Kulera Landscape REDD+ Program for Co-Managed Protected Areas, Malawi

Document Prepared By Terra Global Capital, LLC

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1 GENERAL

1.1 Summary Description of the Project

The Kulera Landscape REDD+ Program for Co-Managed Protected Areas, Malawi, is being developed as part of the Kulera Biodiversity Project (KBP), funded by the United States Agency for International Development (USAID). The Project Area is located in 5 km zones inside the boundaries of three key protected areas in central and northern Malawi, Nyika National Park, Vwaza Wildlife Reserve, and Nkhotakota Wildlife Reserve. These protected areas having limited resources for governance and are under increasing pressure from local populations, which have intensified and expanded their exploitation of forest resources to unsustainable levels. Increasing rates of deforestation and degradation along the margins of the protected zones threaten remaining forests and the valuable climate, community and biodiversity services they provide. The overall goals of the Kulera REDD+ project are to reduce deforestation and forest degradation in these three protected areas, and improve livelihoods by managing natural resources as an asset base, creating long-term sustainable alternative livelihoods, improving biodiversity and increasing food security.

The project proponents, the Department of National Parks and Wildlife (DNPW), the Nyika-Vwaza Association (NVA), Nkhotakota Wildlife Reserve Association (NAWIRA), and Terra Global Capital (TGC) have partnered with a Malawi-based NGO, Total LandCare (TLC), to prepare this Project Description (PD). The PD outlines the implementation program that will be used to mitigate the key drivers of deforestation and degradation and generate verified emission reductions. Deforestation drivers include converting forest to small-scale agriculture and settlements, unsustainable collection of fuelwood, grazing livestock inside the forest and setting fires for hunting, honey collecting, and territorial revenge against other land users. Key project actions are to: strengthen land tenure and improve governance of these protected areas, support development of sustainable resource management activities, improve rural livelihoods, and increase rural incomes through natural resource-based enterprises and the development and marketing of carbon assets.

One of the principle objectives of the project is to improve co-management agreements for protected areas and build the capacity of community associations to carry out park management and enforcement activities. The project will also support a number of interventions designed to provide alternative income sources, improve food security, and reduce pressures on natural resources. Project activities include; strengthening land-tenure and protected area governance, support for the development and implementation of sustainable forest and land use management plans, forest protection through patrolling, social fencing and maintenance of forest boundaries, fire prevention and suppression activities, reducing fuelwood consumption and increasing energy efficiency by introducing fuel-efficient woodstoves, creation of alternative sources of fuelwood through agroforestry and farm woodlots management, sustainable intensification of agriculture on existing agricultural land, and development of local enterprises based on sustainably harvested NTFPs such as honey, coffee, macadamia, and livestock.

1.2 Sectoral Scope and Project Type

This project is an Agriculture, Forestry and Other Land Use (AFOLU) project under the Reducing Emissions from Deforestation and Degradation (REDD) project category. Specifically, the project is of the Avoided Unplanned Mosaic Deforestation and Degradation (AUMDD) typology.

This project is a grouped project. Project activities will be carried out to reduce deforestation in the 5km zones inside of the three protected area as detailed in Section 1.9. Additional instances may be added to the project in the future if they meet the requirements in the methodology and the applicability conditions.

1.3 Project Proponent

1.3.1 Roles/Responsibilities of Project Proponents

The Kulera REDD+ Project proponents are the Department of National Parks and Wildlife (DNPW), the Nyika-Vwaza Association (NVA), the Nkhotakota Wildlife Reserve Association (NAWIRA), and Terra Global, who will work with their implementation partners to develop, implement and monitor the Project. Detailed roles and responsibilities may be found in the REDD+ Agreement as listed in Section 1.13.3.

1.3.2 Project Proponents

The Department of Parks and Wildlife (DNPW)[1] is responsible for the management of the Project Areas.

Department of Parks and Wildlife, Government of Malawi	
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Title:	Director
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The Nyika-Vwaza Association (NVA) is the Community Associations that represents the villages adjacent in the Project Zone around the Nyika National Park, Vwaza Wildlife Reserve.

Nyika-Vwaza Association, Malawi	
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The Nkhotakota Wildlife Reserve Association (NAWIRA) is the Community Association that represents the villages adjacent in the Project Zone Nkhotakota Wildlife Reserve.

Nkhotakota Wildlife Reserve Association (NAWIRA), Malawi	
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[1] The Department of Parks and Wildlife is also refered to the Department of National Parks and Wildlife (DNPW)

Terra Global is a project proponent as an investor in the project and is supporting the registration, issuance and marketing of emission reductions. Terra Global also acts as an implementing partner for the development and on-going management of the emission reductions generated under the Project (see Section 1.4.2).

Terra Global Capital, USA	
Primary Role:	Development of Emission Reductions, Institutional Frameworks Carbon Revenue and Benefit Sharing, and Offset Marketing
Name of Contact Person:	Ms. Leslie L. Durschinger
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1.4 Other Entities Involved in the Project

1.4.1 Roles/Responsibilities of Project Development and Management Team

1.4.1.1 Total LandCare

Total LandCare (TLC) has extensive experience designing and implementing community-based forest management and agricultural projects and environmental sustainability in rural Malawi. TLC has contributed extensively to Malawi's Agriculture Development Program (ADP) and has been widely consulted by the World Bank and the Norwegian Government in formulating their strategic country frameworks. Many others have sought input from TLC to improve the effectiveness of their programs. These demands stem largely from the successful results of USAID's Chia Watershed Project and its follow-on project, Management for Adaptation to Climate Change (MACC) with the Norwegian Government. TLC is a member of the Civil Society Agriculture Network (CISANET) and heads the Irrigation Thematic Group, whose mandate is to advocate policy reform in the irrigation sub-sector, to promote harmonization of methods/approaches and to share experiences. TLC and its partners will continue leading this forum to share lessons from Kulera, and to enhance awareness and knowledge among implementing agencies and the general public.

Total LandCare is the lead institution for project administration, partner coordination, community mobilization, decentralization-governance and monitoring & evaluation; will also coordinate livelihoods strategies with a focus on community-based natural resource management, diversification, conservation agriculture, irrigation, forestry, and enterprise initiatives based on agricultural & natural products.

Total LandCare	
Primary Role:	Project Identification and Design, Implementation of REDD+ Activities and Livelihoods Programs
Name of Contact Person:	Trent Bunderson
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1.4.1.2 Terra Global

Terra Global is the global leader in forest and land-use carbon advisory and finance. Terra was founded in 2006 to provide governments, NGOs and private companies with support for market and payment-for-performance based approaches that benefit rural communities. As proven innovators, Terra provides both technical advisory in the measurement and commercialization of emissions reductions and carbon finance through our dedicated Terra Bella Investment Fund and separately managed investment vehicles. Terra has established itself as a valued partner to a global client base by supporting the sustainable management of natural resources and through the development of rural livelihoods.

Terra's role includes: i) conducting all carbon development work under the VCS and CCB standards for PD development and carbon calculations; ii) support for on-going monitoring and the development of the VCS and CCB monitoring reports; iii) management of the validation and verification process; iv) training for community-based participatory filed data collection; v) establishment of the institutional arrangements for REDD+ legal, operational and financial management; vi) development of web-based monitoring tools; vii) marketing and transaction structuring for emission reductions, and; viii) acting as the general manager for the REDD+ entity for the initial years until local capacity is built.

Terra Global Capital, USA	
Primary Role:	Development of Emission Reductions, Institutional Frameworks Carbon Revenue and Benefit Sharing, and Offset Marketing
Name of Contact Person:	Ms. Leslie L. Durschinger
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1.4.2 Other Implementing Partners

Kulera Biodiversity Project partner CARE Malawi focuses on supporting the formation of Village Savings and Loan groups including training on economic activities, selection, planning and management.

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1.4.3 Legal Advisors

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1.4.4 Funders

United State Agency for International Development (USAID)	
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1.5 Project Start Date

The **project start date is 1 October 2009**. This is when the first Project Actions took place, and the first financial commitments were established.

1.6 Project Crediting Period

The **project crediting period is 30 years**, starting 1 October 2009 and ending 30 September 2039.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Projects are categorized by size according to their estimated average annual GHG emission reductions or removals. According to the VCS Standard v3.3, a project producing ≤ 300,000 tonnes of CO_2e reductions per year is considered a "Project," whereas a project producing ≥ 300,000 tonnes of CO_2e reductions per year is considered a "Large Project." Kulera is classified as a Project based on average annual GHG emission reductions (Table 1).

Table 1. Summary of p roject scale and estimated GHG emission reductions and removals (above) and full 30 year annual estimates (below).

Project	
Project	X
Average Annual VCUs	210,421
Total VCUs	6,312,632

YEAR	ΔGHG from avoided deforestation	ΔGHG from deforestation due to leakage	GHG from improved cookstoves	GHG from emission sources	NER	Risk Buffer	Buffer	VCU
	[tCO_2e]	[tCO_2e]	[tCO_2e]	[tCO_2e]	[tCO_2e]	[%]	[tCO_2e]	[tCO_2e]
2009	71,603	-68,542	22,268	0	25,329	10.00	-7,160	18,169
2010	120,705	-102,300	33,402	0	51,807	10.00	-12,070	39,737
2011	156,752	-126,067	44,537	0	75,222	10.00	-15,675	59,547
2012	209,732	-161,585	77,939	0	126,086	10.00	-20,973	105,113
2013	256,916	-192,225	100,207	0	164,898	10.00	-25,692	139,207
2014	275,207	-206,069	111,341	0	180,479	10.00	-27,521	152,958
2015	319,699	-237,818	111,341	0	193,222	10.00	-31,970	161,252
2016	336,730	-250,387	111,341	0	197,685	10.00	-33,673	164,012
2017	375,717	-269,146	111,341	0	217,912	10.00	-37,572	180,340
2018	398,172	-286,564	111,341	0	222,949	10.00	-39,817	183,132
2019	426,202	-294,925	111,341	0	242,619	10.00	-42,620	199,999
2020	439,170	-300,833	111,341	0	249,678	10.00	-43,917	205,761
2021	449,884	-301,315	111,341	0	259,910	10.00	-44,988	214,922
2022	457,637	-298,614	111,341	0	270,364	10.00	-45,764	224,601
2023	457,697	-297,645	111,341	0	271,393	10.00	-45,770	225,624
2024	460,888	-292,996	111,341	0	279,232	10.00	-46,089	233,144
2025	469,548	-289,415	111,341	0	291,475	10.00	-46,955	244,520
2026	466,052	-284,412	111,341	0	292,981	10.00	-46,605	246,376
2027	464,887	-277,575	111,341	0	298,654	10.00	-46,489	252,165
2028	466,102	-274,416	111,341	0	303,028	10.00	-46,610	256,418

YEAR	ΔGHG from avoided deforestation	ΔGHG from deforestation due to leakage	GHG from improved cookstoves	GHG from emission sources	NER	Risk Buffer	Buffer	VCU
	[tCO_2e]	[tCO_2e]	[tCO_2e]	[tCO_2e]	[tCO_2e]	[%]	[tCO_2e]	[tCO_2e]
2029	465,017	-267,188	111,341	0	309,170	10.00	-46,502	262,669
2030	463,769	-259,604	111,341	0	315,506	10.00	-46,377	269,129
2031	460,606	-251,044	111,341	0	320,903	10.00	-46,061	274,842
2032	454,573	-246,743	111,341	0	319,172	10.00	-45,457	273,714
2033	451,784	-236,747	111,341	0	326,379	10.00	-45,178	281,200
2034	447,776	-231,090	111,341	0	328,028	10.00	-44,778	283,250
2035	444,933	-222,727	111,341	0	333,548	10.00	-44,493	289,054
2036	435,663	-216,251	111,341	0	330,753	10.00	-43,566	287,187
2037	432,732	-210,534	111,341	0	333,540	10.00	-43,273	290,266
2038	426,877	-201,205	111,341	0	337,013	10.00	-42,688	294,325
Total	**11,563,031**	**-7,155,981**	**3,061,886**	**0**	**7,468,935**	**0**	**-1,156,303**	**6,312,632**

1.8 Description of the Project Activity

The Kulera REDD+ project is targeting 169,136 hectares of forest located in a 5km band inside of three critical protected areas in Malawi by working with the DPNW and over 45,000 households living within 10 km of the Protected Areas.

The Protected Areas, now islands of standing forest in a heavily degraded landscape matrix, are rapidly being degraded by communities living alongside these Protected Areas. In order to reduce deforestation and forest degradation, the project proponents, working in partnership with TLC, will be implementing activities designed to improve the capacity of DNPW and communities to manage and protect park resources, and to reduce the communities' needs for park resources, through building alternative livelihoods.

Specifically, the project proponents will support activities in the Project Zones that will reduce pressure on the Project Areas:

- Strengthening land-tenure and Protected Area governance;
- Support for the development and implementation of sustainable forest and land use management plans;
- Forest protection through patrolling, social fencing and maintenance of forest boundaries;
- Fire prevention and suppression activities;
- Reducing fuelwood consumption and increasing energy efficiency by introducing fuel-efficient woodstoves;
- Creation of alternative sources of fuelwood through agroforestry and farm woodlots management;
- Sustainable intensification of agriculture on existing agricultural land, and;
- Development of local enterprises based on sustainably harvested NTFPs such as honey, coffee, macadamia, and livestock

Each of these Project Activities is designed to target one or more of the identified deforestation and degradation drivers (see Table 2).

Table 2. Project and leakage prevention activities and the targeted deforestation drivers

Driver of Deforestation / Project Actions	1. Strengthening of land-tenure and protected area governance.	2. Support for the development and implementation of sustainable forest and land use management plans.	3. Forest protection through patrolling, social fencing and maintenance of forest boundaries	4. Fire prevention and suppression activities	5. Reducing fuelwood consumption and increasing energy efficiency by introducing fuel-efficient woodstove	Creation of alternative sources of fuelwood through agroforestry, farm woodlots management	7. Sustainable intensification of agriculture on existing agricultural land	8. Development of local enterprises based on sustainably harvested NTFPs such as honey, coffee, macadamia, fruit production, and livestock
Wood for cooking and heating locally	●	●	●		●	●		●
Wood and poles for construction and domestic use (including tobacco curing)	●	●	●			●		
Forest fires for other anthropogenic reasons			●	●				●
Conversion of forest to small-scale agriculture	●	●	●				●	●
Forest fires by hunters (mice hunters)	●	●	●	●				●
Collection of wood for charcoal	●	●	●					●
Fire to concentrate animals inside the park	●	●	●	●				●

1.8.1 Strengthening Land Tenure and Protected Area Governance

Strengthening land tenure and providing clarity on governance structures for Protected Areas management are critical first steps in protecting reserves from illegal encroachment. The project will provide support to strengthening land tenure and forest governance by creating and improving participatory, decentralized governance through co-management of the Protected Areas between the DNPW and Community Associations representing over 45,000 villages adjacent to protected areas.

