classification accuracy should be well-distributed throughout the project area (as far as is possible considering availability of high-resolution imagery and/or logistics of acquiring ground-truth data), with a minimum sampling intensity of 50 points each for the forest and non-forest classes.

The classification will only be used in the forest cover change detection step if the overall classification accuracy, calculated as the total number of correct samples / the total number of samples, is equal to or exceeds 90%.

All data sources and processing, classification and change detection procedures will be documented and stored in a dedicated long-term electronic archive.

Information related to monitoring deforestation maintained in the archive will include:

- Forest / non-forest maps;
- Documentation of software type and procedures applied (including all pre-processing steps and corrections, spectral bands used in final classifications, and classification methodologies and algorithms applied), if applicable; and
- Data used in accuracy assessment - ground-truth points (including GPS coordinates, identified land-use class, and supporting photographic evidence) and/or sample points of high resolution imagery.

<u>Forest Carbon Stocks and Degradation</u>

The following steps will be taken to control for errors in field sampling and data analysis:

1. Trained field crews will carry out all field data collection and adhere to standard operating procedures. Pilot sample plots shall be measured before the initiation of formal measurements to appraise field crews and identify and correct any errors in field measurements. Field crew leaders will be responsible for ensuring that field protocols are followed to ensure accurate and consistent measurements. To ensure accurate measurements, the height of diameter at breast height (1.3 m) will be periodically re-assessed by personnel during the course of the inventory.
2. Field measurement data will be recorded on field data sheets and entered into an excel database for data management and quality control. Potential errors in data entry (anomalous values) will be verified or corrected consulting the original data sheets or personnel involved in measurement. Original data sheets will be permanently archived in a dedicated long-term electronic archive. The electronic database will also archive GIS coverages detailing forest and strata boundaries and plot locations.

Quality control procedures for sampling degradation will include steps 1 and step 2, above where warranted.

Quality control procedures related to monitoring leakage include conducting a review of the current literature at least every 5 years to source information on the area of the monitoring parameters MANFOR, PROTFOR, TOTFOR, and PROPIMM.

Personnel involved in the revising of the baseline will have detailed knowledge in regards to spatial modeling and land use change and deep familiarity with REDD methodologies. Remote sensing data used will include officially published dataset, or classified imagery, which meets accuracy assessment requirements as laid out in the methodology.

All measurement and monitoring equipment requiring calibration will be calibrated according to the equipment's specifications and/or relevant national or international standards.

<u>Data Archiving</u>

Data archived will be maintained through at least two years beyond the end of the project crediting period. All project records are secure and retrievable. This includes project documents saved on the desktop of

the Director of Carbon Tanzania and stored in the Director's file cabinets (based in Arusha, Tanzania). An identical version of the project documents are remotely saved on an external hard drive and in the cloud via DropBox. Furthermore, many project documents (e.g., VCS Project Description, Monitoring Reports, CCBA Project Design Document, Project Implementation Reports, Validation and Verification Reports, etc.) are publicly available and stored on the Standards' website. Given the extended time frame and the pace of production of updated versions of software and new hardware for storing data, electronic files will be updated periodically or converted to a format accessible to future software applications, as needed.

Organization, Responsibilities, and Monitoring Frequency

For all aspects of project monitoring, project staff will ensure that data collection, processing, analysis, management and archiving are conducted in accordance with the monitoring plan.

Table 3.46. Type of Monitoring and Party Responsible for Monitoring.

Variables to be monitored	Responsible	Frequency
Monitoring deforestation and natural disturbance	Carbon Tanzania	Prior to each verification
Monitoring illegal degradation	Carbon Tanzania	Every two years
Monitoring project emissions	Carbon Tanzania	Prior to each verification
Activity shifting immigrant leakage assessment	Carbon Tanzania	Prior to each verification event and at least every 5 years.
Updating forest carbon stocks estimates	Carbon Tanzania	At least every 10 years.
Revision of the baseline	Carbon Tanzania	At least every 10 years.

3.3.4 Dissemination of Monitoring Plan and Results (CL4.2)

Results of monitoring will be disseminated to stakeholder by the village carbon champions after each monitoring and verification event.

3.4 Optional Criterion: Climate Change Adaptation Benefits

The project activity, through development and implementation of the Village Land Use Plans, improves the resiliency of the local communities to climate change. Targeted land-use planning is expected to result in improved water storage at the end of dry season, as well as, generally, soil conservation and moderated micro-climates through retention of forest cover.

3.4.1 Regional Climate Change Scenarios (GL1.1)

Climate change scenarios developed specifically for Tanzania identify clear trends relating to increasing temperatures throughout (+0.8-1.8C by 2040). Rainfall will be less predictable, likely with drier dry seasons and wetter wet seasons, measured by less rain days per year. Rainfall overall may increase but could also be paired with generally increased aridity due to increased temperatures and longer periods between heavy rains.[48][49] Due to the communities' main economic activities (agriculture and pastoralism)

[48] FCFA (2017b) Summary: Future climate projections for Tanzania. Cape Town: Future Climate for Africa. www.futureclimateafrica.org/resource/future-climate-projections-for-tanzania
[49] Girvetz, E. H., Gray, E., Tear, T. H., & Brown, M. A. (2014). Bridging climate science to adaptation action in data sparse Tanzania. *Environmental Conservation*, *41*(2), 229–238.

being directly connected to reliability of rains, this change will have a major effect on land use, especially in terms of areas designated as agricultural, pastoral and reserve. Increased exploration of natural resources to offset the negative economic impacts of climate change on the community would be likely in this scenario, that is in addition to the natural pressures on natural resources due to a changing climate.

3.4.2 Climate Change Impacts (GL1.2)

Community well-being

The reliance on rain-fed agriculture in western Tanzania may make future increased rainfall seem positive, however potential floods, soil erosion and crop damage could lead to poor yields and even crop failure. Changes in rainfall reliability, whether increase or decrease can cause crop failure which can be further exacerbated by other stresses such as temperature changes, loss of fertility and lack of land tenure. Crop failure leads to hunger, conflict, poverty and land use change and even migration.[50] Similarly, for livestock keeper's drought can lead to large-scale stock collapse. Increased rainfall could lead to direct human health issues, primarily increases in cholera and malaria both of which are seen at rates positively corelated with rainfall. In these ways community well-being and livelihoods will be directly negatively affected.

Biodiversity conservation status

With livelihoods in jeopardy other natural resources such as fisheries, wildlife stocks, wetlands and forests, are likely to suffer from increased encroachment and deforestation as people turn to charcoal, fuelwood, timber and agricultural expansion as coping strategies. This will only continue as both climatic conditions and natural resource availability and resilience worsen. This will pose a direct threat to the important biodiversity in the area, including specific species of tree and animals already identified as threatened by the IUCN. Chimpanzee populations generally range further in smaller groups when conditions are drier.[51] In our landscape Chimpanzee populations will exploit/depend on woodland foods (Parinari, Strychnos) during the dry season and thus need to maintain mobility across the landscape.

3.4.3 Measures Needed and Designed for Adaptation (GL 1.3)

Land tenure and planning provide one of the most basic and useful adaptations to climate change. Land-use plans can ensure that enough land is set aside to ensure livelihoods even given the variability of future climate scenarios. Land use plans also include projections of future needs compensate for such future scenarios. Diverse livelihoods also provide protection against a changing climate, especially livelihoods attained through education, which are not reliant on exploiting the local natural resource base. Investment in health facilities and interventions also protect the communities against future health issues compounded by a more variable, wetter and hotter climate. Climate smart and adaptive agriculture and grazing regimes also serve as an adaptation mechanism that can increase resilience among communities. Investment and training in good governance and institutions will allow communities to adapt

[50] Hepworth, N. (2010). *Climate Change Vulnerability and Adaptation Preparedness in Tanzania*. [online] Tzdpg.or.tz. Available at: http://www.tzdpg.or.tz/fileadmin/_migrated/content_uploads/TZ_CC_Adaptation_Preparedness_-HBS_2010_02.pdf

[51] ibid

and cope with any climate related situations in the future and will furthermore allow communities to better implement all the other strategies and adaptions already identified. The project activities address all these various measures, individually and holistically, in a matter that will reduce both effects on the community and pressure on the biodiverse habitat and natural resource base that they live in and depend on.

4 COMMUNITY

4.1 Without-Project Community Scenario

4.1.1 Descriptions of Communities at Project Start (CM1.1)

The communities are represented by the population in the eight project villages of Bujombe, Kagunga, Kapanga, Katuma, Lugonesi, Lwega, Mwese, and Mpembe. These villages are primarily composed of Bantu people[52], however with a diversity of tribal and ethnic groups among them including Sukuma, Tongwe, Bende, Fipa - reflecting the diversity throughout Tanzania where there are some 125 distinct ethnic groups. Swahili is the common language, while most people also speak their tribal language as well. The 2012 census only reports at a ward level; the wards of Katuma and Mwese are fully included in the project and were reported as having 9470, and 7520 people respectively. The government also individually identified poor households in some of the project villages and this data is represented, where not available estimations are based on local averages. The local village authority also is responsible for tracking the population in its jurisdiction and as of 2017 reported as such.

Village	Population	# Sub-villages	# Poor households
Bujombe	3832	5	n/a but estimated 50-75% poor
Kagunga	8049	4	n/a but estimated 50-75% poor
Lwega	2943	6	n/a but estimated 50-75% poor
Kapanga	5979	3	n/a but estimated 50-75% poor
Katuma	5923	4	n/a but estimated 50-75% poor
Lugonesi	2400	7	70 Households
Mpembe	7501	6	n/a but estimated 50-75% poor
Mwese	1584	5	126 Households

[52] Bantu peoples is used as a general label for the 300–600 ethnic groups in Africa who speak Bantu languages. They inhabit a geographical area stretching east and southward from Central Africa across the African Great Lakes region down to South Africa. (Wikipedia)

4.1.2 Interactions between Communities and Community Groups (CM1.1)

Each of the eight project villages ("communities") is sub-divided into a number of sub-villages ("community groups") whereby all households in the community are assigned to a sub-village. The village committee communicates with the wider community through the elected sub-village leader who organizes group meetings or speaks individually with each household on important matters. The village government also typically organizes a general assembly on a quarterly basis, to which all villagers are invited. The Ntakata REDD project uses the existing village structure to introduce and communicate about the project. At the start of the project, CT organized meetings separately with all eight village committees to introduce the proposed project. These sessions lasted approximately five hours, were well-attended, and covered all key aspects of the project including: a general introduction to forest carbon projects, an outline of the proposed Ntakata REDD project, the potential risks and benefits, the village responsibility to protect the forest, and the timeline. The sessions also included ample time for discussion and questions. CT made it clear that the project would not take place unless there was a clear invitation from the village to CT to engage. Village committee members expressed unanimous interest in collaborating with CT and a willingness to continue the preparations. The feedback during these meetings may be interpreted as the initial consent to begin engagement on the project. Consideration of the proposal was recorded in official village committee meeting minutes.

Part of the committees' obligation was to organize meetings with the sub-villages to explain the project and seek their input and consent. Some committees pursued initial sub-village meetings and communication on the project soon after the introduction, while others decided to wait until the village contract with CT was presented. Virtually all sub-villages were consulted on the project before the signing of the contracts.

4.1.3 High Conservation Values (CM1.2)

High Conservation Value	**Village water sources**
Qualifying Attribute	The project villages rely on springs, streams, and rivers for their household water use (i.e. for drinking, cooking, and washing). The availability and cleanliness of these water sources are directly linked to community well-being.
Focal Area	Water sources are indicated on the village land use plans. Protecting the forest is often vital to maintain the water sources. Trees serve to retain moisture in the soil, serving an important hydrological function.

High Conservation Value	**"Matambiko" spiritual sites**
Qualifying Attribute	Matambiko are unique cultural sites where villagers pray for good fortune for themselves and their ancestors. For example, they may pray for recovering from an illness, for rain, or for good luck for the deceased. Sometimes ceremonies are organized

	with animal sacrifice and community feasts. In other cases, it may be forbidden to enter the area. The respect and protection of these sites is important for community cohesion, spirituality, and cultural identity.
Focal Area	In some cases, matambiko are marked on the community land use plans.

High Conservation Value	**Beekeeping / honey hunting areas**
Qualifying Attribute	In some areas of forest, villagers have installed logs in trees to attract bees. Periodically they collect the honey from these hives that is for both household use and to sell for supplementary income. The health of the forest ecosystem is important to sustain this traditional livelihood activity.
Focal Area	While hives are usually located in more accessible areas of forest (closer to the village or road), the health of the forest in general is important to sustain these activities due to the fact that bees travel throughout the forest to forage from flowering trees. There are two tree species identified as particularly important as bee forage, namely Msawala (*Sterculia quinqueloba*) and Mbanga (*Pericopsis angolensis, Afrofmosia angolensis*)

4.1.4 Without-Project Scenario: Community (CM1.3)

The existing trends before the project start related to well-being conditions of communities provide a good indication of the 'without-project scenario'. Without the introduction of the project, the trajectory of social indicators would be likely to continue in the same direction. The significant and regular influx of migrants to the area would likely continue. In the without-project scenario, villages would not have the resources to patrol and prevent migrants from burning and clearing forest to establish new residences, farms, and grazing lands. It is likely that land conflicts between residents and new settlers would continue unabated as the competition for limited resources increases. Land holdings would be gradually reduced in size, and without technical support on climate-smart agriculture, soils would become degraded and production reduced.

The loss of the forest would also have an adverse effect on water supply, leading to a less dependable water supply. Sedimentation is also another likely consequence of losing the capacity of forests to prevent erosion.

Furthermore, the high birth-rate of 5.8 children per woman of reproductive age (WRA), though predicted to decline according to National Population Projections (2018), would remain relatively high since until recently most women and couples face obstacles to plan the size of their families. These obstacles included lack of access to contraception as well as misconceptions – for instance the belief that use of birth control could lead to cancer.

4.2 Net Positive Community Impacts

4.2.1 Expected Community Impacts (CM2.1)

Community Group	Villages (all 8 project villages)
Impact(s)	*1. Improved livelihoods (e.g. income, employment, production)* *2. Improved reproductive health* *3. Increased access to education* *4. Reduced conflict over land and resources* *5. Increased resilience*
Type of Benefit/Cost/Risk	*1. Improved livelihoods (e.g. income, employment, production)* Aspects of improved livelihoods are benefits for villagers in the project area. Employment as VGS is a predicted direct benefit. More generalized livelihood improvements such as improved quality of life are also predicted, based on training and resources provided for climate smart agriculture and other capacity building efforts where villagers are expected to adopt new practices and utilize new skills to increase farm production. *2. Improved reproductive health* Better education and services for reproductive health are a direct predicted benefit. Pathfinder provides services throughout the villages and it is up to villagers to use these services and adopt family planning practices, therefore this is a predicted benefit. There are no anticipated risks associated with better reproductive health services. *3. Increased access to and quality of education* The Village Government plan to invest in improving schools and access to education. This will be a long-term benefit for the community. The precise method for increasing access to and quality of education is not yet determined, and will be developed in a participatory method with all the villagers through the Village Government. This is therefore a predicted indirect benefit based on various possible interventions. *4. Reduced conflict over land and resources* With an augmented budget and technical support provided by the project, the Village Government will have increased resources and skills to deal with land conflict in the villages. This is a predicted indirect benefit for the community. *5. Increased resilience* Village governance structures and villagers themselves will benefit from increased resilience to environmental problems. This is a predicted indirect benefit based on the belief that training, capacity development, and better-resourced government services will increase the ability to respond and adapt to crises such as drought, fires, landslides, etc.
Change in Well-being	*1. Improved livelihoods (e.g. income, employment, production)* *2. Improved reproductive health* *3. Increased access to education* *4. Reduced conflict over land and resources*

	5. Increased resilience

Community Group	Women and Women's groups
Impact(s)	*1. Improved livelihoods* *2. Greater control over reproductive health*
Type of Benefit/Cost/Risk	*1. Improved livelihoods* Community conservation banks target women to enable individual to access finance. Carbon Tanzania aims to increase the capital in these banks to enable greater economic opportunities for women. *2. Chicken farming* Specific revenue generating activities in villages include chicken farming as a household revenue generating activity. This activity is often conducted by women. *3. Greater control over reproductive health* Better education and services for reproductive health are an actual benefit for women. Pathfinder provides services throughout the villages and it is up to women to use these services and adopt better health practices, therefore this is a direct predicted benefit. There are no anticipated risks associated with better reproductive health services.
Change in Well-being	

Community Group	Village Game Scouts (VGS)
Impact(s)	*1. Improved livelihoods (e.g. income, employment, production)* *2. Improved capacities (enforcement, negotiation, coordination).*
Type of Benefit/Cost/Risk	*1. Improved livelihoods (e.g. income, employment, production)* VGS will be employed by the village to conduct on-the-ground forest protection activities, including patrolling of forested areas. They will thus benefit from regular income that will contribute to improving their livelihoods. For example, they will be able to purchase food in times of scarcity, contributing to increased food security. They will be paid fairly depending on the time and effort they contribute. Improved livelihoods is an indirect predicted impact. *2. Improved capacities (enforcement, negotiation, coordination).* VGS will be able to increase their capacity through training programs, giving them marketable skills such as knowledge of forestry and wildlife laws, capabilities in enforcement, negotiation techniques, and project coordination. These skills

	will contribute to human resources development. This is a direct predicted impact.
Change in Well-being	

4.2.2 Negative Community Impact Mitigation (CM2.2)

Over time the availability of new agricultural land for expansion will decrease. While agricultural land is currently sufficient for existing families, restrictions on encroachment on remaining forest areas could be negatively perceived by some village families that do not have enough land to divide among all of their children. However, the project will mitigate this potential negative impact by supporting increased agricultural production on existing lands through the introduction of climate smart agriculture techniques. Furthermore, a more vibrant local economy and training courses will open up opportunities for alternative livelihoods for young people such as small businesses. Some villagers will also be employed as VGS.

There are no negative impacts anticipated on HCV related to community well-being.

4.2.3 Net Positive Community Well-Being (CM2.3, GL1.4)

The net well-being impacts of the project are predicted to be positive for all community groups in the eight project villages. The positive impacts of the project include improved livelihoods through increased farm production, employment, and income, increased access to and quality of education, improved reproductive health services, reduced land conflict, and increased resilience in response to environmental shocks. It will be possible for all community groups to experience most of these benefits, including women and marginalized groups. These positive impacts will far outweigh any perceived negative impacts. One potential unwelcome impact could be lack of access to new agricultural land. It will be prohibited to establish new farm plots in the project area. This restriction would primarily affect new migrants, but also possibly the children of existing residents whose family land is limited. New migrants are not considered as project stakeholders and will be discouraged from moving to the project area. Negative impacts on descendants of villagers will be alleviated by more intensive and climate smart agricultural production. An improved local economy will also open up more opportunities for alternative livelihoods, such as small businesses, thus reducing pressure on remaining forests.

4.2.4 High Conservation Values Protected (CM2.4)

The HCVs related to community well-being will not be negatively affected by the project; on the contrary, only positive impacts are expected for water sources, spiritual sites, and beekeeping areas. All of these HCVs are related to the maintenance of forest areas that will be better protected under the project. Better protection of water sources and spiritual sites is enhanced by the fact that they are recognized in the land use plans.

4.3 Other Stakeholder Impacts

4.3.1 Impacts on Other Stakeholders (CM3.1)

Other stakeholders identified include the Tanganyika district government and Mpanda district government. The benefits anticipated for these districts include additional financial resources for district development as well as training and capacity building opportunities for government officers. As a result

these districts have the potential to become models for conservation and sustainable development. There are no anticipated negative impacts.

4.3.2 Mitigation of Negative Impacts on Other Stakeholders (CM3.2)

There are no anticipated negative impacts on other stakeholders so therefore no mitigation measures are needed.

4.3.3 Net Impacts on Other Stakeholders (CM3.3)

Since only positive impacts on the well-being of other stakeholders are anticipated, the net impact is also positive.

4.4 Community Impact Monitoring

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

A separate Community Monitoring Plan (CMP) has been developed to guide the monitoring activities of the Ntakata REDD project. This CMP includes background information on the project, an explanation of how the Plan adheres to the CCB monitoring requirements, a description of the project stakeholders, a description of the key monitoring principles adopted by the project, the roles and responsibilities for monitoring, a description of data management and reporting, and finally, the Community monitoring framework (see appendix 5).

4.4.2 Monitoring Plan Dissemination (CM4.3)

A summary of the monitoring plan will be translated to Swahili and disseminated to the community groups and other stakeholders prior to validation. Monitoring results will be communicated through meetings with the Village Governments in each of the eight villages on an annual basis. A copy of the monitoring results will also be presented to the Tanganyika and Mpanda districts. All of these meetings (with Village Governments and districts) will be an opportunity to analyse and discuss the project strategy and activities to assess effectiveness and possibly adjust.

4.5 Optional Criterion: Exceptional Community Benefits

The project fulfils both criteria for applying exceptional community benefits.

The project area is designated village land recognized under the approved village land use plans (VLUPs). These VLUPs give villagers the management rights to the land and therefore the rights to claim that their activities will generate the project's benefits.

4.5.1 Exceptional Community Criteria (GL2.1)

The project zone is in a low human development country. The human development index (HDI) in Tanzania was reported at 0.538 in 2018, with a rank of 154 out of 189 countries[53], placing Tanzania in the low human development category.