The activities to enforce the Protected Area tenure and establish formalized co-management governance structures includes:

- Clarification of Protected Area boundaries and where necessary facilitation of zoning/re-zoning in collaboration with stakeholders;
- Formation of formation of functional democratically-elected Community Associations with formalized governance through there bi-laws and constitutions;
- Facilitate the transfer of rights and access to natural resources in Protected Areas, including where appropriate revenue sharing in the protected areas from the DNPW to local communities through co-management agreements, and;
- Facilitate development and execution of REDD+ agreements between DNPW and Community Associations to define roles and responsibilities under REDD+ program, carbon tenure and financial and operational governance arrangements;

1.8.2 Support for the Development and Implementation of Sustainable Forest and Land Use Management Plans

Building on strengthened tenure and protected area governance structures in place, the project supports the development of co-management plans that define allowable land uses inside the protected areas. The co-management plans signed between the DNPW and the Community Associations:

- Obligate the communities to ensure compliance with the National Parks and Wildlife Act (2004), as amended, and pertinent laws of Malawi with terms of this agreement, and with approved Nyika National Park and Vwaza Marsh Wildlife Reserve Management Plans, on the part of the

Association members and employees of the Association and the members of the public in general;

- In the event that the Association is unable to ensure compliance, the Association shall inform the appropriate government agency in writing (DNPW, Malawi Police etc), which shall take action to ensure compliance, and;
- Renew co-management agreements to enable communities to share benefits from park entrances and concession fees.

The co-management plans obligated the DNPW to:

- Build capacity in relevant fields in the Association, and;
- Facilitate wildlife-based and other income generating activities for the Association.

At the village level, forest management plans are created and submitted to the district commissioner. In these plans, the village level rules for land and forest uses are adopted by the community and included in the village by-laws, which prescribe penalties for not following the agreed upon uses. When the village level forest management plan is signed off by the district commissioners, this gives the chiefs the formal support needed to impose penalties.

1.8.3 Forest Protection through Patrolling, Social Fencing and Maintenance of Forest Boundaries

The capacity of law enforcement authorities is too limited to defend the boundaries of each of the Protected Areas. Therefore, the Project will provide training and capacity building for communities to engage in participatory forest protection. Once these institutional structures are established and adequate training has been delivered, DNPW and the Community Associations will be able to oversee and enforce community-based co-management of the Protected Area. This approach to improved governance aims to stimulate forest stewardship through "social fencing"[2] of forest resources that are co-managed by local communities (Henkemans 2000).

The activities that mobilize community-based NRM in the Protected Areas through increased awareness and capacity include:

- Recruit and train community workers to support Community Associations in law enforcement, training and other needs;
- Provide training for Protected Area and Community Association officials in NRM institutions in corporate governance, team building, fund raising, project write-ups, resource assessments/problem analysis, basic NR rights and conflict resolution;
- Provide training for Protected Area and Community Association officials in community mobilization, participatory law enforcement, etc.;
- Provide logistical support to Protected Area officials to improve communications and mobility with GPS and radio units;
- Provide motor bikes and bicycles to allow communities to access better facilities for communications;
- Provide support for establishment of village umbrella committees and provide training for community development of NRM activities, and;
- Conduct awareness campaigns through training of primary school teachers in environmental education, facilitate the establishment of youth conservation clubs, Protected Area visits for youth clubs, initiation of the development of environmental education curricula for primary schools and adults.

[2] the protection of forests from external threats through organization and social control

1.8.4 Fire Prevention and Suppression Activities

The DNPW will develop jointly with the Associations a fire management plan, and implement fire management activities within the Protected Areas, including: installation of fire breaks, instituting early warning systems (e.g., use of mobile phones), clearing the forest of dead wood, discouraging fire for hunting, and warding off revenge-based fires.

Activities aimed at preventing and suppressing bush fires include:

- Training and education within the conservation agriculture component on fire reduction;
- DNPW development of a fire management plan in collaboration with Associations;
- Implementation of fire management activities inside of Protected Areas, including controlled burns, fire breaks, weed control, and fire management based on sound ecological principles, and;
- Implementation of a fire control and management campaign for communication and to increase awareness.

The local leaders are taking on responsibility and i) at the village level, rules are adopted by the community and included in the village by-laws and village level forest management plan that prescribe penalties for setting fires, and ii) when the village level forest management plan is signed off on by the district commissioners, this gives the chiefs the formal support to impose penalties.

1.8.5 Reducing Fuelwood Consumption and Increasing Energy Efficiency by introducing Fuel Efficient Cookstoves

The project will deliver a fuel-efficient cookstove to every household to reduce fuelwood consumption. TLC has been promoting the fuel-efficient cookstove across its project sites for over 5 years (2004-2009), and has selected a particular design that is efficient, low-cost, easy to build, and uses readily available locally-sourced materials. The stove is constructed of mud and bricks and can be built in a convenient fireplace within traditional kitchens. The current design yields efficiency in terms of wood use ranging between 30-50%. The cookstove also has the benefit of saving labor among women and girls for collecting wood and cooking.

The ultimate goal is to improve the design to reduce wood use and/or increase efficiency by 50%. In this regard, TLC is working with cookstove designers to produce a more efficient low-cost stove for rural households.

Activities to promote reduced fuelwood consumption and increased energy efficiency include:

- Training of trainers on construction of cookstoves, and;
- Introduce improved kitchen stoves to reduce firewood consumption and impacts of deforestation in communities surrounding NV and NKK, including through community sensitization meetings.

1.8.6 Creating Alternative Sources of Fuelwood through Agroforestry and Farm Woodlots Management

This set of activities focuses on creating an alternative source of fuelwood through agroforestry interventions, such as interplanting trees with crops that increase yields (e.g. *Faidherbia albida*) and the provision of fuelwood to local farmers.

In addition, under the Kulera Biodiversity Project, woodlots will be planted in communal village areas to produce fuelwood. Similarly, the management of existing woodlands will be improved through workshops and capacity building sessions. The increase in biomass in woodlots and improved woodlands is accounted for in a different carbon project (see Kulera Woodlots PD). However, the effects on the protected forest areas from a reduction in fuelwood collection due to the existence of woodlots and woodlands is accounted for in the REDD+ project.

Activities to create alternative sources of fuelwood include the following:

- Community sensitization and training on nursery creation and management, and outplanting;

- Village-level nurseries established and maintained in communities surrounding NV and NKK;
- Outplanting of seedlings, and;
- Community management of natural woodlots.


Figure 1. Mr Jonas Kagona' Natural tree regeneration woodlot in Kasungu , Enfeni EPA, (left) and individual planted woodlot (right) in Muhuju, Rumphi being appreciated by a USAID Stock Taking Mission.

1.8.7 Sustainable Intensification of Agriculture on Existing Agricultural Lands

Agricultural intensification activities are essential to improving productivity of agricultural lands and increasing the yields of crops supported by those lands. Distributing higher-yield varieties of crops grown locally, such as cassava, results in faster maturation times over traditional varieties. Improving irrigation access and efficiency promotes more productive irrigation seasons that support a higher diversity of crops, with as many as three crops supported per year. Resulting improved water efficiency and residual soil moisture due to irrigation interventions also improves agricultural yields, while the distribution of pumps reduces the opportunity costs associated with other methods of water collection. Conservation agriculture techniques also improve the viability and yield of vegetable crops, as well as improve residual soil moisture and nutrient content. The Kulera project will promote an increase in productivity and agricultural yields on existing agricultural lands through the following activities:

- Community sensitization meetings focused on the use and installation of treadle pumps and other irrigation methods to produce vegetables;
- Diversify farming using improved crops and varieties with high yielding, disease resistant, drought-tolerant characteristics adapted to the local agro-ecology.
- Introduction of improved crops will include training in sound agronomic practices with special attention to land preparation, early planting and weeding.
- Integrate conservation agriculture as a standard farming practice with agroforestry, organic manures, intercropping, and legume rotations to produce higher and more stable yields with significantly less labor, while dramatically reducing environmental degradation from the effects of soil erosion and runoff and;
- The distribution of higher-yielding, improved cassava bundles.

Figure 2. A farmer using conservation agriculture with rotation of maize and groundnuts, Mpumo Village, Nkhotakota District. (Photo: April 2013.)

1.8.8 Development of Local Enterprise based on Ecotourism and Sustainably Harvested NTFPs (coffee, honey, macadamia, livestock)

The development of rural enterprise through the promotion of ecotourism activities and the production, processing and marketing of sustainably produced non-timber forest products is critical to transforming livelihoods away from subsistence and improving rural livelihoods through increased self-sufficiency. The NTFPs being most heavily promoted include honey, coffee, and macadamia. Small livestock husbandry is also an important skill for diversifying and increasing protein sources available in communities while reducing hunting pressure and encroachment on protected areas.

Activities to support the development of local enterprise based on ecotourism and sustainably harvested NTFPs include:

- Promote the development of new eco-tourism sites and projects;
- Collaborate with Wilderness Safaris to organize ecotourism activities in and around Protected Areas;
- Provide training to local communities, including community sensitization meetings, on the construction and management of beehives for honey production;
- Purchase and distribute apiary equipment to households in the Project Area;
- Identify markets for the sale of local honey produced from NRMAs, and facilitate the distribution and sale of honey;
- Conduct community sensitization meetings in agriculturally appropriate areas, such as NtchenaChena and Ntchisi, on the benefits of coffee production;
- Conduct extension work with farmers in order to teach them how to produce and maintain seedling outplants and coffee plants;
- Assist smallholder farmers in finding markets for their products;
- Conduct community sensitization meetings in agriculturally appropriate areas, such as NtchenaChena and Ntchisi, on the benefits of macadamia production;
- Establish and maintain regional nurseries;
- Carry out extension work with farmers on the production and maintenance of macadamia seedling outplants and macadamia trees;

- Assist smallholder famers in finding markets for their products;
- Support program facilitate entry into low cost & fast returns (rapid growth & reproduction) livestock with poultry, guinea fowl, rabbits, pigs and goats;
- Provide training through extension services in animal husbandry and animal health' and
- Promotion of producer groups and MSME with production, processing, business and marketing skills and access to finance.

Figure 3. Kulera Project coffee intervention in Ntchisi area. Mr John Kanyangala of Ng'ombe Village, Ntchisi with his 2000 + coffee seedlings ready for transplanting

Figure 4. Some of the farmers that were trained in bee keeping

1.9 Project Location

1.9.1 Regional Location

The project is located in three different Protected Areas in the Northern and Central Regions in Malawi: Nyika National Park, Vwaza Marsh Wildlife Reserve, and Nkhotakota Wildlife Reserve (see Figure 5). Nyika National Park (NP) occupies a tract of mountain plateau and associated hills and escarpments in northern Malawi in an area covering 3,200km^2 and bordering Chitipa, Karonga, and Rumphi Districts whilst the western boundary borders Zambia. It is the largest national park in Malawi and is centered upon 10°33'S, 33°50'E. Vwaza Wildlife Reserve occupies a tract of diverse terrain in northern Malawi covering 978 km^2 and it is centered upon 11° 00'S, 33° 28' E. The reserve comprises a region of hills and pediments in the east, and a region of wetland and alluvium in the west. The reserve lies partly in Rumphi and partly in Mzimba District, whilst its western and part of its northern boundary coincides with the Malawi – Zambia border. Nkhotakota Wildlife Reserve is the oldest and largest wildlife reserve covering 1082 km^2 and is centered upon 12°55′00″ S, 34°18′00″ E. It is located in the Central Region of Malawi. Most of the reserve is comprised of *miombo* woodlands with large patches of grasses bordering wetlands.

Malawi is a landlocked country of high mountains and deep lakes. One fifth of Malawi is covered by Lake Malawi, which fills the trough of the Great African Rift Valley that traverses the country from north to south. East and west of the lake, the land forms high plateaus that reach as high as 2,600 meters in the Nyika uplands, and 3,048 meters at Mount Mulanje (US Department of State 2010). Malawi shares borders with Mozambique to the east and south, with Zambia to the west, and with Tanzania to the northeast. There are four major urban centers: Blantyre, Lilongwe, Zomba, and Mzuzu. Out of a total land area of 9,448,741 ha, 48% is considered arable.

Most of the Project Areas are in the basin of Lake Malawi. Freshwater systems within the basin that are of relevance to the Project Areas include Lake Kazuni (adjacent to the Vwaza Wildlife Reserve), the Bua river (in the central region, in the vicinity of the Nkhotakota Game Reserve), and the Rukuru river (which flows from the Nyika plateau in the northern region).

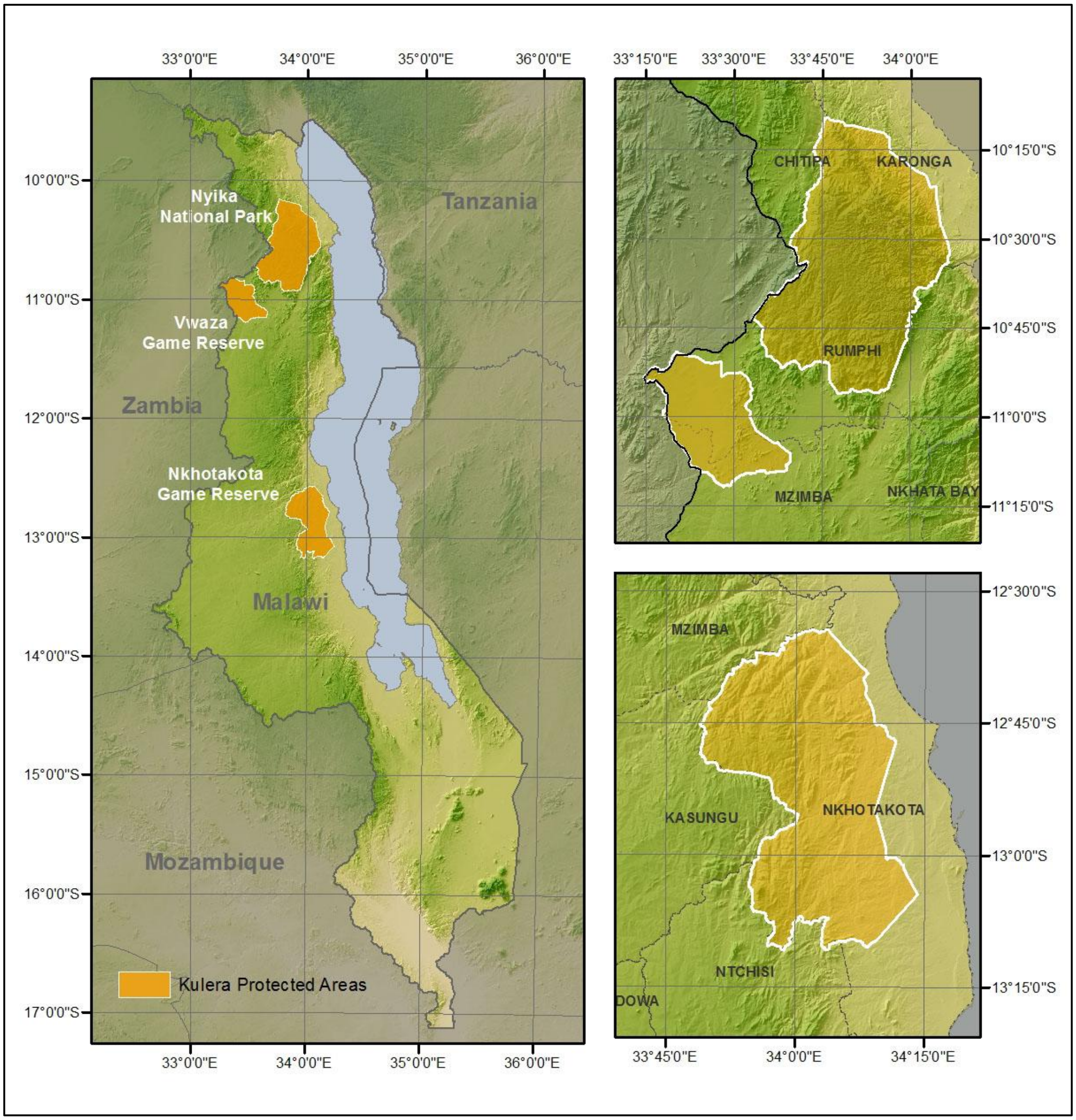

Figure 5. Regional location of Kulera Biodiversity Project areas in Malawi.

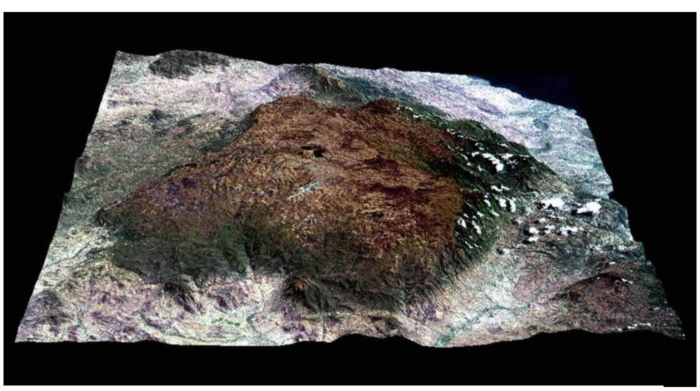

Figure 6. Landsat 8 imagery from 2013 draped over SRTM elevation data.

The Nyika National Park is located on a high dissected plateau that consists of rolling plains with rocky outcrops, with an elevation ranging from 600-2600 m asl. Nyika is in an area of relatively high rainfall (see Section 1.9.2). The name "nyika" means "where the water comes from," and it is among a number of Protected Areas established to secure water sources. It is an important headwater area and is the source of tributary streams that feed the South Rukuru river. Nyika National Park was established as a reserve in 1948. In order to protect several key water catchment areas, the park boundary was later extended in 1978 (Department of National Parks and Wildlife 2004a).

Vegetation consists of montane grasslands and evergreen forests with patches of relic montane evergreen forests. Predominantly, expansive rolling grasslands are interspersed with evergreen riverine forests along waterways. On the escarpment and at lower elevations, the vegetation is mainly deciduous *miombo* woodland (*Brachystegia-Jubernardia spp*).

Most streams and rivers are perennial, and stream flow characteristics are ascribed to high overall rainfall with some rain throughout the year, low evaporation (cloudiness and low ambient temperature), good vegetation cover to promote infiltration, and deep, freely draining soils. However, a recent survey of river conditions revealed that rapid bank erosion is occurring in some places. River channels are becoming wider and shallower, and silt is being deposited over gravel beds (Environmental Affairs Department 2006). Soils are of two types: either deep, well drained, red and fine textured with high levels of acidity, or moderately deep to shallow, well drained, medium to fine textured, and stony (Mawaya et al. 2011).

Nyika National Park is a biodiversity hotspot, important for both plants and mammals. According to the GOM Biodiversity Strategy, it has the highest number of large mammals and the highest concentration of Roan Antelopes on the African continent. Important wildlife species include: zebra, roan antelope, eland, reedbuck, bushbuck, common duiker, bush pig, leopard, hyena, and a small population of elephants. It also supports the world's largest breeding population of blue swallow (*Hirundo atrocaerulea*), and has 215 orchid species. Farmers report continued depredations of their crops by wildlife from the park, particularly monkeys, baboons, wild pigs, elephant, and buffalo (Department of National Parks and Wildlife 2004a).

Communities around Nyika practice subsistence farming consisting mainly of maize, beans, cassava, and groundnuts. Cash crops are tobacco, cotton and, on a limited scale, coffee in the Nchenachena area east of Nyika. There is also high potential for honey production and collection of termites and wild mushrooms, which are abundant during the rainy season. Livestock includes cattle, goats and sheep but the tsetse fly found around the southwestern borders poses a risk of trypanosomiasis[3].

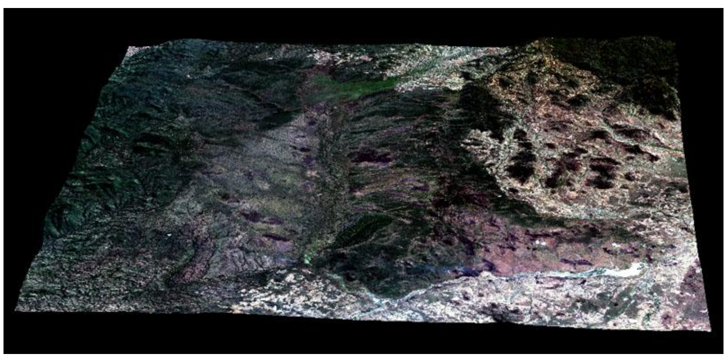

Figure 7. Landsat 8 imagery from 2013 draped over SRTM elevation data.

The Vwaza Wildlife Reserve, at an elevation of 1100-1600 m asl, consists of flat plains with dotted hills and marshy wetlands fed by streams arising on the Nyika plateau. The South Rukuru River on the southern boundary drains into Lake Kazuni, which is located at the south-eastern tip before it turns east. The lowest point is at Lake Kazuni (1,082 m) in the southeast, and the highest point is 1,660 m at Mahobe Hill in the northeast. Vwaza Marsh was declared a protected area in 1941 and expanded to its current size in 1984 (DNPW 2004b).

The vegetation is a mosaic of open to dense woodland dominated by areas of *Brachystegia*, Acacia-*Bauhinia-Combretum*, and *mopane* woodlands, with wetland grasslands and marshes in the central lowlands. Soils are very deep, brown, and medium textured, with variable drainage (well drained to poor).

Wildlife species include buffalo, elephants, roan antelope, greater kudu, Liechtenstein's hartebeest, eland, and impala. Lake Kazuni supports large populations of hippopotami and crocodiles.

Communities around Nyika practices subsistence farming consisting mainly of maize, beans, cassava, and groundnuts.

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[3] Human African trypanosomiasis (sleeping sickness) is a parasitic disease of people and animals, caused by protozoa of the species *Trypanosoma brucei* and transmitted by the tsetse fly.

The Nkhotakota Wildlife Reserve, found at an elevation ranging from 500-1,700 m asl, consists of rolling to steeply dissected and undulating topography, which is mountainous in the west, where Chipata hill rises to a height of about 1,700 m. The wildlife reserve is an important catchment area for Lake Malawi because three major rivers (Bua, Dwangwa and Kaombe) pass through it.

Figure 8. Landsat 8 imagery from 2013 draped over SRTM elevation data.

The vegetation is comprised of dense *Brachystegia* woodland and riverine forests, interspersed with occasional patches of tall *Hyparrhenia-Andropogon* grasses in the low-mid altitudes, and dense evergreen forest in the uppermost elevations. Soils are moderately deep to deep, well drained, coarse to medium textured, and occasionally stony with often a skeletal subsoil.

Wildlife species include: lion, elephant, buffalo, leopard, zebra, hippo, crocodile, warthog, kudu, roan antelope, sable antelope, eight other species of antelope, and over 160 species of birds. The Bua River is a breeding haven for two endemic fish species: Mpasa and Sanjika.

The human population around the reserve practices subsistence farming of cassava, maize, groundnuts, beans, and rice. They also fish in the Bua River and in Lakes Chikukutu & Malawi. Cash crops grown here are rice, cotton and tobacco. In addition, termites and wild mushrooms are harvested and honey is produced. Livestock include cattle, goats, pigs, poultry, but numbers are low and there is a high risk of trypanosomiasis due to the tsetse fly.

1.9.2 Climate in the Project Region

The area's climate is subtropical with distinct wet and dry seasons, with 95% of rainfall occurring between November and April (see Figure 9). The average annual rainfall across Malawi ranges from a minimum of 725 mm to a maximum of 2,500 mm. In the central/northern region in the vicinity of the lake, annual rainfall ranges from approximately 1,000 to 1,800 mm per year. Nationwide, mean temperatures vary between 17 and 27 °C and between 25 and 37 °C during the hot dry season in September and October. Maximum temperatures range from 22 to 30 °C, and minimum temperatures from 12 to 20 °C.

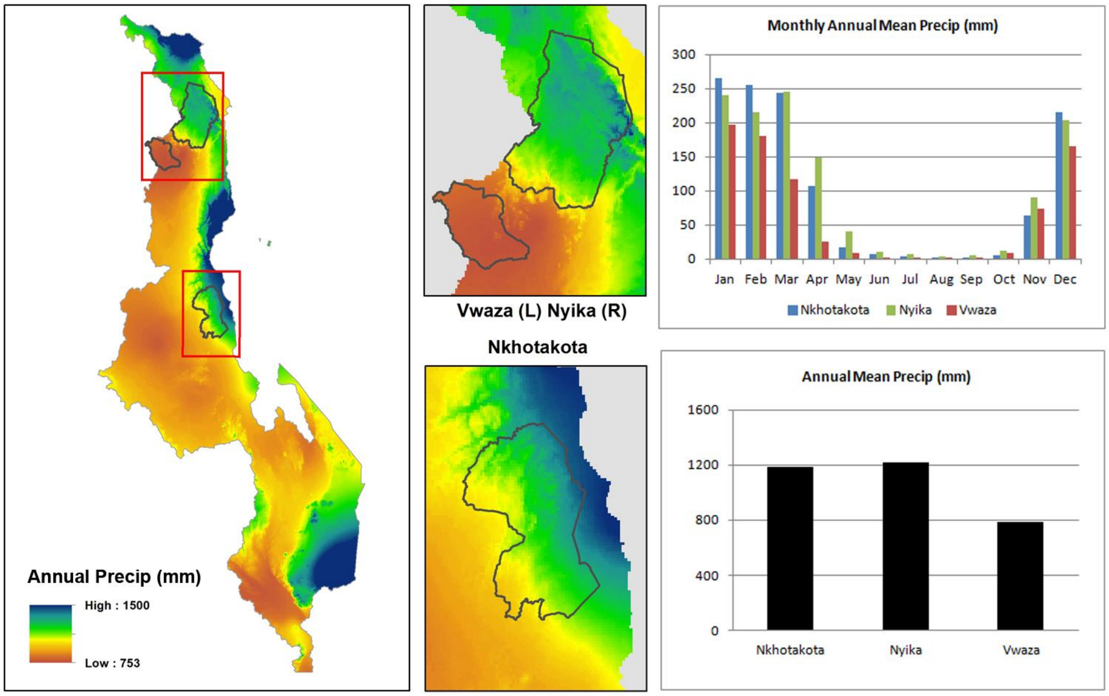

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Figure 9. Annual precipitation based on interpolated climate station datasets from a period between 1950 and 2000. Source: WorldClim, Robert Hijmans (2005)

Precipitation varies between the three project Protected Areas. The Vwaza Wildlife Reserve is one of the driest areas of Malawi while the Nyika National Park and Nkhotakota Wildlife Reserves receive significantly higher rainfall.

Table 3. Climatological information by Project Area

	Nyika NP	Vwaza WR	Nkhotakota WR
Mean monthly temperature during growing period (°C)	12.5 -20.0 (mean minimum temperature in July is 2.5 - 5.0)	20.0 - 22.5	20.0 - 25.0
Mean annual rainfall (mm)	850 – 1,600	700 – 1,000	940 – 1,500
Growing period (days)	180 – 225	165 - 180	150 - 195

Source: WorldClim, Robert Hijmans (2005)

1.9.3 Project Zone and Project Areas

The project is located in three different Protected Areas in the Northern and Central Regions in Malawi: Nyika National Park, Vwaza Marsh Wildlife Reserve, and Nkhotakota Wildlife Reserve.

Communities living within 10 km of the Nyika and Vwaza areas have formed Natural Resource Committees, which are cooperating with Malawi's Department of National Parks and Wildlife to collaboratively manage these areas. In exchange, resource user groups from the communities can obtain permits, which allow them to collect NTFPs up to 5km inside of the park. Communities in Nkhotakota are currently organizing a similar Collaborative Management Programme. The Project Area includes the resource use zones 5 km within the park, The Project Zone, 750,898 ha in size, includes the Project Areas (169,136 ha in size) and the communities living 10 km outside of the park boundaries. Figure 10 illustrates the spatial distribution of the Project Areas and the Project Zone. The Project Area is defined as the area within 5km of the park boundary that meets the forest definition at both the start of the historic period and at the start of the Project.

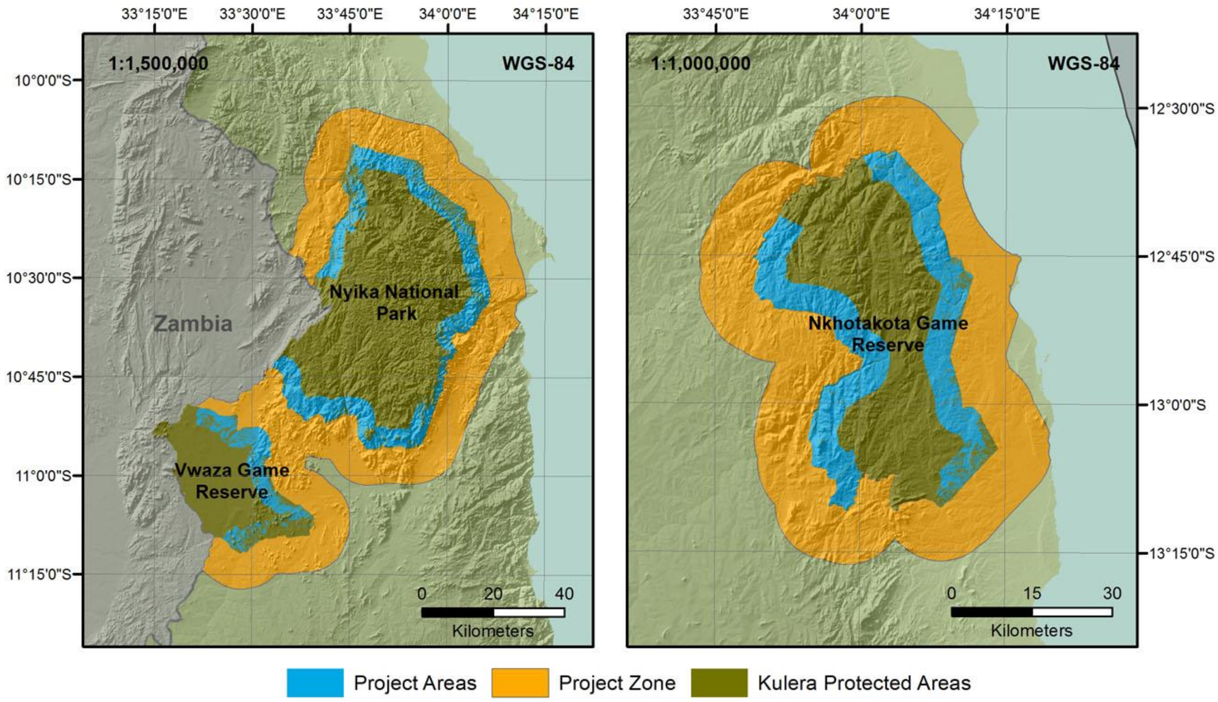


Figure 10. The REDD+ Project Area consists of forest within a 5 km buffer area inside the three project protected areas. The Project Zone is a 10 km buffer outside of the three project protected areas.