[53] United Nations Development Programme. Human Development Indicators; Tanzania. http://hdr.undp.org/en/countries/profiles/TZA

4.5.2 Short-term and Long-term Community Benefits (GL2.2)

In both the short-term and long-term, the project generates benefits to well-being. In the short-term, the project provides capacity development training and education on REDD+, project governance, forest management, forest law enforcement, as well as reproductive health etc. The project also provides employment for some villagers as village game scouts, thus providing income to them and their families. In the longer term, well-being will be boosted by the village development projects funded by carbon revenues. The exact nature of these projects will be decided by the Village Governments in consultation with villagers, but it is likely that they will provide longer-term well-being benefits such as improved food security, greater access to education (including higher education), and improved health standards.

4.5.3 Community Participation Risks (GL2.3)

There are a few risks associated with the participation in the project. One of the risks is that some villagers may dedicate an amount of time to the project that is not commensurate with the benefits they individually receive. For instance, Village Government members may spend significantly more time to support the project, whereas the benefits from the project are distributed to the village as a whole. The project team aims through the consultations to make sure that Village Governments do not have higher expectations for their own benefits and understand that the project is meant to benefit the village as a whole.

Another risk is that women will be excluded from participating in some activities due to cultural barriers and existing gender imbalances (such as in the Village Government for example). The project will proactively address gender issues by encouraging gender balance in participation in project activities and by raising awareness on the importance of including women's perspectives in decision making. Door-to-door visits by carbon champions and reproductive health officers will increase communication and involvement of women in the project.

4.5.4 Marginalized and/or Vulnerable Community Groups (GL2.4)

Community Group 1	Poor households
Net positive impacts	Poorer households in the community will experience net positive impacts from the project as a result of several activities. These include improved livelihoods resulting from projects supported by the Village Government using project carbon revenues. Though these projects are not yet clearly defined, they are likely to include projects related to primary and secondary education, water and electricity, and agricultural improvements which will have wide benefits, also for poor households. The Village Government have specific strategies to alleviate poverty in their villages, and thus village development activities under the project will align to these strategies.
Benefit access	The members of poorer households risk being excluded due to illiteracy and lack of time to attend meetings. The project addresses this issue by relying on verbal communication and door-to-door meetings through the carbon champions who

	share information and seek input from all households in the villages. The Village Government already have a mechanism for identifying poor households in the community in order to target additional assistance.
Negative impacts	While no negative impacts are anticipated, the Village Government will regularly monitor project impacts. The Village Government has a role to facilitate feedback from the most vulnerable members of the community. This process of regular interaction will prevent negative impacts on community members.

Community Group 1	Women in the villages
Net positive impacts	Women will positively benefit from the project activities. In particular, women will benefit from the reproductive health services that will be supported by the project, resulting in better health conditions. They will also benefit from some of the livelihood activities, such as climate smart agriculture.
Benefit access	Women risk being excluded due to illiteracy and lack of time to attend meetings. The project addresses this issue by relying on verbal communication and door-to-door meetings through the carbon champions and reproductive health officers.
Negative impacts	While no negative impacts are anticipated, the Village Government will regularly monitor project impacts. The Village Government has a role to facilitate feedback from the most vulnerable members of the community, including women. This process of regular interaction will prevent negative impacts on women.

4.5.5 Net Impacts on Women (GL2.5)

The project villages are traditionally patriarchal, and while discrimination is often not overt or even recognized, women do not hold the same status or decision-making power as men in the village. They are also considered to be more vulnerable from a livelihood standpoint. The project will seek to have a positive influence on the status of women in the project area with benefits including improved livelihoods, improved reproductive health, and influence in decision-making. This objective will be achieved through several strategies as outlined in the description of project activities. First, CT will encourage greater participation of women as VGS by urging committees to attain gender balance in their selection. The project will also build the skills and confidence of women by providing various training opportunities. The project/Tuungane will promote women's entrepreneurship, thus giving women and their families more financial stability and contributing to improved livelihoods. Project facilitators are also conscious of the need to seek and encourage women's input in decision making related to the project. Women's perspectives on the issues and needs in their communities may differ significantly from those of men. Therefore, during meetings, facilitators highlight the need to hear women's voices and opinions on the

issues discussed. When needed, separate discussions with women's groups will be arranged in order to encourage participation. Door-to-door visits by the carbon champions (some of whom are women) increase the interaction with women on project matters.

4.5.6 Benefit Sharing Mechanisms (GL2.6)

The benefit sharing mechanism of the project is based on existing democratic governance structures and procedures. It incorporates checks and balances and allows for participation of the wider community through the elected village committee representatives. Payments from carbon sales will flow directly to the official village government account based on the project steering committees decision on a bi-annual basis (every six months). Together all eight villages will receive 50% of the net revenues from sales with 50% remaining with CT to cover its operating costs, verification and pay taxes (village governments are exempt from tax) and invest in new projects. The benefit sharing mechanism was communicated in a participatory way to communities in two ways; the 50%-50% split in revenue distribution between Carbon Tanzania and the villages was introduced in the contract training seminars and meetings, and is also outlined in the contract (see appendix). The more detailed concept around dividing revenue between villages is based on; a base payment (50%) and the size of the village (50%) and was communicated at the introduction to the contract meetings, in following meetings and will be communicated at every bi-annual project steering committee meeting.

The steering committee will in turn apply payments received to priorities already established in the existing village development plans. These plans include addressing community needs related to health, education, relief for the poorest, and infrastructure. The precise division of funds may vary depending on the community needs and priorities, however all adjustments and transfers are made based on discussion and decision-making among the village committee members. To increase transparency in the process, CT will publicly post the amount of the bi-annual payment in an accessible and visible way so that the wider community is aware of the amount received. Whenever possible, CT will also attend and make a short presentation to the general assembly to update the wider community on the project activities and revenues.

4.5.7 Benefits, Costs, and Risks Communication (GL2.7)

The introductory meetings held in all eight villages have provided information to the communities on the predicted benefits, costs, and risks associated with the project. Evidence of communication and comprehension on these issues may be found in the meeting minutes that are taken by the committee members themselves. The risks discussed included failure of CT to be able to sell the carbon credits at an acceptable price, potential for arguments or conflict about spending priorities within the community, corruption, massive influx of new migrants, and uncontrollable fire. In addition, the CT team made it clear that VGS, though compensated, might not have as much time to devote to other livelihood activities such as farming (opportunity costs). The CT team also presented potential benefits such as training, employment and most importantly, payments to the village treasury, with the caveat that the amount of these payments would be subject to more precise estimates of forest biomass and allocated according to the established criteria of participation, forest area, and performance. In addition, written material on the project was distributed to explain the concept of the project along with benefits and responsibilities for the community.

Actual costs and benefits will also be presented in the village committee meetings and general assemblies on a regular basis. CT will provide written and oral updates that include information on payments, trainings, educational activities, and forest status (based on satellite imagery, when available).

4.5.8 Governance and Implementation Structures (GL2.8)

The project governance structure is led by Carbon Tanzania in partnership with Tuungane, a collaborative program of The Nature Conservancy and Pathfinder. Carbon Tanzania, as the project proponent, holds overall responsibility for the project in ensuring that its objectives are attained. Carbon Tanzania manages the day-to-day higher-level project operations including planning, monitoring, reporting, credit marketing, financial management and external relations. TNC and Pathfinder (under Tuungane) share many of the same objectives of the project and have made long-term commitments to collaboration with Carbon Tanzania and the project communities. CT and Tuungane share an office in Mpanda and hold regular meetings to exchange information and updates on project progress. This partnership in effect provides co-financing and allows CT to maximize carbon payments to the community since Tuungane provides support to conservation, livelihoods improvement, and reproductive health through its own funding sources. The local government is also a key actor in project governance and implementation, particularly in ensuring that the forest protection and village development activities are implemented. The project relies on the existing governance structure represented by Tanganyika District, Mwese and Katuma Wards, and the village committees and sub-village representatives of the eight project villages. This democratic structure (with elected representatives) has checks and balances embedded.

4.5.9 Smallholders/Community Members Capacity Development (GL2.9)

CT has a long-term approach to developing the capacity of community members and local government institutions. A number of trainings have already been conducted and future trainings are also planned. CT has prepared a short course on REDD+ and forest carbon projects implemented with all the village committees (See training manual). In addition, CT plans to support profession VGS training at the Pasiansi Training Institute in Mwanza. This 3-month course teaches skills in forest law enforcement and results in a certificate. Certified trainees of the course are legally authorized to enforce forest regulations in the village forest reserves.

CT will also provide training in financial management to the village committees so that they are more adept at managing budgets, expenses, and balance sheets.

CT has conducted training for 16 VGS (2 from each village) on forest inventory. The two-day training was followed by one week of practical field inventory work, led by international experts. Trainees gained valuable skills in plot establishment, tree measurement, and data collection. CT will also conduct training on Spatial Measurement and Cybertracker (SMART) for VGS so that they can more easily collect field data on forest management and patrolling activities and relay it efficiently for reporting purposes.

In addition, a Community Manager, visits the project villages on a regular basis and provides coaching to village leaders so that they can deal with any challenges that arise.

Finally, a range of training, demonstration, and coaching is planned by Tuungane to enhance local livelihoods and health.

5 BIODIVERSITY

5.1 Without-Project Biodiversity Scenario

5.1.1 Existing Conditions (B1.1)

Habitat is typical of the Zambezian (miombo) Woodland Ecoregion characterised by *Brachystegia* and *Julbernardia* spp that provides high-quality habitat for a variety of species, including chimpanzees, savanna elephants and zebras. The project area is bordered by Mahale Mountain National Park (MMNP) to the west along Lake Tanganyika. There are two clear seasons across the region, with a wet season from November to April, and a dry season from May to October. Average rainfall is 1800mm / year with temperatures ranging from 18 C to 32 C depending on altitude and time of year. The topography of the region is characterized by broad but steep hills of miombo woodland broken up by thin strips of gallery forest, typically in valley bottoms. There are also patches of seasonally inundated swamps, wooded grasslands, rocky outcrops and expansive tracts of bamboo woodlands, especially along the eastern border of Mahale Mountains National Park. The Greater Mahale Ecosystem is framed by Lake Tanganyika in the west and by major rivers – Malagarasi in the north, Ugalla in the east – as well as smaller riverine systems that flow into Lake Tanganyika.

Threats to biodiversity are predominantly from habitat loss driven by shifting agriculture contrary to village land use plans. Poaching of mammals using snares, predominantly for the bush meat trade is present although there is little knowledge on how this impacts mammal populations. Research by the Greater Mahale Ecosystem Research and Conservation (GMERC) indicates that poaching is not a major threat to Chimpanzee populations, as Tanzanians have a tradition and taboo against eating primates.[54]

Knowledge of biodiversity in the region is limited to one major survey conducted in 2006[55] and supplemented by published surveys of Chimpanzee (surveys carried out in 2001)[56] and work conducted by our research partner, GMERC. Knowledge of avifauna within the region is limited to data collected during the 2006 survey by Moyer et al. and records from the Tanzania Bird Atlas[57] which has been compiled from both historical and current observer data from the region. Whilst the Ntakata project area is predominantly Miombo woodland dominated by *Brachystegia* and *Julbernardia* spp. There are also extensive areas of gallery forest defined by *Garcinia huillens*, *Albizia glaberrhima*, *Chionanthus africana*, *Julbernardia unijugata*, especially along river valleys. Bamboo thickets of the genus (*Oxytenanthera*) occurred in scattered thickets on the plains and hillsides, and some areas along valley bottoms.