Table 4. Size and location of the Project Areas at Project start. No-data values from the LULC classification, such as clouds, burned land, shadow, and data gaps excluded from totals.

ID	National Park (NP) Name	Size of Project Areas (ha)	Land Class or Forest Stratum at Project Start [hectares]		Centroid Coordinate [decimal degrees] WGS-84	
			Evergreen	Miombo	Lon (X)	Lat (Y)
NYKA	Nyika National Park	76,805	6,476	70,329	33.4482	-11.0134
VWZA	Vwaza Wildlife Reserve	22,140	0	22,140	33.8483	-10.5703
NKHT	Nkhotakota Wildlife Reserve	70,191	28	70,163	34.0353	-12.8740
	Total	169,026	6,504	162,632		

1.9.4 Boundaries of the Project Areas

The Project Areas are found within a 5 km wide area inside of the participating protected areas in Malawi (see Figure 11). GIS shapefiles of the Protected Areas were provided by the Department of Parks and Wildlife and used for defining the Project Area locations. The 5 km inside buffer distance was selected to address observed deforestation and degradation occurring on the edges of Malawi's Protected Areas. According to the Department of Parks and Wildlife there are four main reasons for this: (1) lack of Protected Area enforcement, (2) community uncertainty of formal park boundaries, (3) depleted forest resources from areas surrounding the Protected Areas, and (4) livelihood needs of surrounding communities. The Protected Area edges are impacted due to the proximity of populated areas with diminishing impact towards the interior; the 5 km buffer distance represents an estimated mean maximum distance a villager will travel into the Protected Area for agriculture or wood product harvesting.

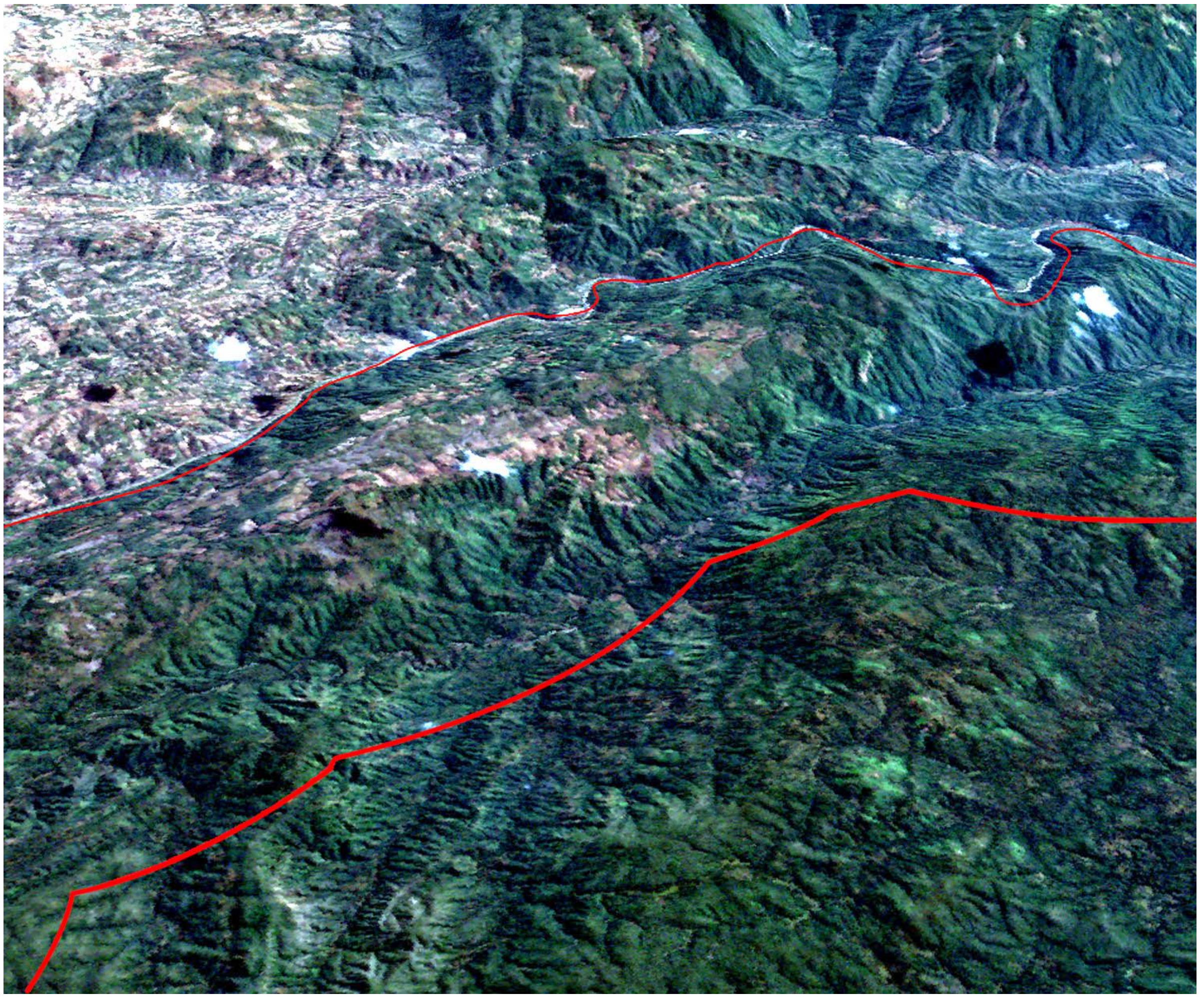


Figure 11. Five kilometer buffer area (between the red lines) in the northwest corner of Nkhotakota Wildlife Reserve. The ridgeline deforestation observable within this buffer zone demonstrates edge deforestation due to unenforced Protected Area boundaries. Image created using 2013 Landsat 8 imagery draped over a digital elevation model.

The Project Areas were set using the 5 km wide inside buffer of the Protected Area boundaries. Areas adjacent to the Zambia border were removed from both Nyika and Vwaza Project Areas along with areas adjacent to Forest Reserves (Mndilandsadzu FR and Dwambadzi FR) to the north and south of the Nkhotakota Project Areas. To complete the Project Areas from the resulting gaps, the parcel ends were set using watershed boundaries. Watersheds were generated using ESRI ArcHydro software based on an SRTM 90 m resolution elevation data, with the accumulation threshold set to 972 hectares (1200 pixels). Upon completion of the LULC classification, all areas which did not qualify as forest at both the start of the historic period and at the start of the project were removed from the projected area (Figure 12).

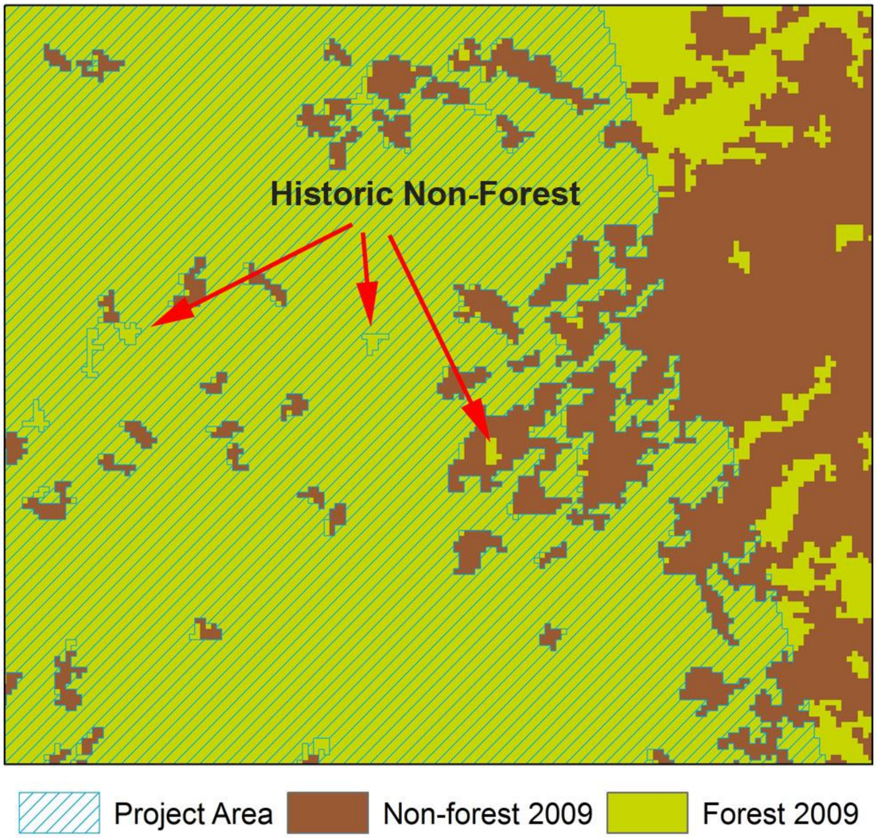


Figure 12. Non-forest Project Area exclusions. Areas which do not meet the forest definition at both the Project start and at the beginning of the historic period were removed from the Project Area.

1.9.5 Reference Region

A Reference Region was selected to assess historical and current deforestation and forest degradation quantities and trends for the Project Area baseline according to the process set out by VCS Methodology VM0006 v2.1. Variables considered in selecting the Reference Region location were: (1) forest laws and policies, (2) land use history and dynamics (e.g. forest cover, agricultural systems), (3) ecological conditions (forest types present and climatic conditions), and (4) social conditions (e.g. population density, sources of income).

The methodology requires that the minimum size of the Reference Region excluding the Project Area and Leakage Area must be 250,000 ha or the size of the Project Area at the start of the crediting period, whichever is greater. However, the Exclusive Reference Region defined for this project is only 232,782 hectares in size (see methodology deviation 2.6) due to the lack of additional suitable area. The Reference Area is set across a swath of forest use areas inside and outside of Protected Area boundaries. The Reference Region includes both the 5 km boundary area inside and the community forest use areas adjacent to the Protected Areas. The bounds of these regions are constrained within the footprint of the satellite imagery (3 Landsat scenes). These Protected Areas include all the Game Reserves, Forest Reserves and National Parks in the proximity of our Project Area. The community forest use areas around the Protected Areas were calculated using the same isochrone methods used in producing the Leakage Area (see Section 1.9.6). Including only nearby Protected Areas ensures that the Reference Region conservatively reflects the historic deforestation rate and that it is similar from the point of view of deforestation drivers due to the similarity of forest laws, land use history, ecological conditions and social conditions to those of the Project Areas. In addition to the three Project Protected Areas, other nearby Protected Areas were included in establishing the Reference Region boundaries. These additional areas are the Mndilandsadzu Forest Reserve bordering the north of Nkhotakota, Dwambadzi Forest Reserve bordering the south of Nkhotakota, and Ntchisi Forest Reserve located ~10 km south of Nkhotakota (Figure 13). No other Protected Areas were identified within the footprint of the remote sensing imagery used to produce the historic baseline.

The resulting potential Reference Region area was clipped to fit within the footprint of the remote sensing imagery used for classification. Additionally the boundary of a pine plantation observed in remote sensing imagery located within the Reference Region, south of Nkhotakota was manually digitized and removed from the Reference Region. The final Reference Region, see Figure 13, has an area of 232,782 ha, The area used for creating the historic baseline is the combined areas of the Project Areas, Leakage Belt, and Reference Region, known as the Inclusive Reference Region as opposed to the Exclusive Reference Region described above. The Inclusive Reference Region has a total of 687,802 ha.

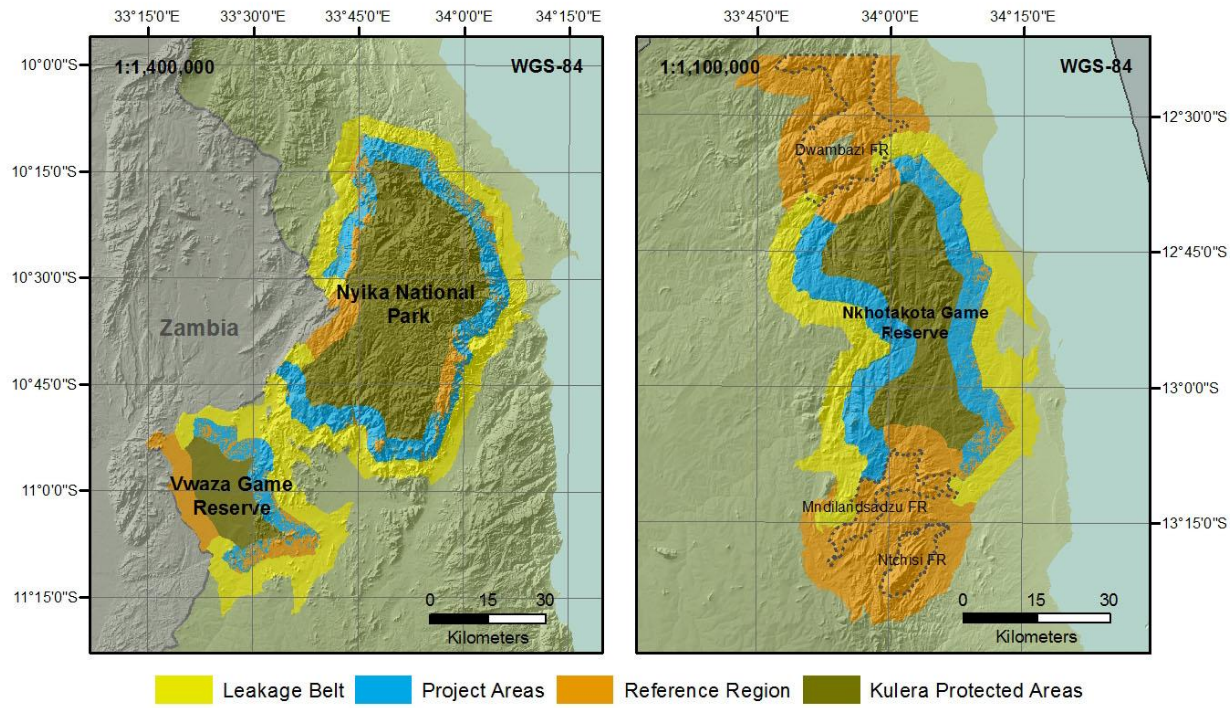


Figure 13. Overview of the extent and location of the Leakage Belt, Reference Region, and Project Areas. The surrounding Protected Areas used for the Exclusive Reference Region (Nkhotakota on right) are bounded by dashed lines.