Eight species of threatened Mammal and seven species of threatened bird species have been confirmed as resident within the project area.

[54] Tanzania Chimpanzee Conservation Action Plan.
[55] Moyer, D et al. (2006) Surveys of Chimpanzee and other Biodiversity in Western Tanzania. WCS JGI UCSD.
[56] Ogawa H. et al. (2006) Chimpanzee in Ntakata and Kagunga areas, Tanzania. Reaserchgate.
[57] www.tanzaniabirdnet.net

5.1.2 High Conservation Values (B1.2)

High Conservation Value (HCV			Specific HCV		
Genus	**species**	**Common names (Eng)**	**Red List status**	**Population trend**	**Focal area**
Bucorvus	*leadbeateri*	*Southern Ground-hornbill*	*VU*	*decreasing*	Throughout the project area
Gyps	*africanus*	White-backed Vulture	CR	decreasing	Recorded within the project area
Gyps	*rueppelli*	Rüppell's Vulture	CR	decreasing	Recorded within the project area
Polemaetus	*bellicosus*	Martial Eagle	VU	decreasing	Resident within the project area
Sagittarius	*serpentarius*	Secretarybird	VU	decreasing	Resident within the project area
Trigonoceps	*occipitalis*	White-headed Vulture	CR	decreasing	Resident within the project area
Piliocolobus	*tephrosceles*	Red Colobus	EN	decreasing	Resident in highland forests in Ntakata, Mwese, Mpembe and Katuma
Pan	*troglodytes*	Robust Chimpanzee	EN	decreasing	Resident across the project area
Giraffa	*camelopardalis*	Giraffe	VU	decreasing	Resident within the project area. Possibly migratory populations.
Loxodonta	*africana*	African Elephant	VU	Globally populations have declined with Tanzania suffering one of the greatest declines of 60% from 2010-2015 (great Elephant census).	Resident within the project area with migratory populations between Mahale and Katavi NPs
Lycaon	*pictus*	African Wild Dog	EN	decreasing	Resident within the project area
Panthera	*leo*	African Lion	VU	decreasing	Resident within the project area
Panthera	*pardus*	Leopard	VU	decreasing	Resident within the project area
Smutsia	*temminckii*	Temminck's Ground Pangolin	VU	decreasing	Resident within the project area

5.1.3 Without-project Scenario: Biodiversity (B1.3)

The land-use scenario in the without project (baseline) scenario is detailed and justified in the VCS PD Section 3.2. In the baseline scenario, 64,329.6 ha of native forest are projected to be deforested over the period from 2017 to 2026.

Table 5.1. Area deforested in the Ntakata REDD project baseline scenario (areas in hectares).

Year	Native Forest Area Deforested
2017	11,229.8
2018	14,144.1
2019	13,023.1
2020	11,169.0
2021	6,914.3
2022	7,435.7
2023	4,972.1
2024	4,830.2
2025	4,746.6
2026	4,441.0
2017-2026 TOTAL	82,906.0

With loss of native forest cover and discontinuity of the larger forested landscape, it is anticipated that in the baseline scenario biota associated with native forest are subject to reductions in areal coverage and population declines.

5.2 Net Positive Biodiversity Impacts

5.2.1 Expected Biodiversity Changes (B2.1)

Measurable biodiversity indicators and monitoring and estimation procedures are detailed in the accompanying Biodiversity Monitoring Plan and summarized in the following table.

Anticipated impact	Indicator	Area monitored	Sampling method	Frequency of monitoring	Responsible to monitor
Maintenance of forest cover	Change in areal coverage of forest	Carbon project area, 204,807 ha	Assessment of forest cover change via time series of classified satellite imagery Detailed protocol in PD Section 3.3, Monitoring Plan	Initial forest cover assessment 2017, subsequently every five years or less	Carbon Tanzania
Potential negative offsite impacts due to displacement of deforestation	Change in areal coverage of forest due to displaced deforestation	Activity shifting leakage belt as defined in PD	Assessment of forest cover change via time series of classified satellite imagery Detailed protocol in PD Section 3.3, Monitoring Plan	Initial forest cover assessment 2017, subsequently every five years or less	Carbon Tanzania
Maintenance of native tree diversity	Tree (woody plants > 5 cm dbh) species richness and composition, relative basal area (percent of total tree basal area represented) of each species	Carbon project area, 204,807 ha	Forest inventory Detailed protocols provided in “Mahale Forest Inventory Feb2018”	Initial inventory in 2017 Re-inventory every ≤ 10 years	Carbon Tanzania

Maintenance of habitat suitability for eastern Chimpanzees (*Pan troglodytes schweinfurthii*)	Average remote sensing-derived habitat suitability index value (0-1), difference between actual and baseline scenarios	Carbon project area, 204,807 ha	Monitoring will apply the habitat suitability model developed by Jantz et al 2016[58], incorporating any future refinements made to the model. Note that the Jantz et al 2016 model had the highest predictive capability (r^2 = 0.89) in the Ntakata REDD Project region (for the eastern Chimpanzee sub-species). For each monitoring event, the model will incorporate predictor variables derived from the most recent Landsat data. The average habitat suitability index for the baseline scenario will be derived applying the same model and Landsat data, clipped to the projected area of forest remaining in the baseline for the corresponding year (previously derived in the PD Section 3.2), with predicted non-forest areas assigned a habitat suitability value of 0.	Conducted every ≤ 5 years	Carbon Tanzania GMERC

Anticipated impact	Indicator	Area monitored	Sampling method	Frequency of monitoring	Responsible to monitor
			The model will be re-validated periodically as ground-truth field observation data becomes available.		

[58] Jantz, S.M., Pintea, L., Nackoney, J. and Hansen, M.C., 2016. Landsat ETM+ and SRTM data provide near real-time monitoring of chimpanzee (Pan troglodytes) habitats in Africa. *Remote Sensing*, *8*(5), p.427.

Net impacts resulting from project activities are assessed as the difference, with respect to defined biodiversity indicators, between the without-project baseline scenario and direct-monitored project outcomes. Indicator values for the without-project scenario are estimated applying defensible assumptions or referencing values from relevant studies or monitoring in representative proxy areas.

Through the project lifetime, positive impacts to biodiversity are expected to be generated through ongoing implementation of the VLUPs and conservation of forest in the Ntakata REDD project area.

Conservation of native forest cover and maintenance of forest connectivity at the landscape scale are anticipated to benefit native forest biota with stability or expansion in their populations. The project activity is essentially the avoidance of the baseline scenario, and thus is expected to generate net positive benefits to forest communities and forest-dependent species by avoiding negative impacts expected in the baseline scenario. Specifically, all biodiversity indicators monitored in the Biodiversity Monitoring Plan are expected to be maintained at similar or increasing levels throughout the project lifetime.

Biodiversity Element	Areal coverage of forest
Estimated Change	Anticipated to be maintained at or above 80% of initial 2017 areal coverage.
Justification of Change	Monitored via periodic assessment of classified satellite imagery

Biodiversity Element	Tree (woody plants > 5 cm dbh) species richness and composition
Estimated Change	Anticipated to be maintained within +/- 10% of initial 2017 levels.
Justification of Change	Monitored via periodic forest inventory. Detailed protocols provided in “Mahale Forest Inventory Feb2018”

Biodiversity Element	Habitat suitability for Chimpanzees
Estimated Change	Anticipated to be maintained within +/- 10% of initial 2017 levels.
Justification of Change	Monitoring will apply the habitat suitability model developed by Jantz et al 2016[59], incorporating any future refinements made to the model. Note that the Jantz et al 2016 model had the highest predictive capability (r2 = 0.89) in the Ntakata REDD Project region (for the eastern Chimpanzee sub-species). For each monitoring event, the model will incorporate predictor variables derived from the most recent Landsat data.

[59] Jantz, S.M., Pintea, L., Nackoney, J. and Hansen, M.C., 2016. Landsat ETM+ and SRTM data provide near real-time monitoring of chimpanzee (Pan troglodytes) habitats in Africa. *Remote Sensing*, *8*(5), p.427.

	The average habitat suitability index for the baseline scenario will be derived applying the same model and Landsat data, clipped to the projected area of forest remaining in the baseline for the corresponding year (previously derived in the PD Section 3.2), with predicted non-forest areas assigned a habitat suitability value of 0. The model will be re-validated periodically as ground-truth field observation data becomes available.

5.2.2 Mitigation Measures (B2.3)

The main threats to megafauna in this landscape stem from habitat fragmentation and loss of landscape connectivity, addressing these forms the fundamental design of this project. By successfully implementing the Village Land Use plans, the habitat will be enhanced for Chimpanzee populations as well as resident and migratory megafauna. The design of this project enables the Village Governments to take the necessary actions, where needed, to maintain the protection of biodiversity within the project area. The governance, management and implementation of VLUPs by the Village Governments is supported by Carbon Tanzania, the District Government and Tuungane. Based on project design, implementation and structure of the VLUPs, the precautionary principle in environmental science[60] follows: to take preventive action in the face of uncertainty; shifting the burden of proof to the proponents of an activity; exploring a wide range of alternatives to possibly harmful actions; and increasing public participation in decision making.

5.2.3 Net Positive Biodiversity Impacts (B2.2, GL1.4)

Net impacts on biodiversity resulting from the project activity are expected to be positive, as outlined in the baseline scenario above (all negative impacts anticipated in the baseline scenario are prevented or lessened in the with-project scenario).

Net positive impacts on biodiversity will be demonstrated over time through periodic monitoring and reporting of biodiversity indicators (see Biodiversity Monitoring Plan).

5.2.4 High Conservation Values Protected (B2.4)

Biodiversity conservation is a priority objective of the project, and it is not anticipated that HCVs related to biodiversity will be negatively affected by the project activity.

Absence of negative impacts will be demonstrated over time through periodic monitoring and reporting of biodiversity indicators (see Biodiversity Monitoring Plan).

[60] D Kriebel, J Tickner, P Epstein, J Lemons, R Levins, E L Loechler, M Quinn, R Rudel, T Schettler, M Stoto Precautionary Principal in Environmental Science. Environ Health Perspect. 2001 Sep; 109(9): 871–876.

5.2.5 Species Used (B2.5)

No species are grown or introduced as part of project forest conservation activities. Maize, bananas, beans, cassava, sweet potatoes, Irish potatoes, sesame, coffee, sunflower, millet, and sorghum have been used in ongoing agricultural activities.

5.2.6 Invasive Species (B2.5)

As stated above, no species are grown or introduced as part of project forest conservation activities.

The project is a REDD activity and does not involve any introduction of new biological material. Agricultural crops and livestock in areas designated in the VLUPs for agriculture and grazing represent species and stock already existing in the project region and not known to invade native ecosystems and displace native species. No known invasive species are introduced by the project, and in fact the project activity is expected to reduce vectors of invasives by reducing the development of new access routes in forest protection areas.

5.2.7 Impacts of Non-native Species (B2.6)

As stated above, no species are grown or introduced as part of project forest conservation activities.

Species	None
Justification of Use	N/A
Potential Adverse Effect	None

5.2.8 GMO Exclusion (B2.7)

The project uses no GMOs to generate GHG emissions reductions or removals. GMOs are illegal in Tanzania.

5.2.9 Inputs Justification (B2.8)

In village agricultural areas the following fertilizers are legally used by villages. Whilst there is limited data on adverse effects in Tanzania, a single study identifies possible adverse effects to farms using organophosphate pesticides in Arusha Region, Tanzania[61]. The following pesticides, and herbicides are used in ongoing agricultural activity:

Name	Calcium Ammonium Nitrate
Justification of Use	Fertilizer
Potential Adverse Effect	Runoff from fertilizer may cause degradation of water quality in the region

Name	DAP (Diammonium Phosphate)

[61] Pesticide exposure and health problems. Tanzania 2018.

Justification of Use	Adds phosphorus and ammonium to soils with limited fertility
Potential Adverse Effect	Runoff from fertilizer may cause degradation of water quality in the region

Name	Urea
Justification of Use	Fertilizer
Potential Adverse Effect	*Runoff from fertilizer may cause degradation of water quality in the region*

Name	Phosphate
Justification of Use	Fertilizer
Potential Adverse Effect	Runoff from fertilizer may cause degradation of water quality in the region

Name	Roundup
Justification of Use	Herbicide
Potential Adverse Effect	Roundup may be potentially harmful to human and animal health.

Name	Selecron (organophosphate)
Justification of Use	Insecticide
Potential Adverse Effect	Insecticides may be potentially harmful to human and animal health.

5.2.10 Waste Products (B2.9)

No waste products are generated through project activities.

5.3 Offsite Biodiversity Impacts

5.3.1 Negative Offsite Biodiversity Impacts (B3.1) and Mitigation Measures (B3.2)

Potential negative impacts on biodiversity outside the project zone that result from the project relate to displacement of deforestation outside of the Ntakata REDD project area (i.e. leakage). Leakage from REDD activities will be monitored and periodically reported in monitoring reports.

Village Land Use Plans are developed to address the full span of village land resource needs, and designate fixed areas for agricultural and livestock production, helping to contain the expansion of the agricultural frontier.

Negative Offsite Impact	Mitigation Measure(s)
Deforestation due to leakage outside the project area	Village Land Use Plans contain efforts to mitigate the effects of deforestation due to leakage by designating areas of agricultural activity.

5.3.2 Net Offsite Biodiversity Benefits (B3.3)

Biodiversity indicators, all directly related to forest cover, will be tracked both within the Ntakata REDD project area and leakage belt as part of climate impact monitoring activities, and net impacts on biodiversity indicators periodically quantified and reported.

It can be expected that some un-mitigated and undetected displacement of deforestation outside of the Ntakata REDD project area attributable to the project takes place, however such displacement would not be expected to exceed the amount of deforestation prevented in the project area, thus net impacts of the project are unlikely to be negative.

5.4 Biodiversity Impact Monitoring

5.4.1 Biodiversity Monitoring Plan (B4.1, B4.2, GL1.4, GL3.4)

All biodiversity indicators are identified and addressed in the Biodiversity Monitoring Plan that accompanies this document. The Biodiversity Monitoring Plan will be implemented periodically and results reported to CCBA and disseminated to Communities and Other Stakeholders identified in this document.

5.4.2 Biodiversity Monitoring Plan Dissemination (B4.3)

A summary of the monitoring plan will be translated to Swahili and disseminated to the community groups and other stakeholders prior to validation. Monitoring results will be communicated through meetings with the Village Governments in each of the eight villages on an annual basis. A copy of the monitoring results will also be presented to the Tanganyika and Mpanda districts. All of these meetings (with Village Governments and districts) will be an opportunity to analyse and discuss the project strategy and activities to assess effectiveness and possibly adjust.

5.5 Optional Criterion: Exceptional Biodiversity Benefits

5.5.1 High Biodiversity Conservation Priority Status (GL3.1)

Below we demonstrate, per CCB, the presence of at least a single individual of a species on the IUCN Red List that is critically endangered or endangered, or the presence of at least 30 individuals or 10 pairs of a vulnerable species.

Eastern Chimpanzee (Pan troglodytes schweinfurthii) – IUCN Red List threat category Endangered

Leopard (Panthera pardus) - IUCN Red List threat category Vulnerable

Giant Ground Pangolin (Smustia gigantea) - IUCN Red List threat category Vulnerable

Martial Eagle (Polemaetus bellicosus) - IUCN Red List threat category Vulnerable

5.5.2 Trigger Species Population Trends (GL3.2, GL3.3)

The Ntakata REDD project area is a site of high biodiversity conservation priority, meeting the vulnerability criteria of the CCBA standard, defined by the presence of the following "trigger" species:

Trigger Species	Eastern Chimpanzee *(Pan troglodytes schweinfurthii)*
Population Trend at Start of Project	IUCN Red List threat category Endangered
Without-project Scenario	Population trends in the Ntakata REDD project region of the trigger species identified above are not well understood, however, it is anticipated that these species, all with some degree of association with native forest cover, would suffer declines in the without-project scenario.
With-project Scenario	Chimpanzee landscape level habitat suitability will be monitored and reported periodically to assess the impacts of project conservation actions.

Trigger Species	Leopard *(Panthera pardus)*
Population Trend at Start of Project	IUCN Red List threat category Vulnerable
Without-project Scenario	Population trends in the Ntakata REDD project region of the trigger species identified above are not well understood, however, it is anticipated that these species, all with some degree of association with native forest cover, would suffer declines in the without-project scenario.
With-project Scenario	Impacts on identified trigger species will be inferred by tracking change in forest cover over time; per CCBA v3.1 GL3, "Population status or even presence at the site may be hard to establish for some species that are threatened, rare or cryptic, for example. Evidence that threats to the species are being addressed may be used to demonstrate that species population status is likely to be maintained or enhanced as a result of project activities."

Trigger Species	*Temminck's Ground Pangoloin (Smustia temminckii)*
Population Trend at Start of Project	IUCN Red List threat category Vulnerable

Without-project Scenario	Population trends in the Ntakata REDD project region of the trigger species identified above are not well understood, however, it is anticipated that these species, all with some degree of association with native forest cover, would suffer declines in the without-project scenario.
With-project Scenario	Impacts on identified trigger species will be inferred by tracking change in forest cover over time; per CCBA v3.1 GL3, "Population status or even presence at the site may be hard to establish for some species that are threatened, rare or cryptic, for example. Evidence that threats to the species are being addressed may be used to demonstrate that species population status is likely to be maintained or enhanced as a result of project activities."

Trigger Species	Martial Eagle *(Polemaetus bellicosus)*
Population Trend at Start of Project	IUCN Red List threat category Vulnerable
Without-project Scenario	Population trends in the Ntakata REDD project region of the trigger species identified above are not well understood, however, it is anticipated that these species, all with some degree of association with native forest cover, would suffer declines in the without-project scenario.
With-project Scenario	Impacts on identified trigger species will be inferred by tracking change in forest cover over time; per CCBA v3.1 GL3, "Population status or even presence at the site may be hard to establish for some species that are threatened, rare or cryptic, for example. Evidence that threats to the species are being addressed may be used to demonstrate that species population status is likely to be maintained or enhanced as a result of project activities."

APPENDICES

Appendix 1: Stakeholder Identification Table and bi-annual meeting protocol.

The key stakeholders, communities, and community groups include:

Stakeholder	Rights, Interest and Overall Relevance to the Project
Tanganyika District Government	Rights: Higher level decision-making authority in the district, including the right to decide whether or not to host the project. Interest: Concern for the effects of climate change on the district. Financial resources to enable better services in the district. Raising the profile of the district as a model for attracting 'green' private sector investment. Relevance: Provides higher level support to the project villages for forest law enforcement when required. Liaises with national government.
Mpanda District Government	Rights: Since the division of the district, Mpanda District Government no longer has governing authority in the area of the project, however, relevant departments continue to play a role, at least in the interim. Interest: There is an opportunity to learn from the project and engage in forest and land-related activities in partnership with neighboring Tanganyika District. Relevance: District forest officer and district land officer are assigned to support the project.
Bujombe Village (+5 sub-villages)	Rights: Village self-determination and governance, including enforcement of local land use plans and forest regulations, consent (or withholding of such) to the project. Interest: Potential for improved livelihoods, employment, training and capacity development, health and education benefits, ecosystem services from forests. Relevance: Land use plan designates an area of 13,380 ha of forest reserve in the project area.
Kagunga Village (+4 sub-village)	Rights: Village self-determination and governance, including enforcement of local land use plans and forest regulations, consent (or withholding of such) to the project.

	Interest: Potential for improved livelihoods, employment, training and capacity development, health and education benefits, ecosystem services from forests. Relevance: Land use plan designates an area of 6,089 ha of forest protection in the project area.
Kapanga Village (+ 3 sub-villages)	Rights: Village self-determination and governance, including enforcement of local land use plans and forest regulations, consent (or withholding of such) to the project. Interest: Potential for improved livelihoods, employment, training and capacity development, health and education benefits, ecosystem services from forests. Relevance: Land use plan designates an area 5,923 ha of forest reserve in the project area, and 2,336 ha of grazing reserve.
Katuma Village (+4 sub-villages)	Rights: Village self-determination and governance, including enforcement of local land use plans and forest regulations, consent (or withholding of such) to the project. Interest: Potential for improved livelihoods, employment, training and capacity development, health and education benefits, ecosystem services from forests. Relevance: Land use plan designates an area of 909 ha of forest reserve in the project area.
Lugonesi Village (+7 sub-villages)	Rights: Village self-determination and governance, including enforcement of local land use plans and forest regulations, consent (or withholding of such) to the project. Interest: Potential for improved livelihoods, employment, training and capacity development, health and education benefits, ecosystem services from forests. Relevance: Land use plan designates an area of 38,324 ha of forest reserve in the project area, and 5,981 ha grazing reserve.
Lwega Village (+6 sub-villages)	Rights: Village self-determination and governance, including enforcement of local land use plans and forest regulations, consent (or withholding of such) to the project. Interest: Potential for improved livelihoods, employment, training and capacity development, health and education benefits, ecosystem services from forests. Relevance: Land use plan designates an area of 30,426 ha of forest reserve in the project area, and 11,018 ha of grazing reserve.