1.9.6 Leakage Area

The Leakage Area was selected to be sufficiently large to encompass all forests around the Project Areas that could be under higher pressure from deforestation displaced by Project activities during the project's lifetime. The location was selected by taking into account the "cost" local agents of deforestation would need to incur to move their activities. It is assumed that leakage will only occur when the cost to displace the deforestation activity is below a certain threshold or is less than alternative resources. To select the extent of the Leakage Area, this threshold was set conservatively by using the maximum distance travelled for forest products, 10 km, as reported in the Participatory Rural Appraisals. Leakage from drivers of deforestation that are not constrained by geography is discounted by using a factor approach

The cost distance analysis was conducted using the Spatial Analyst extension for ArcGIS software. This process requires a Cost Weight surface and the source(s) of displacement, which are the Project Areas.

An initial step of setting the potential bounds of the Leakage Belt was conducted by excluding the Protected Area cores (5 km inside the Protected Area boundaries) inside Zambia and Lake Malawi.

The Cost Weights surface was created by assigning the following weights for roads, assuming that one can travel easier (thus farther) on Primary Roads:

- Primary Roads = 5
- Secondary Roads = 7
- Tertiary Roads = 10
- Tracks = 15

Weights assigned to terrain outside of the road network used rivers and terrain ruggedness as factors. A Digital Elevation Model (DEM), SRTM, was used to calculate a Terrain Ruggedness Index (TRI) which determines how difficult terrain is to traverse: The following weights were assigned to the Cost Weights surface for terrain outside of the road network:

- Level ground = 20
- Rivers = 30
- Difficult Terrain = 30
- Rugged Terrain = 50
- Very Rugged Terrain = 100

The Cost Distance output is a raster grid with values indicating the cost of traversing each pixel. These values increase in cost based on distance from the Project Areas with weighting values added depending on the type of road for travel over the road networks or weighted by the difficulty of terrain, such as crossing rivers or steep hills. To set the threshold for bounding the Leakage Belt, travel speeds were calculated from PRA reported speeds and distances. The mean speed for the greatest travel period was selected, and travel time increased using the 1.5 factor required by the methodology. The cost distance raster grid was then calibrated to units of time based on the time to traverse a single pixel (30m) at the mean speed reported in Table 5. The isochrone representing the distance travelled over 15 hours (maximum 10 hour travel time with 1.5 factor applied) was selected as the Leakage Belt boundary.

Table 5. Mean speeds for each mode of transport of deforestation drivers. The greatest travel time was reported for agricultural workers and was selected for establishing the Leakage Belt isochrone boundary.

Driver	Primary Mode	Avg Speed (km/hr)	Max Time (hr)	1.5 * Time
Agriculture	Walking	1.25	10	15.00
Fuelwood	Walking	1.51	6	9.00
NTFP	Walking	1.50	6	9.00
Timber Harvest	Walking	1.06	3	4.50

The resulting Leakage Belt has an area of 285,994 hectares. Figure 14 provides an illustration of the Cost Distance output and the method of setting the threshold. See Figure 13 above for the full extent of the leakage belt.

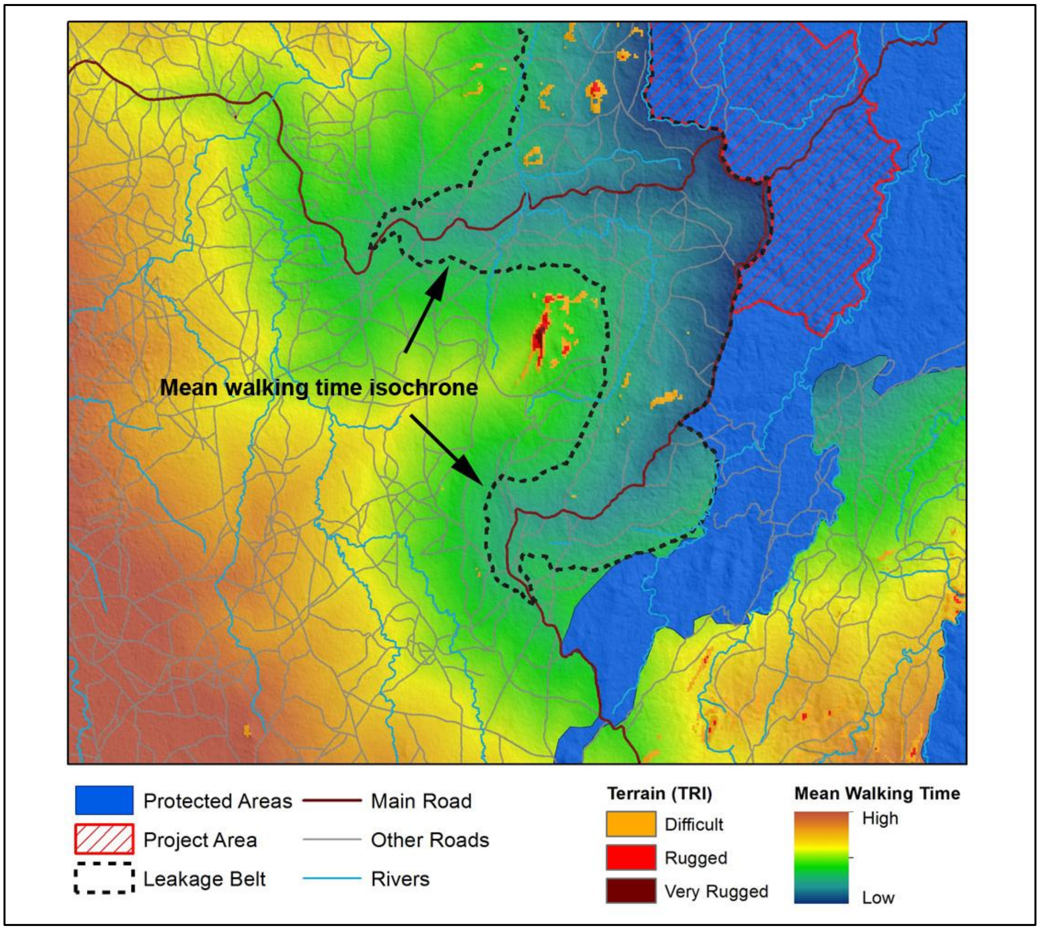


Figure 14. Method of setting the Cost Distance threshold for defining the Leakage Belt boundaries.

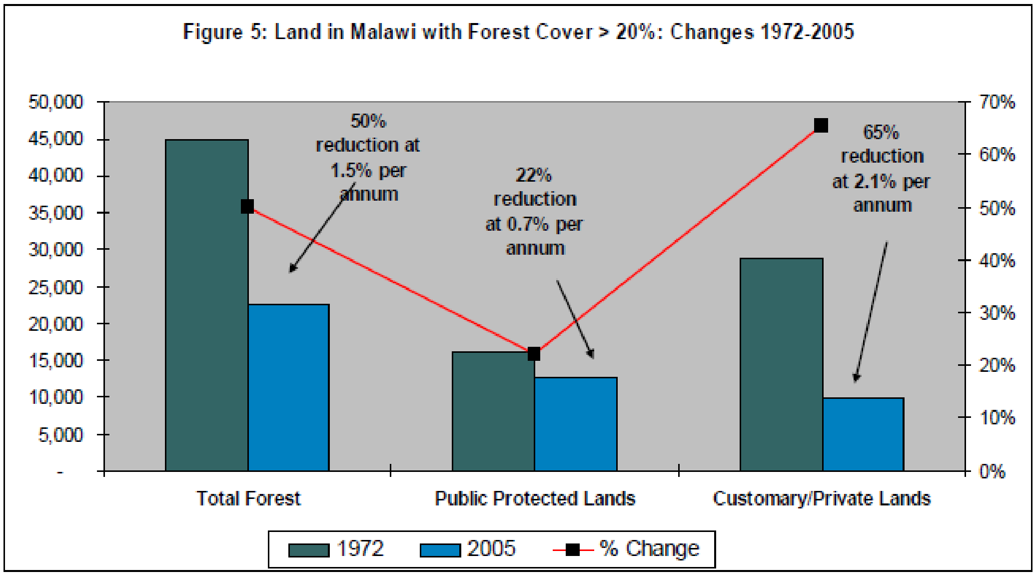
1.10 Conditions Prior to Project Initiation

This Project was initiated when Total LandCare, Terra and other partners were successful in winning a USAID competitive grant in Malawi to promote biodiversity within the context of mounting population pressure was is leading to unsustainable land-use. Total LandCare designed the program to meet these goals and named it the "Kulera Biodiversity Project" after the Chichewa term Kulera - to nurture, look after, enrich – a description that aptly reflects the project's goal from a Malawi perspective which is fully aligned with current policies and strategies of government, USAID and other key donors. Assessments reveal that mounting population pressures have led to severe degradation of the country's natural resources from unsustainable land-use practices and encroachment into key protected areas.

This was one of the first large USAID programs that included financial support to assess the feasible of developing emission reductions, and to undertake the activities to produce verified emission reductions. The program was award in October 2009, but took approximately 6-9 months to get fully functional. The emission related work started with a feasibility assessment to determine which of the Kulera land-use activities would be eligible for developing verified emission reductions and that with the successful sale of the carbon could generate long-term incomes streams to continue to support the program after USAID funding ended.

1.10.1 Overview of Deforestation and Forest Degradation in Malawi

Nationwide, forest area estimates range from 2.6 to 3.4 million ha, including primary forest, modified natural forest, and production forest. Between 1972 and 1990, forest cover in Malawi declined by 41%, at an average rate of 2.3% a year, and an additional 15% between 1990 and 2005 (Bunderson *et al*. 2008) (see **Error! Reference source not found.**). Forest degradation has been particularly severe in Malawi's Northern Region, the location of Nyika National Park and Vwaza Wildlife Reserve, at rates of up to 3.4% annually (Environmental Affairs Department 2010), although the deforestation rates adjacent to the parks are estimated at closer to 3% annually (Department of National Parks and Wildlife 2004a). After the democratic transition in 1994, encroachment into Protected Areas increased dramatically as people living near these areas interpreted increased democratic freedoms as a license to reclaim benefits from government-controlled land in forest reserves and national parks (Walker and Peters 2001).



Source: Calculated from Bunderson and Hayes 1995; MFNR 1993; WB 1992.

[1] Sources: 1) World Bank. (1992). Economic report on environmental policy, Malawi. Volumes I and II. Lilongwe. 2) Bunderson, WT and IM Hayes (1995). Agricultural and Environmental Sustainability in Malawi. Proceeding of Sustainable Agriculture for Africa, Abidjan, Côte d'Ivoire, July 1995. 3) Ministry of Forestry and Natural Resources. (1993). Forest resources mapping and biomass assessment for Malawi. Satellitbild, Kiruna Sweden in cooperation with the Department of Forestry, Lilongwe.

Figure 15. Land in Malawi with forest cover>20% Changes 1972-2005

1.10.2 Types and Condition of the Vegetation in the Project Area and Project Zone

The three Kulera project protected areas, including the Project Area and Project Zone, combined are representative of vegetation communities found throughout Malawi. Of nine major vegetation types found in the country, the most prevalent are *miombo* woodlands, deciduous forests and thickets, evergreen and semi-evergreen forests, and afromontane grassland (EAD 2006).

Across Malawi, land classified as forests is found in:

- Plantations - 110,000 ha (2.5%)
- Forest reserves - 870,052 ha (22%)
- National parks and game reserves - 981,479 ha (25%)
- Customary land 1,988,255 ha (50.5%) - mostly disturbed, 20-70% cultivated.

The majority of the forests in Malawi are *miombo* woodland, and are commonly restricted to protected areas. *Miombo* woodland is a wooded savanna, similar to oak woodlands of California. *Miombo* woodland is a dry-deciduous ecosystem, where some trees will lose their leaves in the dry season. Grass can be seen through gaps in the woodland canopy, and fire can burn in the understory (Terra Global Capital, LLC 2010).

Brachystegia spp. and *Julbernardia globiflora* are dominant *miombo* woodland species and play an important role in water conservation by protecting steep slopes from erosion. Other *miombo* wooldland species include *Acacia spp., Bauhinia spp, Combretum spp., Sclerocarya birrea, Strychnos cuccloides, Parinari curatellifolia, Vangueria infausta, Azanza garckean and Schinziophyton rautanenii.* Over 20 genera were recorded, including *Brachystegia, Julbernardia, Terminalia, Combretum, Acacia, Pterocarpus, Uapaca, Syzygium, Erica, Protea, Parinari, Pericopsis, Diospyros* and *Diplorrhynchus*. *Miombo* woodlands are under threat from deforestation for firewood, charcoal, honey collection, poaching, fire, and encroachment (Mawaya et al. 2011).

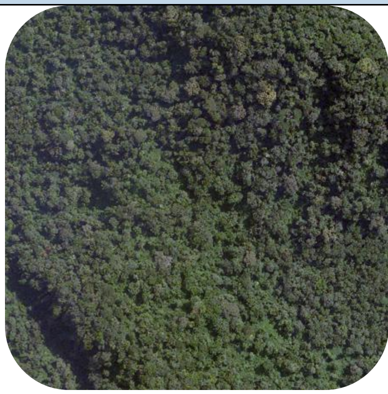
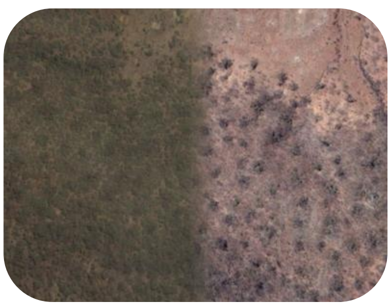
See Section 1.9.1 for vegetation descriptions for each of the three Kulera project protected areas.