Mpembe Village (+6 sub-villages)	Rights: Village self-determination and governance, including enforcement of local land use plans and forest regulations, consent (or withholding of such) to the project. Interest: Potential for improved livelihoods, employment, training and capacity development, health and education benefits, ecosystem services from forests. Relevance: Land use plan designates an area of 19,401ha of forest protection in the project area.
Mwese Village (+5 sub-villages)	Rights: Village self-determination and governance, including enforcement of local land use plans and forest regulations, consent (or withholding of such) to the project. Interest: Potential for improved livelihoods, employment, training and capacity development, health and education benefits, ecosystem services from forests. Relevance: Land use plan designates an area of 112 ha of forest reserve in the project area.
Village Women & Women's Groups	Rights: To participate in project activities and decision-making. Interest: Women are interested in the well-being of their families and the long-term protection of the resources and assets that contribute to better livelihoods. They also tend to have strong concerns about health and education of their children. Relevance: Since men tend to dominate in decision-making and have better access to employment and other opportunities, the project makes deliberate efforts through targeted strategies to ensure that women participate and also benefit from the project.

Bi-annual meeting procedures

carbontanzania
NtakataMountains
Protecting forests for farmers, wildlife and climate

Procedures and Agenda for the Bi-Annual Grievance and Finance Steering Committee Meetings

Agenda No 1. Opening the Meeting

Selecting Chairman and Secretary

Each Meeting the committee members will select Chairman and Secretary, and this will be rotating. The Chairman will lead the meeting and Secretary will be writing the minutes

Agenda No 2. Report from each village

- Patrol reports
  The village will bring a patrol report conducted by VGS done each month
- Sign sheets
  The VEO will bring sign sheet payment for VGS and Carbon Champions paid by CT
- Expenditures of Carbon Revenues Report
  The VEO will bring Carbon Revenues Village payment and expenditures Reports during the meeting show how the previous periods carbon revenue was used/allocated
- Bringing stamp from each village
  During the Meeting each village should bring Mhuri (Stamp) that will be stamped on Ntakata Project Steering Committee General Report

Agenda No 3. Grievance

The village representative can voice any concerns or grievances with CT/ the carbon project. Grievances are bested framed in terms relating to the contract terms or Project Document

Agenda No 4. Finance and annual report: Sales Report from CT

Carbon Tanzania will bring Sales Report (Carbon Credit sales) from each village forest Project areas. This will allow the villages to understand the sales for the period and how much revenue they will each receive. Carbon Tanzania to provide it's annual report detailing all activities conducted by Carbon Tanzania in relation to both field and office operations

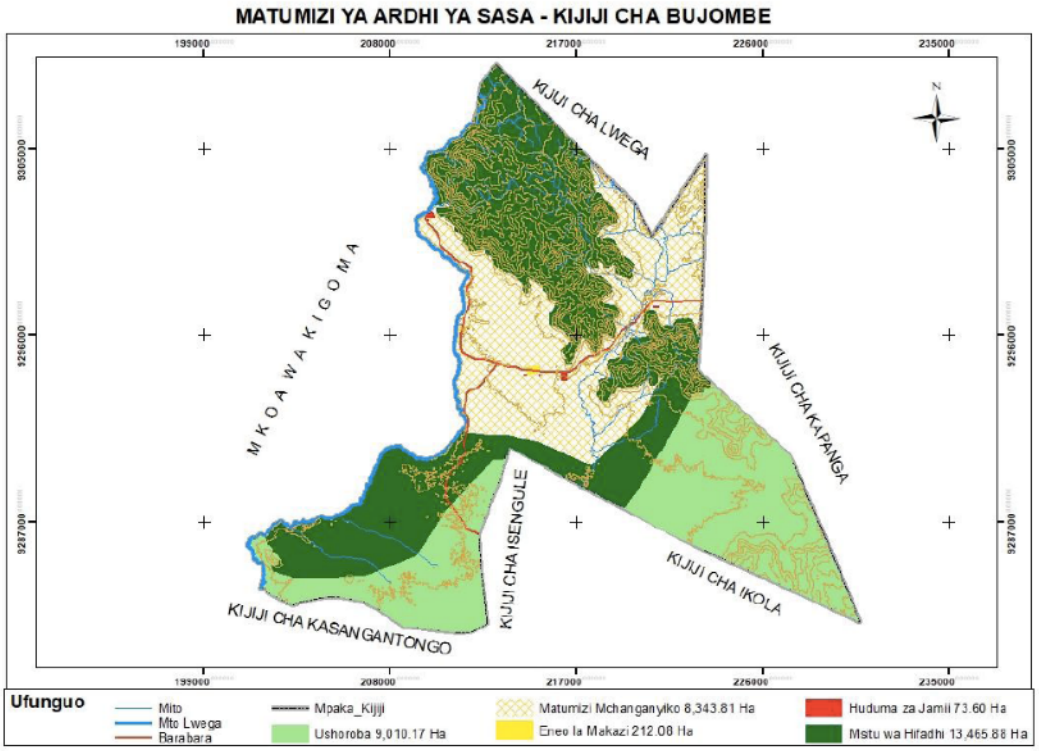
Agenda No 5. Close Meeting

Appendix 2: Project Risks Table

Identify Risk	Potential impact of risk on climate, community and/or biodiversity benefits	Actions needed and designed to mitigate the risk
1. Increased mining especially gold mining	- *Mining leads directly to clearing of forest to access minerals but also to clearing for settlement of migrants attracted to the area.*	- *Maintaining a close relationship with district and local government ensures any mining prospecting is known prior to mining.* - *Active participation in the EIA process would ensure social and environmental safeguards are enacted and mining would be stopped.* - *Empowerment of villagers to protect their resources for equitable benefit sharing.*
2. New major roads	- *New major roads (such as the road planned to link Mpanda to Uvinza) would lead to clearing of forest for road construction but also to further clearing from roadsides due to easier access and increased land values.*	- *Active participation in EIA processes to ensure avoidance of critical forest habitat and inclusion of mitigation measures.*
3. Change in national REDD+ policy to disallow voluntary market carbon projects	- *The suspension of carbon revenues associated with the project (unless replaced immediately by national sources) would lead to great resistance by the communities and possibly a return to pre-project conditions. Forests and biodiversity would be at much greater risk of loss.*	- *Continued involvement in national REDD+ dialogue.* - *Technical support for nesting of the project within a national GHG accounting system.* - *Active engagement of district government and other stakeholders with delivery of benefits to develop a constituency of support for the project.*
4. Diminished village engagement	- *If villages disengage from participation in VLUPs, forestland and wildlife habitat may face increased pressure due to illegal harvest and/or land conversion for agriculture.*	- *Meet regularly with villages to remain engaged with the process and to support the needs of the communities.*

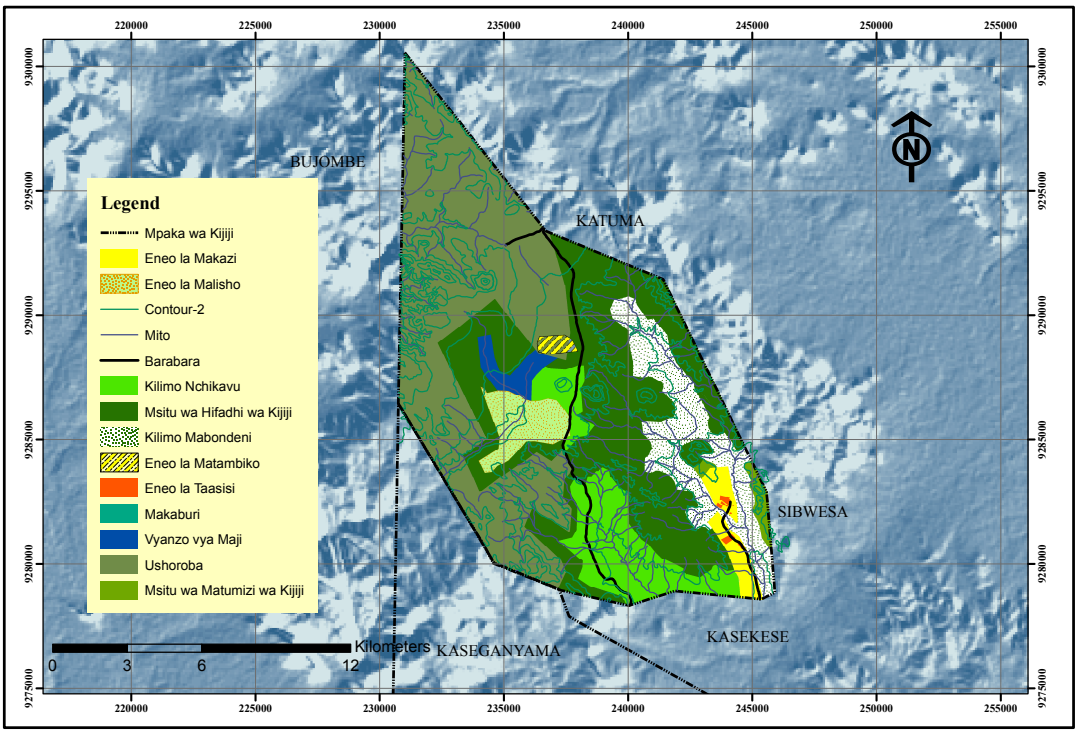
5. Climate change results in species compositional shifts and negatively impacts conservation target species	- *As the climate changes, species' habitat ranges may be diminished within the project area or eliminated entirely.*	- *Continued support and development of REDD+ carbon projects to mitigate the impacts of climate change.* - *Develop climate change adaptation measures for species habitats.* - *Maintaining large areas of habitat, risk of habitat loss is potentially mitigated.*
6. Risk of VLUPs and village engagement attracting new immigrants and increased pressure on natural resources	- *Current natural resource availability in villages may not be able to support an influx of immigrants and may increase pressure on natural resources.*	- *Supporting successful development of VLUPs in other communities that create opportunities for sustainable use of resources in neighbouring regions reduces the need for migration to these villages.*
7. Risk that sufficient carbon revenue is not generated, reducing support to villages.	- *A lack of sufficient carbon revenue may reduce the efficacy of the project activity because villages may increase pressure on natural resources to compensate for a lack of financial resources.*	- *Work to find buyers for carbon credits generated through the REDD+ project.*

Appendix 3: Approved Village Land Use Plans

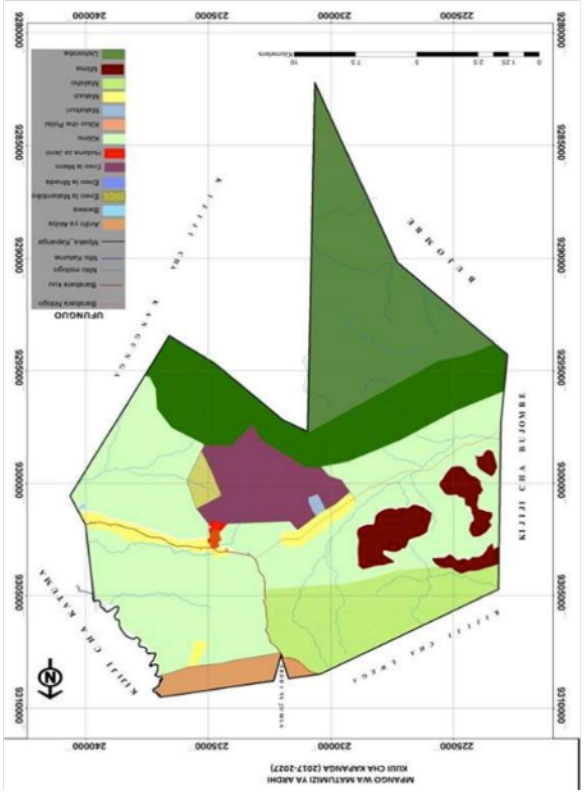


Bujombe village land use plan

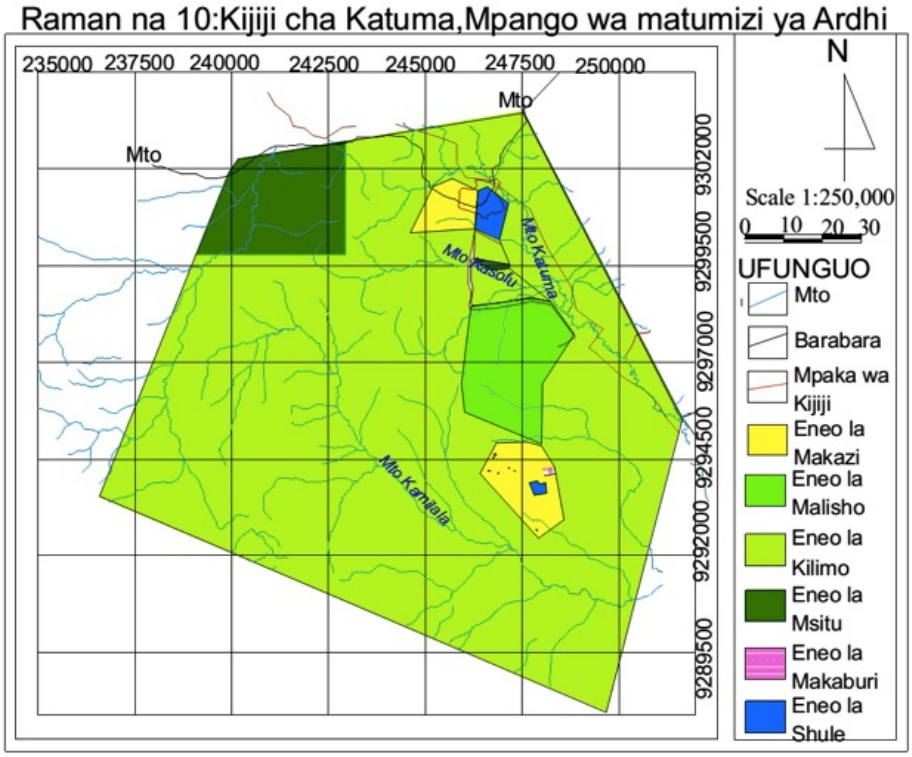
RASIMU YA RAMANI YA MPANGO WA MATUMIZI BORA YA ARDHI YA KIJIJI CHA KAGUNGA



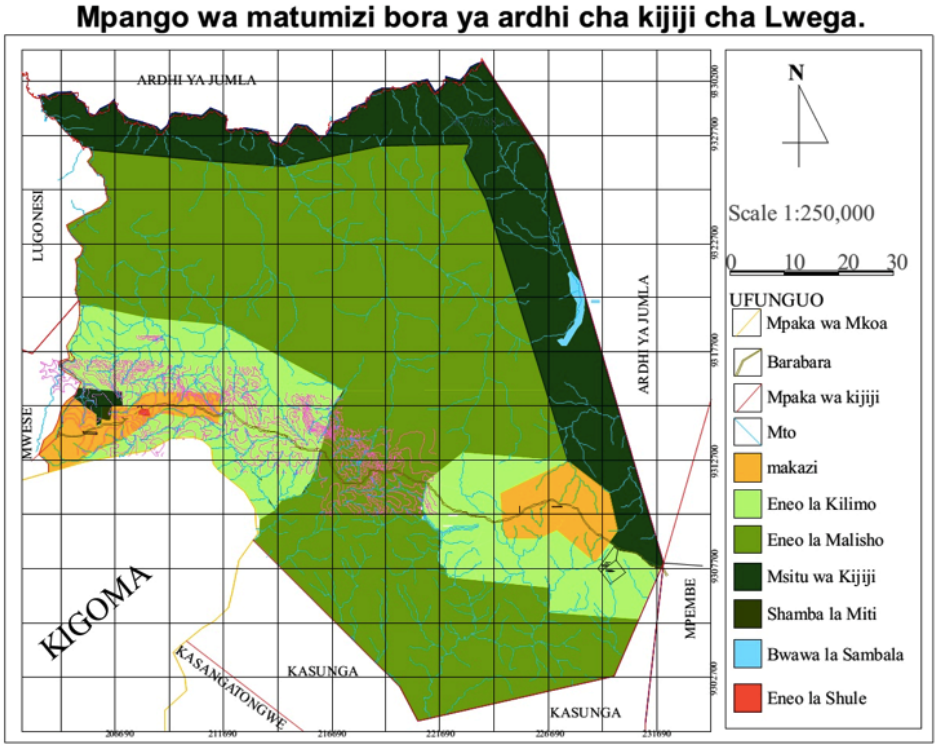
Kagunga land use plan



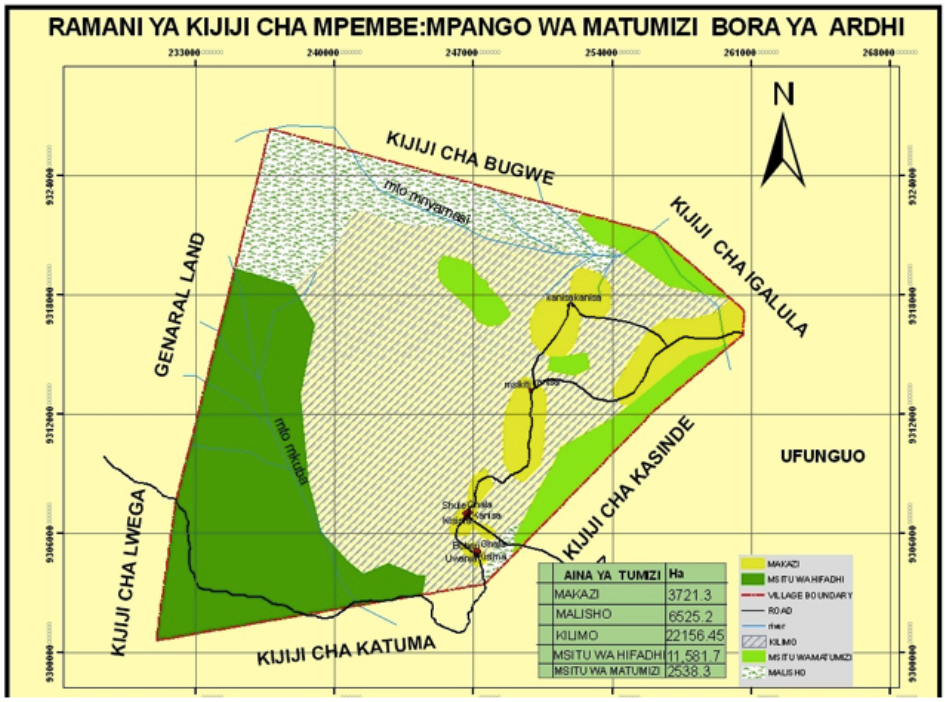
Kapanga land use plan



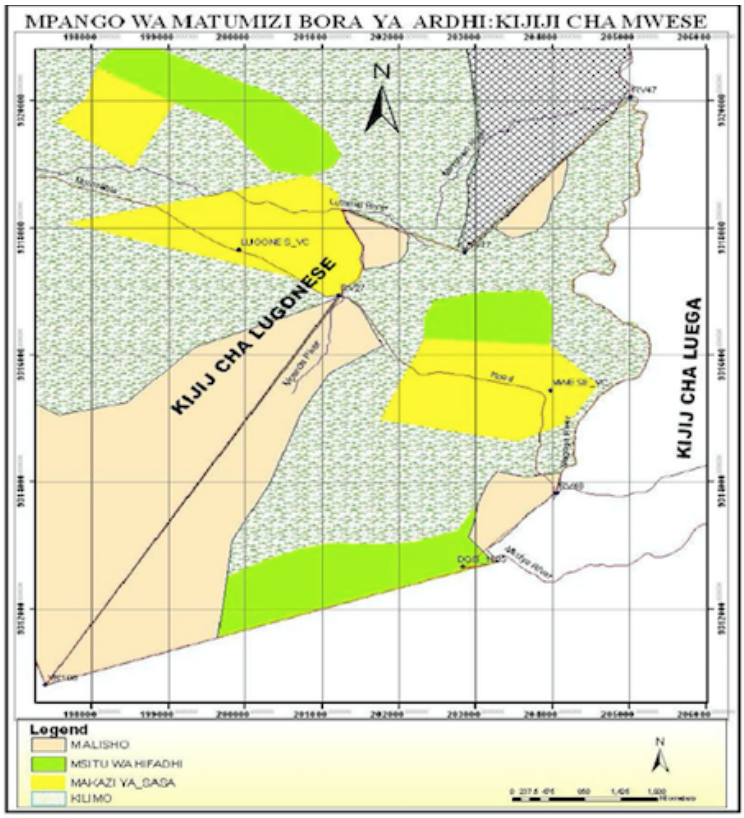
Katuma village land use plan



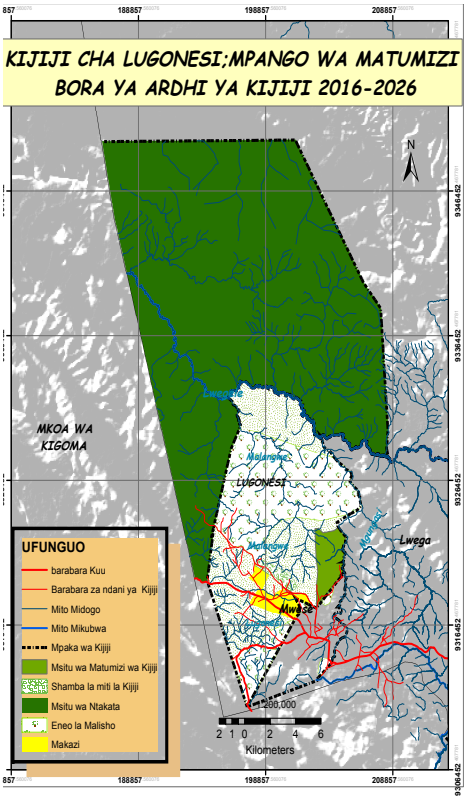
Lwega village land use plan



Mpembe village land use plan



Mwese village land use plan



Lugonesi village land use plan

Appendix 4. District introduction to Carbon project February 2016. Letter from Mwese confirming the meeting and translation. Certificate from Pasiansi training college for Village Game Scout from Mwese village.