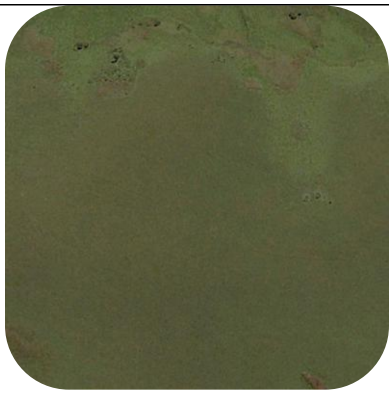
1.10.3 LULC Classes and Forest Strata in the Project Area

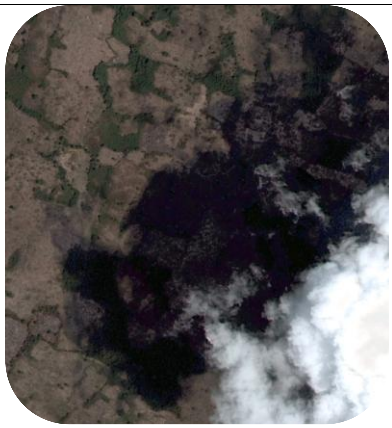
Six land cover classes were identified within the Project Area, and several non-data classes based on the Intergovernmental Panel on Climate Change's 2006 Guidelines for National GHG Inventories for Agriculture, Forestry and Other Land Use. The six IPCC LULC classes include Forest, Grassland, Cropland, Wetlands, Settlement, and Other Land. The Forest class was further divided into forest strata of Miombo Forest and Evergreen Forest. Further stratification was not possible due to spectral confusion between alternate potential forest strata. The non-forest classes, Grassland, Croplands, Wetlands, Settlement and Other Land were ultimately consolidated (lumped) into a single non-forest class. Additionally three no-data classes were used in the classification. These are Cloud, Shadow, and Burned Land. Burned Land is included as a non-data class since burned open woodland is indistinguishable from burned grassland in medium resolution multispectral imagery.

The full Standard Operation Procedures used for classification, containing detailed descriptions and criteria to identify the LULC classes is available to the verifier.

Table 6. Classification schema grouped into Forest, Non-Forest and No-Data types.

Forest Classes	Class Codes: EVG, MIO
	**Evergreen Forest** The class includes both evergreen, semi-evergreen, and riverine forest. Only relatively small patches or strips of these forest types are found within the Project Area. It is characterized in medium resolution satellite multispectral imagery by a year round high Near Infrared spectral signature. It is visually identified in high resolution imagery by its closed canopy, rich green color and larger individual tree canopies as compared to *miombo* woodlands. Evergreen Forests remain largely intact within the Project Area for the last three decades as observed on archival Landsat imagery.
 	**Miombo Forest** This class includes miombo, mixed deciduous, and thickets which meet forest definition (10% canopy cover, trees 5 meters tall and a area of 0.5 ha). Nearly all of the forest within the Project Area falls within this forest class. Miombo is challenging to classify due to complex phenology and relatively weak Near Infrared spectral response. It is found in both open woodland and closed canopy configurations. To illustrate the phenology challenge, the lower image on the left, from Google Earth, shows a seam between two image dates. On the left side the forest canopies have leaves, while on the right the leaves have fallen. Miombo forest has varying levels of deforestation and includes closed forest down to 10% canopy cover. For this reason miombo forest has greatly varying biomass densities.

Non-Forest Classes	Class Codes: BAR, WTR, GRS, SHB
	**Shrubland** Shrublands are areas of woody growth, including understocked degraded woodland that do not meet the minimum forest definition. Trees can be differentiated from shrubs as trees cast a longer shadow and have larger canopies. Though shrublands may have trees, the often degraded state has less than 10% canopy cover. Very degraded miombo woodland falls into this class of non-intact forest as it is no longer functioning as a forest system. The Shrubland class is reclassed into the BAR class code prior to analysis.
	**Grassland** This class includes green season montane grasslands, lowland grasslands, and savannahs that do not meet the forest definition. This class also includes green agriculture such as corn, sugarcane, row crops that are spectrally indistinguishable from naturally occurring grasslands. This class is characterized by low Near Infrared multispectral response and is readily identifiable in high resolution imagery. The Grassland class is reclassed into the BAR class code prior to analysis.
	**Bare Ground** This class includes exposed soil as well as senesced grasslands and wetlands, Characterized by very low Near Infrared multispectral response and is readily identifiable in high resolution imagery. The Bare Ground class is reclassed into the BAR class code prior to analysis.
	**Water** This class includes open water and water saturated soils. Characterized by almost complete absorption of Near Infrared wavelengths.

No-Data Classes	Class Codes: BRN, SHD, CLD
	**Burned Land** Fire is a regular annual occurrence throughout the Project Area. Agriculture, forest and grasslands all burn and are difficult to differentiate in medium resolution multispectral imagery. As such, burned areas are considered a no-data class. These systems are fire adapted and typically recover quickly after a fire event.
	**Cloud and Shadow** Both cloud and shadow obscure the underlying land cover class thus requiring these areas to be removed from analysis.

1.10.4 Current Carbon Stocks for LULC Classes and Forest Strata

Table 32 in Section 3.1.3 provides the carbon stock densities for the LULC classes and forest strata.

1.10.5 Forest Cover, Deforestation and Degradation in the Project Zone

Forest cover[4] in the total Project Area is 169,136 hectares and this is declining rapidly as a result of deforestation caused by population pressure and poverty. Fuelwood collection, charcoal production, and clearance for agriculture are some of the only sources of income for the increasing number of poor rural households and result in direct removal of forest biomass. In the absence of Project Activities, it is likely that current deforestation rates, estimated at 1 to 3% per year, will continue and will likely accelerate over the next decade due to the growing population.

[4] Since no definition has been published by the Malawian Designated National Authority (DNA), the definition of forest developed by Food and Agriculture Organization (FAO) has been used. According to the FAO, Forests are: land with a tree canopy cover of more than 10 percent and area of more than 0.5 ha. Forests are determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 m. Forest includes natural forests and forest plantations.

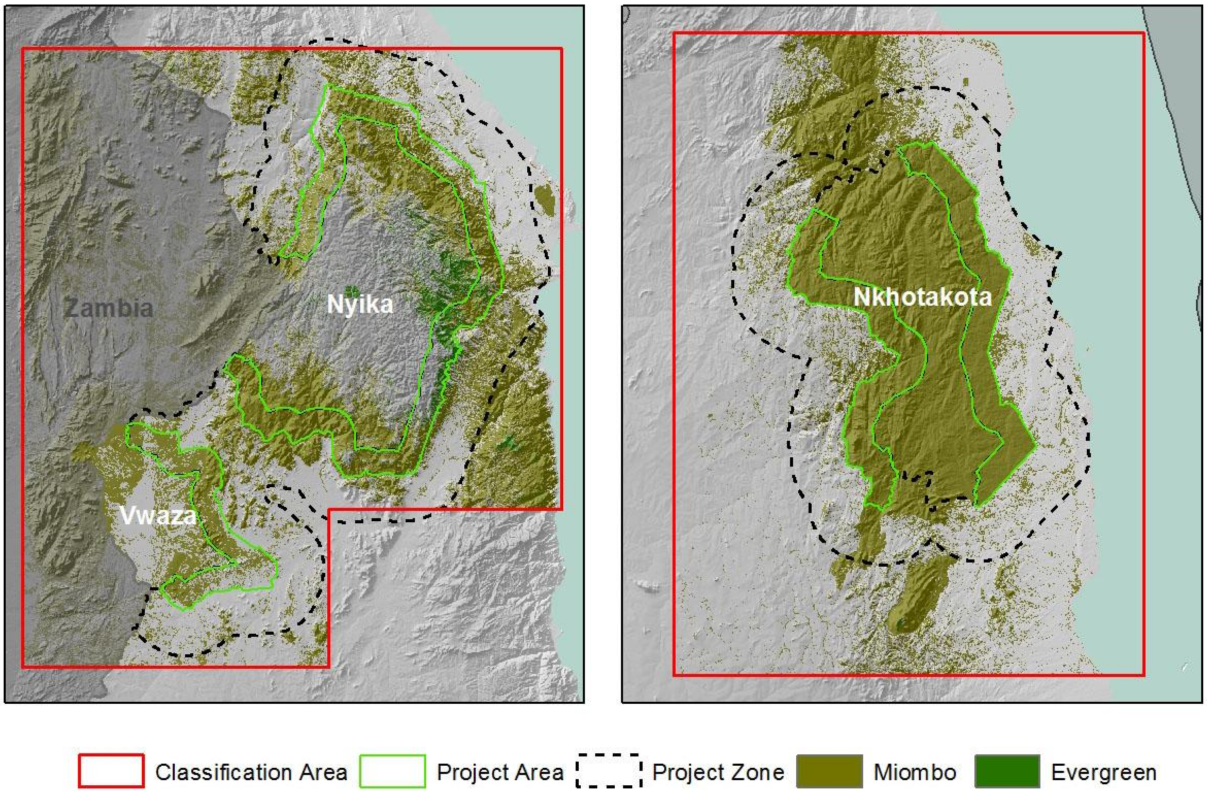


Figure 16. 2009 forest cover in and around the three protected areas of the Kulera Biodiversity Project

1.10.6 Description of Communities in the Project Zone

Key challenges for conservation in Malawi are a rapidly growing and predominantly rural population that is poor and heavily dependent on natural resources to meet livelihood needs. The current population is 13 million, with an annual growth rate of 2.8%, of which 85% is rural. From 1998 to 2008, population increased by 32%, as density increased from 105 to 139 persons per km² (National Statistical Office 2008). The average life expectancy is 52.4 years. Poverty is high: 65% of the population is living below the national poverty line, with 90% of the population earning less than USD2 per day, and 74% earning less than USD1.25 per day (UNDP 2009).

The highest concentration of the population (45%) is found in the Southern region, while 42% lives in the Central region and 13% lives in the Northern region. However, the share of population in the Project Zones in the central and northern regions is rapidly increasing (National Statistical Office 2008).

The Project is targeting a total of more than 45,000 households in the Project Zones. This total number of households represents a total population of 225,000 people who are living in rural communities in the border zone of the targeted protected areas. A detailed socio-economic baseline survey was conducted in the three Project Zones over 13 weeks from December 2010 to March 2011 (Phiri, Mapemba, and Sopo 2011).

Most households living around these PAs are characterized by dire poverty, undertaking practices that are destructive to the same resources upon which their livelihoods depend. The main occupation in the Project Zones is small-scale farming (92% of households) followed by small-scale or barter trade (48-50% of respondents). Average annual incomes in the Project Zones ranged from MK66,798.00 (approximately USD 248) to MK 68,548.80, roughly USD 254 (based on an exchange rate of 270 Malawi Kwacha to USD 1). Food insecurity is chronic in many areas in Malawi. In the Project Areas, one-fifth to one-quarter of the survey respondents reported running short of food the previous year. The worst month for food shortages and insecurity occur between December and March, at the start of the planting season before food crops are mature enough to harvest. Almost without exception, fuelwood is the main source of energy for cooking and heating households.

In addition, most communities have limited access to support services such as health care, education, agricultural extension, inputs, markets and tele-communications because they reside in remote areas with poor roads and infrastructure. Survey respondents reported lacking access to training in basic skills needed to run small enterprises.

In the mid-1990s the DNPW started the co-management program in Nyika and Vwaza to involve communities in the co-management of protected areas. The co-management agreement provided specified rights of sustainable use of land, water and natural resources within Nyika National Park and Vwaza Marsh Wildlife Reserve to communities and created a benefits-sharing program to facilitate wildlife-based income generating activities for the association.

The National Parks and Wildlife Act provides for sharing of 50% of Park entry fees and 20% of concession fees with communities. The revenue sharing programme has been piloted in Nyika-Vwaza area and between 2004 and 2008 the NVA collected USD7000 annually. The funds were used to construct school blocks, teachers' houses, health centres and boreholes. These benefit sharing programmes have promoted community participation in construction of fences, clearing of boundaries and surrendering of muzzle loading guns in Nyika-Vwaza (Environmental Affairs Department 2010).

1.10.6.1 Communities around Nyika National Park

Communities living within 10 km of Nyika National Park and Vwaza Marsh Wildlife Reserve formed village-level NRMCs. The NVA is an umbrella group comprised of members elected from the communities. The NVA acts on behalf of the village- and zone-level NRMCs in meetings with the DNPW to establish general rules for the co-management agreements and benefits-sharing arrangements. This is the first program of its kind in Malawi, and it is being replicated in national parks and reserves across the country. Project proponents are currently supporting the creation of a similar co-management program in the newly created NAWIRA and its Project Zone.

The population in the areas around Nyika National Park are predominantly ChiTumbuka-speaking agriculturalists, with some Ngoni who migrated to the area from the south in the mid-1800s, and a smaller number of more recent migrants from the Central and Southern regions of Malawi. A group of hunter-gatherers known as the Phoka were evicted from the park in the 1960s and 1970s and resettled or assimilated in adjacent communities or near Lake Malawi (McCracken 2012). Most people practice a mix of Christian and traditional religious beliefs. Historically, Christian mission influence in the North contributed to much higher rates of education. Today, the communities around Nyika are some of the most well-educated in Malawi, with nearly one-third of respondents completing secondary school (32.2%), and nearly half (46.8%) completing Standard 8 (Phiri, Mapemba, and Sopo 2011).

The communities around Nyika practice subsistence farming consisting mainly of maize, beans, cassava, and groundnuts. Cash crops are tobacco, cotton, soy, and, on a limited scale, coffee in the Nchenachena area on the eastern side of Nyika. There is also high potential for honey production and collection of termites and wild mushrooms, which are abundant during the rainy season. Livestock includes cattle, goats and sheep but the tsetse fly found around the southwestern borders poses a risk of trypanosomiasis.[5]

Expansion of the park in the 1970s required the resettlement of about 5,000 people. The evictions were undertaken over a protracted period between 1978, largely by district government officials. Many of the evicted families lost their property during the resettlement exercise and were placed on inferior land, which has resulted in increased confrontation between the park and neighboring communities (Department of National Parks and Wildlife 2004a). Illegal use of park resources, including cultivation and

[5] Human African trypanosomiasis (sleeping sickness) is a parasitic disease of people and animals, caused by protozoa of the species *Trypanosoma brucei* and transmitted by the tsetse fly

setting fires for hunting, has increased since the evictions (Department of National Parks and Wildlife 2004a).

1.10.6.2 Communities around Vwaza Wildlife Reserve

Livelihoods and cultural history are similar to those described for Nyika above, due to the geographic proximity of the two areas. Between 1977 and 1984, approximately 2000 people were resettled outside of the park boundaries (Department of National Parks and Wildlife 2004b). Illegal extraction of resources from the park, opening gardens for cultivation, and setting fires for illegal hunting activities or retaliation have increased since the resettlement of these populations. However, communities participating in the Collaborative Management Program who are eligible to collect NTFPs from the reserve report improved relationships with the DNPW. Small portions of the park boundaries have been realigned in order to accommodate community requests for increased access to land and water resources (Department of National Parks and Wildlife 2004b).

1.10.6.3 Communities around Nkhotakota Wildlife Reserve

The population around the reserve practices subsistence farming of cassava, maize, groundnuts, beans, and rice. They also fish in the Bua River and in Lake Chikukutu and Lake Malawi. Cash crops grown here are rice, cotton and tobacco. In addition, communities harvest termites and wild mushrooms as well as produce honey. Livestock include cattle, goats, pigs, poultry, but numbers are low and there is a high risk of trypanosomiasis due to the tsetse fly. Currently the Project partners are supporting community organizers in the Nkhotakota area as they organize village-level and zone NRMCs as well as form an umbrella organization in order to establish co-management and benefits-sharing arrangements with the DNPW.