MPANDA DISTRICT COUNCIL

Tel: 25 – 2820068
Fax No. 025 – 2820068
E-mail:halmashaurimpanda@mpandadc.go.tz
Website:www.mdc.go.

P.O Box 1,
MPANDA

Ref. No. RK/MDC/F.30/21/123

8th, February 2016

The Manager,
Tuungane Project,
P.O Box 894,
KIGOMA

Re: RECONNAISSANCE REPORT

Please refer to the subject matter above.

Mpanda District Council would like to appreciate the efforts done by your organization in supporting conservation activities in this district. In fact the carbon credit project will help in supporting the villagers who have shown efforts in conserving forests and other biodiversity within the district.

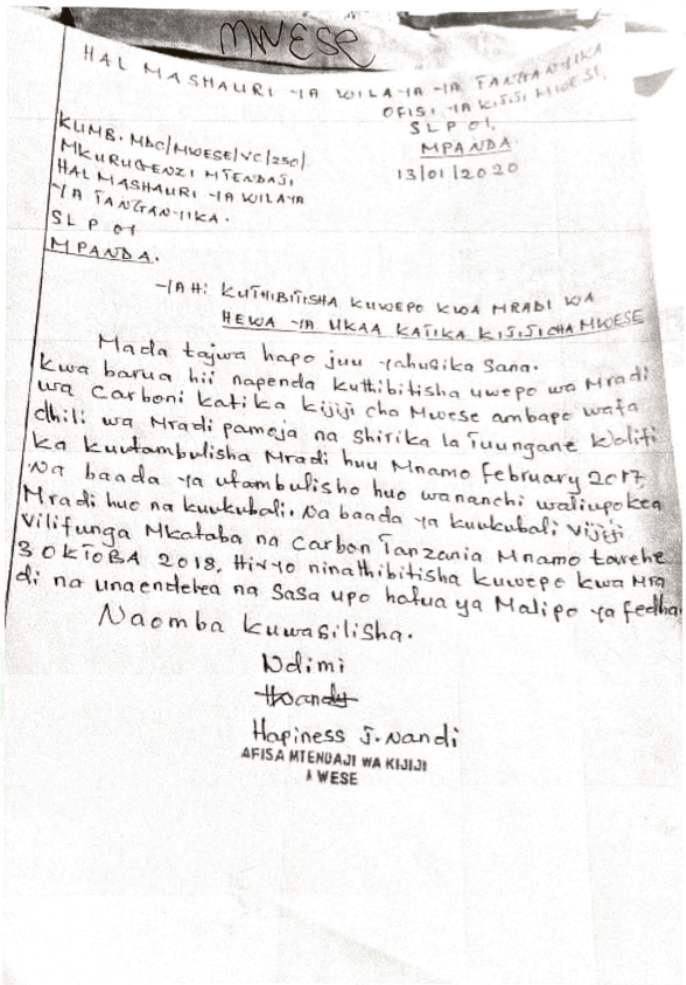
Before embarking on this activity, the district formed a reconnaissance team that went through all the proposed villages to introduce the project and picked up some issues that would help in plan implementation. In that accord, I am sending you the report of reconnaissance team in a tabular that summarized all the issues found within those villages.

The attached here is the report of this work.

Yours sincerely

Rupia, J.B
LAND AND NATURAL RESOURCES OFFICER
MPANDA DISTRICT COUNCIL

1



MWESE

HALMASHAURI YA WILAYA YA TANGANYIKA
OFISI YA KIJIJI MWESE,
SLP 01,
MPANDA
13/01/2020

KUMB. Mbc/MWESE/VC/250
MKURUGENZI MTENDAJI
HALMASHAURI YA WILAYA
YA TANGANYIKA.
SLP 01
MPANDA.

YAH: KUTHIBITISHA KUWEPO KWA MRADI WA HEWA YA UKAA KATIKA KIJIJICHA MWESE

Mada tajwa hapo juu yahusika Sana.
Kwa barua hii napenda kuthibitisha uwepo wa Mradi wa Carboni katika kijiji cha Mwese ambapo wafadhili wa Mradi pamoja na Shirika la Tuungane Kolitika kuutambulisha Mradi huu Mnamo February 2017 Na baada ya utambulisho huo wananchi walipokea Mradi huo na kuukubali. Na baada ya kuukubali Vijiji Vilifunga Mkataba na Carbon Tanzania Mnamo tarehe 3 OKTOBA 2018, Hivyo ninathibitisha kuwepo kwa Mradi na unaendelea na Sasa upo hatua ya Malipo ya fedha.

Naomba kuwasilisha.

Ndimi

Hapiness J. Nandi
AFISA MTENDAJI WA KIJIJI
MWESE

Re: To Confirm the Presence of the Carbon Project in Mwese Village

The above heading is very relevant.

In this letter I would like to confirm the presence of the Carbon Project. Whereas the project proponent and Tuungane organization came and introduced the project in February 2017 and after this introduction the citizens received and agreed to the project. After the citizens agreed all villages eventually signed a contract with Carbon Tanzania on Oct 3, 2018. In this way I am confirming the presence of the Carbon Project which is still active and has already brought financial benefit.

I am requesting it submitted,

Village Executive Officer Mwese

Mkutano wa kuanzisha mradi wa carboni kwa wajumbe wa serekali za kijiji, February 2017

The United Republic of Tanzania
MINISTRY OF NATURAL RESOURCES AND TOURISM
PASIANSI WILDLIFE TRAINING INSTITUTE

Cheti cha Mahudhurio
Hii ni kuthibitisha kuwa
GABRIEL S. MSOME
Amehudhuria Mafunzo ya muda wa miezi mitatu ya kozi fupi ya Uhifadhi na Usimamizi wa Maliasili na Himasheria kuanzia
Februari 20, 2017 hadi Mei 24, 2017.

Masomo waliyojifunza
1. MATUMIZI YA SILAHA (BASIC BALLISTICS SKILLS)
2. MAFUNZO YA KIJESHI (BASIC PARAMILITARY TECHNIQUES)
3. HIMA SHERIA (INTRODUCTION TO LAW ENFORCEMENT)
4. UHIFADHI WA RASILIMALI YA MISITU (FOREST MANAGEMEN
5. MATUMIZI ENDELEVU YA ARDHI (SUSTAINABLE LAND USE)
6. GPS NA USOMAJI WA RAMANI (GPS AND MAP READING)
7. HUDUMA YA KWANZA (INTRODUCTION TO FIRST AID)
8. IKOLOJIA NA USIMAMIZI WA ARDHI BILASHI (RANGE LAND ECOLOGY AND MANAGEMENT)
9. UHIFADHI WA WANYAMAPORI (WILDLIFE MANAGEMENT)
10. ELIMU YA UHIFADHI (COMMUNITY CONSERVATION EDUCATION)
11. SAYANSI YA WANYAMA JAMII YA MAMMALIA (MAMMOLOGY)
12. JINSIA YA KIKE NA WATOTO KATIKA UHIFADHI WA MALIASILI MISITU (WOMEN, CHILDREN AND NATURAL RESOURCES)

TUME YA TAIFA YA UCHAGUZI
KADI YA MPIGA KURA
Jina Kamili - Full Name
GABRIEL S MSOME
Tarehe ya Kuzaliwa - Date of Birth
01/01/1985
Jinsia - Gender ME
Kata - Ward
MWESE
Mtaa/Kijiji - Street/village
MWESE
Kituo cha Kuandikisha - Registration Centre
OFISI YA KUJIJI MWESE
Namba ya Mpiga Kura
T-1002-3100-891-2

Deputy Principal-Academics
Principal
Mei 24, 2017

Appendix 5. Community Monitoring Framework.

Area	Objective	Activities	Term	Indicator/Output	Unit/Measure	Data Collection Method/Tool	Frequency of Monitoring	Responsible to Monitor
Human Capacity	1. Project stakeholders have the human capacity needed for effective forest management.	1.1 Village governments receive training on good governance for project management.	March 2019	# of Village Government members participating in governance training	# of Village Government members	- attendance lists from training and meetings - training reports	annual	CT
		1.2 Village Game Scouts receive training on forest law enforcement and are on active duty.	2017-2022	# of VGS trained at the Pasiansi Institute # of VGS employed with project funds # of VGS participating in training courses (e.g. SMART, forest inventory)	# of VGS	- training certificates - attendance lists*	annual	CT
		1.3 Training and employment of Carbon Champions	2018 and as needed	# of people educated on REDD project activities: climate change, project plan, land use plan and revenue distribution	# of people	-attendance lists	annual	CT
		1.4 Forests are effectively patrolled and monitored to prevent illegal activity	2017 onwards	# of patrols conducted # incidents reported	# of patrols conducted #incidents reported	- VGS patrol reports	Bi-annual	Village Government CT
Local Livelihoods	2. Livelihoods of villagers is improved	2.1 Carbon revenues are channeled to support village development plans	January 2020	- amount of money transferred to Village Governments to support village development # Amount of money spent on education with project support # Amount of money spent on health with project support	-amount of money transferred	- proof of transfer to Village Governments - expenditure within each village on health and education	Bi-annual	Village Government CT

Area	Objective	Activities	Term	Indicator/Output	Unit/Measure	Data Collection Method/Tool	Frequency of Monitoring	Responsible to Monitor
		2.4 Provide training and matching grants to Community Conservation Banks (COCOBA) in each village to enable micro-finance for enterprise development	2020 onwards	# of grants provided through project support	# members in the COCOBA # registered COCOBA	Member lists	Bi-annual	Village Governments CT
		2.5 Provide training on entrepreneurship to women's groups and young mothers	2020 onwards	# of new women-owned businesses formed with project support	# members in the COCOBA # registered COCOBA	Member lists	Bi-annual	Village Governments CT
Reproductive Health & Population	3. Improved reproductive health services lead to healthier families.	3.1 Provide door-to-door education on reproductive health methods	2018	- # of couples/women receiving personalized support on reproductive health	# couples/women	lists	annual	CT
				- # of women with improved reproductive health	# women	lists	annual	CT
	4. Village population is effectively tracked	4.1 Track and keep accurate records on the number of births, deaths, immigration and outmigration to the villages.		District updates to village population statistics continue	updates	updates log	annual	District Government