1.10.7 Description of Current Biodiversity and Threats to Biodiversity

Malawi has one of the highest population densities in sub-Saharan Africa; consequently, most of the land outside of Protected Areas has been converted to farmland and wildlife numbers are low. However, Malawi’s national parks and reserves protect the habitats of a number of plant and animal species. The Project Area is home to over 1,200 species of plants, including some of the last remaining evergreen forests in Malawi, and eighteen endemic or rare species. Wildlife species in the Project Areas include: lion, elephant, buffalo, leopard, zebra, hippo, crocodile, warthog, kudu, ten species of antelope, and over 500 species of birds. The Bua River in Nkhotakota Wildlife Reserve is an important watershed and a breeding haven for two endemic fish species: Mpasa (lake salmon) and Sanjika.

Loss of habitat, which is occurring with increasing speed, has been recognized as a major threat to biodiversity in the Project Area. In addition, hunting by community members with homemade firearms and wire snare traps for large mammals represents a significant threat to animal species within the Protected Area. There is a higher incidence of illegal hunting and unsustainable land-use practices in the Nyika-Vwaza Complex than in the Nkhotakota area.

In 2011, as part of the Kulera Biodiversity Project, a baseline wildlife survey was conducted in the Project Area. The surveys mostly relied on recent wildlife counts from the DNPW. In addition resources included old and recent documents on wildlife resources in the national parks, wildlife and forest reserves such as master plans; the Fourth National Report on Biodiversity Resources in Malawi 2010; the Malawi State of Environment Outlook Report 2010; the Status of Wildlife Management in Malawi 2010; and the National Biodiversity Strategy and Action Plan (NBSAP) 2006.

1.10.7.1 Description of Current Biodiversity and Threats to Biodiversity in the Project Zone.

As a whole, the Project Area contains exceptional biodiversity.

Nyika National Park is home to:

- More than 95 species of mammals, including zebra, warthog, roan antelope, common duiker, bushbuck, klipspringer, reedbuck, side-striped jackal, hyena and eland;

- An estimated 430 species of birds, the most important of which include the Bustard and Wattled Crane (largest breeding populations in Malawi are on the Nyika); Red winged francolin (subspecies endemic to Nyika); Greater Double-collared Sunbird and Baglafecht Weaver (endemic to Nyika); and Red-tufted Malachite Sunbird and Mountain Marsh Whydah (found nowhere else in Malawi);
- 47 species of reptiles, three of which are endemic to Nyika: Goetzei Nyika Chameleon (*Chameleo goetzei nyikae*), Nyika skink (*Mabuya varia nyikae*), and Hilda's Skink (*Mabuya hildae*);
- 34 species of amphibians, three of which are endemic to Nyika: Nyika Dwarf Toad (*Bufo taitanus nyikae*), Nyika Squeaker (*Arthroleptis xenodactyloides nyikae*); and black striped sedge frog (*Hyperlorius quinquevittatus merdensi);*
- roughly 27 species of fish (that have been recorded); and,
- 287 species of insects (that have been recorded), 120 of which are butterflies. Five species of butterflies are thought to be endemic to Nyika (Mawaya 2011).

Vwaza also supports diverse fauna, including:

- 50 mammal species, including elephant, hippo, buffalo, zebra, roan antelope, hartebeest, reedbuck, warthog, bush pig, impala, grysbok, duiker, bushbuck and kudu;
- 341 species of birds, including waterfowl, wading birds, crowned cranes and many raptors such as marsh Harriers;
- 10 species of fish;
- Most reptiles and amphibians seem not to have been documented in the wildlife reserve.

Finally Nkhotakota Wildlife Reserve hosts tremendous biodiversity due to its diverse habitats, including:

- Low densities of large mammals, including elephant, buffalo, kudu, reedbuck, roan antelope, sable antelope, waterbuck, bushbuck, warthog, zebra, lions and leopard. The small patch of evergreen forest on Chipata Mountain is an important habitat for the Blue Monkey (*Cercopithecus mitis*), one of the rare animals in Malawi;
- A total of 280 bird species including the Taita falcon and Black stork, both of global conservation concern;
- 24 species of fish, including *Opsoridium microlepis* or Lake Salmon (mpasa) that is listed as endangered.

1.11 Compliance with Laws, Statues and Other Regulatory Frameworks

1.11.1 Background

Current forestry and related laws have been enacted as part of the push towards democratization and land reform in Malawi. These laws create or reinforce a mandate for decentralization of authority, along with greater democracy and transparency in decision-making, particularly with respect to natural resource management. The Project Areas are in legally recognized Projected Areas under the National Parks and Wildlife Act, CAP 66.07 (1992) as amended and the Regulations Game Act, CAP 66.03.

The Project supports the co-management of the Protected Areas with the government and communities through the establishment of Community Associations, which represent the villages around the Protected Areas. Kulera Project Activities comply with all Malawian laws and are designed to work with a number of land use and forestry laws to achieve project objectives. Extensive stakeholder consultation and involvement in the project, together with law enforcement ensure that compliance with laws, statutes and other regulatory frameworks will be achieved throughout project implementation.

1.11.2 List of Relevant Laws and Demonstration of Compliance

Laws relevant to the Kulera REDD+ project are listed below. Together, these land use and forestry laws and policies strengthen land tenure for rural communities, create a socio-economic framework for promoting sustainable development and management of Malawi's land resources, and provide a basis for enabling the success of the Kulera project.

1.11.2.1 Protected Area, Forest and Land-use Related

National Park and Wildlife Act, CAP 66.07, 1992 and the Game Act, CAP 66.03 - The National Parks and Wildlife Act and the Game Act were implemented to protect rare, endangered and endemic species of wild plants and animals, and guides the establishment and management of national parks and wildlife areas throughout Malawi. These Acts provide for wildlife management, designate rare and endangered species that are protected under the Acts, and outline administrative procedures required for species protection. The 2004 amendment to this act provides for community co-management of national parks and the wildlife and forest resources found within its boundaries. The Project Area in Nyika National Park is governed under the National Park and Wildlife Act and the Project Areas in Nkhotakota and Vwaza are governed by Game Act.

National Forestry Policy (1996) and the Forestry Act, CAP 63.01 (1997) - control and regulate forest products, declaration of forest reserves, protection, control and management of forest products, tree planning, and other enterprises. The Forest Policy within these laws regulates forest areas, reforestation, felling etc.

Malawi's National Forestry Programme, 2001 - Not a law but a policy, Malawi's National Forestry Programme highlights the link between forest degradation and poverty. It also notes that agricultural expansion is being made at the expense of forests, a situation that discourages smallholders from planting trees to diversify their sources of income and increase food security. In the twelve strategies stated in the National Forestry Programme, the goal of "sustainable management of forest goods and services for improved and equitable livelihoods" reflect the key issues facing the sector and supports underlying design and implementation strategies of the Project.

Malawi Decentralization Policy, 1998 - According to Malawi's Decentralization Policy (1998), District Assemblies constitute Malawi's system of local government. District Assemblies can create committees at Area, Ward or Village levels for the purpose of facilitating popular participation in the Assembly's decision-making. The District Assembly is comprised of an elected Chairman/Mayor and one councillor per Ward, as well as ex-officio non-voting members, including the Traditional Authority and Sub-Traditional Authority from the local government area, five people appointed by elected members to represent special interest groups, and members of parliament from constituencies that fall within the local government area. In this sense, the District Assembly is both a governmental and "non-governmental" entity. This policy may authorize District Assemblies responsible for forest management and conservation on customary lands, including having the legal capacity for local level planning and licensing (FGLG 2008). Most of this responsibility rests with the District Forest Offices, which are accountable to the District Assemblies. The Kulera project is designed to work with and benefit from this decentralization policy, as most legal decisions relevant to forest management can be made locally through District Assemblies.

Local Government Act, 1998 - This act supports the implementation of the Decentralization Policy, devolving administration and political authority to the district level. Together the Decentralization Policy and Local Government Act emphasize elected local government based on participation, democratization, accountability, and people's empowerment, with the twin goals of poverty reduction and good governance (Chiweza 2010).

1.11.2.2 Community-based Management Related

The Chiefs Act, 1967 - According to The Chiefs Act (1967), traditional authorities, or "chiefs," may appoint Group Village Headmen and Village Headmen to assist him in carrying out his functions. Each village or group village, represented by a Group Village Headman that decides to enter into community forest management, is required to elect a Village Natural Resource Management Committee (VNRMC) to represent their interests and act as points of liaison in dealing with forestry extension workers and other government officials. The VNRMC must also be willing to take on the lead role in forest planning, management and administration, and to participate in training. The project will be implemented through these Headmen to aggregate individually owned trees planted in privately owned lands.

Malawi National Land Policy, 2002 - According to National Land Policy of 2001, the government may assign as public land any land that is held in trust and managed by the Government or Traditional Authorities and accessible to the public at large. Within the boundaries of Traditional Authorities, public lands are lands that are not allocated exclusively to any group, individual or family; however, they are reserved for the exclusive use of members of the respective Traditional Authority. These include, for example, *dambos* or communal grazing and communal forest areas. The policy emphasizes that public lands held in trust for members of a particular community does not automatically transfer ownership of that land to the Headsperson, Chief or public official, and therefore is not considered private. On the contrary, private lands, also called "customary estates," are customary lands that are allocated exclusively to a clearly defined community, corporation, clan, family, or individual. Once registered, customary estates provide the proprietor private usufructuary rights in perpetuity, and can be leased or used as security for a mortgage loan. However, it is important to note that because the interest of a customary estate is usufructuary, only the sale, lease or mortgage are subject to what are known as the overriding interests of the community and the sovereign rights of the state.

Community Based Forest Management Policy in 2003 - The National Land Policy (2002) defines categories of land ownership in Malawi, while the specific use of forest resources within these particular land tenure systems is defined in the National Forest Policy of Malawi (1996), and further refined in Community Based Forest Management Policy (2003). Specifically, the Community Based Forest Management Policy allowed for communities on customary lands – mostly unallocated customary lands – to achieve a full forest ownership and control through the conclusion of a Forest Management Agreement with the government. It is important to note that "ownership" in this sense also means *usufructuary*, or use rights, only. The Forest Act (1997) requires charcoal production to be licensed, and for license applications to be consistent with approved forest management plans and agreements. The project will conform to this law for any charcoal promotion in the Project Areas.

1.12 Ownership and Other Programs

1.12.1 Right of Use

Based on the VCS Standard Section 3.11.1, the project demonstrates that the proponents have right of use over the emission reductions under Sections 4:

"A right of use arising by virtue of a statutory, property or contractual right in the land, vegetation or conservational or management process that generates GHG emission reductions and/or removals (where such right includes the right of use of such reductions or removals and the project proponent has not been divested of such right of use)"

The Government of Malawi, as managed by the DPNW, is the legal owner of the land and forests in the Project Areas. Through the laws and policies detailed in Section 1.11, the DNPW has the rights to manage the Project Areas and implement the activities that produce emission reductions.

Under Section 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 the right of use in the project proponent.

To perform the activities that produce emission reductions, the DNPW has entered into formal agreements (see REDD+ Agreements Section 1.13.3) with the Communities Associations to recognize the Associations' as a project proponents, along with the DNPW, for the Project.

1.12.2 Emissions Trading Programs and Other Binding Limits

Malawi is a non-Annex I signatory of the Kyoto Protocol and it does not have an emissions trading program to binding limits on GHGs.

1.12.3 Participation under Other GHG Programs

The Project has not been registered, nor is it seeking registration under any other GHG program.

1.12.4 Other Forms of Environmental Credit

GHG emissions reductions credits are currently the only environmental credit being generated from this Project. In addition, the appropriate legal agreements are in place between project participants to ensure credits are not sold more than once.

1.12.5 Projects Rejected by Other GHG Programs

The Project has not been rejected by any other GHG program.

1.13 Additional Information Relevant to the Project

1.13.1 Eligibility Criteria

The methodology used for this project is revised VM0006 v2.1, and this is a grouped project. However, no new instances are being added for this version of the Project Document, and therefore no eligibility criteria are provided.

1.13.1.1 Applicability Conditions for the Inclusion of New Instances to the Project Area

The project is being developed as a Grouped Project under the assumption that additional Project Areas will be added in the future under Grouped Project guidelines. For example, communities have been engaged surrounding the Ntchisi Forest Reserve in anticipation of the future inclusion of Project Areas located within the Ntchisi Forest Reserve. These additional parcels can be added to the Project Area at subsequent verification events. At each verification event when parcels are added, the flowing criteria must be met:

1) The project must meet the conditions set in section 9.3.6 of the Methodology VM0006, and procedures followed must be documented in the Monitoring Report.

2) Measurements must follow Standard Operating Procedures (SOPs) developed under the Kulera Project. Using SOPs guarantee consistency across different field crews an in different Project Areas. This guarantees reliable, replicable data over the life of the project. SOPs may be updated to improve quality of the sampling, given that the same carbon pools are measured, unless it is more conservative to exclude a specific carbon pool. An SOP or a sampling method may change to adapt to new conditions given that the end result (data collected) is consistent with the original SOP. If SOPs are updated, all instances in the project must use the same measurement procedure in the updated SOP at the next required sampling event.

3) The technologies and techniques applied in the PD must be followed through the life of the project and on new instances unless more accurate data becomes available. It is expected that data quality, accuracy, and availability will improve over time. As these new datasets become available and meet the minimal requirements of the methodology they may be followed to measure any new instances.

4) The new instances are subject to the baseline scenario as described in the PD. At a baseline update, all new instances must also follow the new baseline. The baseline update must be applicable to all instances and must be documented in the Monitoring Report.

5) The new instances added to the project must be within the Country of Malawi, and have ecological, social and cultural similarities, as well as similar drivers and agents of deforestation to the initial project instances. New project parcels are not required to be within the jurisdiction of DNPW. Within the

Monitoring Report there must be documentation of how the new instances have similar characteristics to the original instances.

1.13.2 Leakage Management

A number of the activities implemented under the Project that address the deforestation and degradation agents in the Project Zone, also reduce deforestation from shifting to other forest areas. There is no commercial timber harvesting in the baseline and thus, there is no market leakage.

1.13.3 Commercially Sensitive Information

The following information is commercially sensitive and is not publically available. This information will be made available to the validator.

- REDD+ Agreements
- Project Budget
- Financial Projections
- Standard Operating Procedures and Forms
- LULC Classifications and computer code used to produce them
- Government Approvals
- Agreements between implementing, technical partners and communities
- Models used to create carbon calculations and supporting computer code

1.13.4 Further Information

No further information provided.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

The revised version of VM0006, “Carbon Accounting for Mosaic and Landscape-scale REDD+ Projects” is the methodology used for this project.

The Project Area meets all applicability criteria of the methodology. These criteria, the relevance of optional criteria and project conditions, are described in the sub-sections below.

2.2 Applicability of Methodology

2.2.1 Criteria Related to Eligible Land Conditions

The Project Area is multiple parcels totalling 169,136 hectares. The Project Area was forest at the time of project start and for 10 years before the project began.

The results of the social assessments demonstrated that the following unplanned drivers of deforestation and degradation were present in the baseline period and would continue in the absence of the Project. Each of these drivers is allowable under the methodology. For further detail on drivers see Section 3.1.2.

Table 7. Unplanned Drivers Present in Project Areas

Driver / Agents
Collection of wood for charcoal
Conversion of forest to small-scale agriculture
Wood and poles for construction and domestic use (including tobacco curing)
Wood for cooking and heating locally

To establish the baseline, at least three historical remote sensing images are used with at least one remote sensing image from 0-3 years before the project start date, at least one image from 4-9 years before the project start date, at least one image from 10-15 years before the Project start date, and no images older than 15 years used for the historical reference period. For specific image dates see Section 3.1.1.4.The classification accuracy of LULC and forest cover maps was greater than 70%, see Section 3.1.1.7.3 for details. The Project Area does not include any organic soils or peatland.

2.2.2 Criteria Related to Eligible Project Activities

In the Project Area and Project Zone, one or more of the following activities are being implemented, all of which are allowable under the applicability criteria of the methodology:

- Strengthening of land-tenure status and forest governance. Supporting the development and implementation of sustainable forest and land use management plans;
- Demarcating forest, tenure and ownership boundaries; promoting forest protection through patrolling of forests and forest boundaries; promoting social inclusion and stewardship in local communities; facilitating social fencing through capacity building; and creating mechanisms to alert law enforcement authorities of forest trespassing;
- Fire prevention and suppression activities including the construction of fire breaks, reduction of fuel loads, prescribed burning, education to minimize intentionally started fires, support for fire brigades, water cisterns, fire lookouts, and communication systems;
- Reducing fuelwood consumption and/or increasing energy efficiency by introducing fuel-efficient woodstoves;
- Creation of alternative sources of fuelwood through agroforestry, farm woodlots management and introduction/intensification of other renewable and non-fossil fuel based energy sources (such as solar);
- Sustainable intensification of agriculture on existing agricultural land; and,
- Development of local enterprises based on sustainably harvested non-timber forest products (NTFPs) such as honey, coffee, macadamia, and livestock. The livestock activities supported by the Project are to support programs that facilitate entry into low cost & fast returns (rapid growth & reproduction) livestock with poultry, guinea fowl, rabbits, pigs and goats. These types of livestock are not part of the scope of livestock that must be accounted for under the methodology see:

  8.3.4.3 Estimate GHG Emissions from Increased Livestock Stocking Rates,

  8.3.4.3.1 Scope and Applicability

  See Section 4.2.6 of VM0006 for a list of applicability conditions when increasing livestock stocking rates. Livestock stocking rates must be increased through either or both of the following measures:

- Increasing the stocking density of livestock on existing grazing land
- Moving of cattle to a zero-grazing system, defined as a system of feeding cattle or other livestock in which forage is brought to animals that are permanently housed instead of being allowed to graze.

The optional Project Activities that are being implemented for the project include:

- Cookstove and Fuel Efficiency (CFE) activities meet the methodology requirements in the following manner:
- The Project Activities that reduce fuelwood consumption and increasing energy efficiency by introducing fuel efficient cookstoves are being implemented by Project Proponents with the households and/or local institutions that are the actual users of forest resources in the Project Area and located in the Project Zone.
- Based on the HH surveys that were completed for the project (see Socioeconomic Baseline inventory for the Kulera Biodiversity Project), it was estimated that only 6.3% of the HH used fuel efficient stoves.

Table 8. Use of fuel saving technologies by households (percent of households)

Use fuel saving technologies	Name of protected area: Mkuwazi forest reserve		Ntchisi forest reserve		Nkhota-Kota wildlife reserve		Nyika national park		Vwaza wildlife reserve		Total	
	Impact (n=81)	Control (n=16)	Impact (n=110)	Control (n=125)	Impact (n=457)	Control (n=333)	Impact (n=453)	Control (n=384)	Impact (n=153)	Control (n=140)	Impact (n=1254)	Control (n=998)
Yes	7.4	0.0	5.5	11.2	5.7	4.2	10.4	7.6	12.4	4.3	8.3	6.3
No	92.6	100.0	94.5	88.8	94.3	95.8	89.6	92.4	87.6	95.7	91.7	93.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

- One of the deforestation drivers that has been document for the Project Area is wood for cooking and heating. This source of wood is non-renewable wood from the Project Area, and is consistent with the overall Malawi “Default values fraction of non-renewable biomass” as reported by the CDM as 81% for Malawi.
- The project is implementing sustainable intensification of agriculture on existing agricultural lands with the communities in the Project Zone, which is directly reduces deforestation in the Project Area as well as reduces the risk of leakage. The Project Zone overlaps with the leakage belt. These activities are promoted on lands that are existing agricultural lands that are primarily annual (maize) or bi-annual (cassava).
- The Project plans to implement Assisted Natural Regeneration (ANR) activities on degraded lands in the Project Area to increase the forest quality and biomass. These will be implemented on degraded land on which no prior ANR activities have taken place, and on areas that were forest at the start of the project. These ANR activities include: thinning, removal of invasive species, enrichment planting, and coppicing.

2.3 Project Boundary

The spatial boundaries and areas of the (1) Project Area, (2) Project Zone, (2) Leakage Area and (3) Reference Region are described in Section 1.9. The shapefiles are available to the verifier.

2.3.1 Carbon Pools

Carbon pools relevant to the project are summarized in Table 9 below.

Table 9. Carbon pools included in the project

Carbon Pool	Included	Justification/ Explanation of Choice
Aboveground tree biomass	Yes	Major carbon pool affected by Project Activities
Aboveground non-tree biomass	Yes	Expected to increase from Project Activities

Carbon Pool	Included	Justification/ Explanation of Choice
Belowground biomass	Yes	Major carbon pool affected by Project Activities
Dead wood	Yes	Major carbon pool affected by Project Activities
Litter	No	Excluded as per VCS AFOLU requirements.
Soil organic carbon	Yes	The conversion of forest for small-scale agriculture is one driver of deforestation, but more importantly forest land that is cleared due to other drivers becomes agricultural land due to population pressure for food. These agricultural systems are primarily conversion to annual crops of maize.
Wood products	No	Not a major carbon pool affected by Project Activities, as there are no significant drivers that are used for long term wood uses. The deforestation drivers for the Project have shown that the wood extracted from the forest is mostly used for short term uses. The only use that could be considered longer term would be poles for tobacco barns. However, these are small poles that are used for very poorly constructed barns that require replacement in about 2 years.

2.3.2 GHG Sources

In accordance with the methodology, all potential emissions of CO_2, N_2O and CH_4 from sources not related to changes in carbon pools were accounted for in the Project (Table 9). Insignificant emission sources were excluded according to the rules of the VCS and after using the “Tool for testing significance of GHG emissions” in EB31 Appendix 16 (http://cdm.unfccc.int/EB/031/eb31_repan16.pdf) (See Section 3.4.2).

Table 10. GHG emissions from sources not related to changes in carbon pools (“emission sources”) included in the GHG assessment

Source		Gas	Included	Justification/Explanation
Baseline	Baseline Deforestation and Forest Degradation	CO_2	Yes	Emissions are related to changes in carbon pools. Degradation is not included while CFE activities are implemented. Therefore, CO_2 emissions from CFE activities are included.
		CH_4	Yes	Non-CO_2 emissions from CFE activities included.
		N_2O	Yes	Non-CO_2 emissions from CFE activities are included.
Project	Cookstove and Fuel Efficiency (CFE) activities	CO_2	Yes	CO_2 emissions from CFE activities are included.
		CH_4	Yes	CH_4 emissions of burning woody biomass in CFE activities are included.
		N_2O	Yes	N_2O emissions of burning woody biomass in CFE activities are included.
	Removal of woody biomass for fire prevention and suppression activities, and for ANR activities	CO_2	No	Emissions related to changes in carbon pools are taken into account. No removal of woody biomass is expected.
		CH_4	No	CH_4 emissions from removal of woody biomass are significant when prescribed burning is used to clear the land. Some prescribed burning on Nyika Plateau has been used to create a fuelbreak before project start, and is accounted for in the baseline. In this project prescribed burning is not promoted nor is planned for biomass removal above the baseline rate. Even though, CH_4 emissions are included, these are essentially 0.
		N_2O	No	N_2O emissions from burning woody biomass are assumed negligible and conservatively excluded. In this

Source		Gas	Included	Justification/Explanation
				project controlled burning is not used therefore N_2O emissions are 0.
Leakage	Increased area of rice production systems	CO_2	No	Not relevant, rice very limited and rice the same under baseline and project scenario
		CH_4	No	Rice cultivated is very limited in the Project Area and there is no increase or plan for expanding the fields. Therefore, this emission is not applicable to the project.
		N_2O	No	Not relevant, rice very limited and rice the same under baseline and project scenario
	Increased livestock stocking rates	CO_2	No	Not applicable
		CH_4	No	CH_4 emissions related to increases in livestock stocking rates can be significant, however project actions only support small scale livestock, such as poultry, rabbits, pigs and goats; There is no significant increase in CH_4 with these animals, as the quantification of CH_4 emissions applies to cattle.
		N_2O	No	N_2O emissions related to increases in livestock stocking rates are significant. However, this is not applicable to this project.

2.4 Baseline Scenario

2.4.1 Identification of the Baseline Scenario

Under this methodology, the most plausible baseline scenario according to the CDM modalities and procedures, paragraph 22, is option (a): *Existing or historical, as applicable, changes in carbon stocks in the carbon pools within the project boundary.*

There is no evidence to suggest that the deforestation observed in the fifteen years before the Project start will not continue in the future, given the number of deforestation drivers, their proximity to the Project Area, and the mosaic type of deforestation characteristic of the Reference Region. Therefore, the most likely scenario is that the historical deforestation rate, deforestation trend, and dynamics of deforestation and forest degradation will continue in the future, leading to a deforested landscape in the Project Area. No new economically attractive course of action is expected in the future, therefore option (a) was selected, and not option (b).

2.4.2 Underlying Causes of Deforestation and Forest Degradation

A detailed socio-economic baseline survey was conducted in the three Project Zones over thirteen weeks from December 2010 to March 2011 (Phiri, Mapemba, and Sopo 2011). Most households living around these PAs are characterized by dire poverty, undertaking practices that are destructive to the same resources upon which their livelihoods depend. The main occupation in the Project Zone is small-scale farming (92% of households) followed by small-scale or barter trade (48-50% of respondents). Average annual incomes in the Project Zone ranged from MK66,798.00 (approximately US$248) to MK68,548.80 (approximately US$254). Food insecurity is chronic in many areas in Malawi. In the Project Areas, one-fifth to one-quarter of the survey respondents reported running short of food the previous year. The worst months for food shortages and insecurity occur between December and March, at the start of the planting season before food crops are mature enough to harvest. Almost without exception, fuelwood is the main source of energy for cooking and heating households.

In addition, most communities have limited access to support services such as health care, education, agricultural extension, inputs, markets and tele-communications because they reside in remote areas with poor roads and infrastructure. Survey respondents reported lacking access to training in basic skills needed to run small enterprises.

2.4.3 Overview of Deforestation Drivers and Agents

Social appraisals carried out by TLC identified eight distinct deforestation drivers, and five deforestation agents operating in the Project Area (TLC, 2011) shown in Table 11.

Table 11. Summary of deforestation drivers and corresponding agents active in the Project Areas

Driver / Agents	Hunters/Poachers	Local Communities	Local Farmers	Migrants	Tobacco farmers
Collection of wood for charcoal		●		●	
Conversion of forest to small-scale agriculture			●	●	
Forest fires by hunters (mice hunters)	●				
Forest fires for other anthropogenic reasons	●				
Wood and poles for construction and domestic use (including tobacco curing)		●	●		●
Wood for cooking and heating locally		●		●	

2.4.4 Description of Deforestation Drivers

2.4.4.1 Collecting Wood for Charcoal Making

Charcoal is a leading driver for deforestation in Malawi, and is a prominent source of income for many poor rural communities. The charcoal trade is worth an estimated MK 5.78 billion (USD 41.3 million) per year – almost the same value as the nation's tea industry[6]. Trees are seen as a relatively free resource, and other input costs of charcoal are minimal. Charcoal is not used in rural areas as it is viewed as a "cash product." The main advantages for using charcoal are that it contains smaller amounts of volatile compounds for indoor cooking, lights easily, burns uniformly and at a higher temperature, is light to transport, and is culturally accepted. Charcoal is made in rural areas and is transported to urban centres. Charcoal can be seen for sale along almost every major road in Malawi (Figure 17).

Due to the extreme exploitation of forests for charcoal production, the Malawian government made the production of charcoal illegal, unless it is produced from a sustainable source. Sustainable charcoal makers must be issued a permit (proving that wood used comes from a sustainable source), which is also carried/ used by the seller. Though this is a national law, the government has issued no permits so far, and funds or capacity for enforcement are insufficient. Despite controls, large-scale charcoal businesses buy significant quantities of charcoal in rural areas and transport it to cities by truck. Any standing tree has the potential to be made into charcoal; it is created in rural areas, transported, sold, further transported and re-sold, etc. Pressures on standing trees are greater in areas near cities, and along roads leading to them.

[6] www.ifmslp.org/reports/ifmslp_charcoal_study_options_25_aug.doc

Figure 17. Wood charcoal is sold along roadsides and is used for domestic heating and cooking in urban areas

2.4.4.2 Conversion of Forest to Small-scale Agriculture.

Approximately 85% of Malawi's population lives in rural areas, making Malawi one of the most densely populated countries in Africa (per km²). Currently, there is a land rush where individuals or families move from populated areas to more rural areas, seeking permission from village chiefs for access to land. If granted, these new farmers are not treated as migrant workers, but are incorporated into the village community.

Migrants are most commonly entering areas near Nkhotakota, where as many as twelve new families per year join a village. In rural communities, shifting slash-and-burn agriculture is practiced. New migrant farmers are surprised by this activity, as land is limited and must be used long-term. Often, new settlers from more urban areas have better land practices, and are more knowledgeable about forest protection. Most landholdings in Malawi are 0.4 ha per family. A village commonly consists of 30 families (ranging from 10-60) and covers an area totalling about 5 ha.

Figure 18. Forest conversion as a result of slash-and-burn agriculture, practiced outside of Nkhotakota Wildlife Reserve

2.4.4.3 Fires to Hunt Mice

Mice are a common food in the Lilongwe Plains and in surrounding areas. Mice vendors, usually boys, sell boiled mice along the roadside (Figure 19). Though mice prove to be a good source of protein, hunting practices are very destructive. In the dry season, mice hunters set fire to fields to find mouse holes. In the burnt field, mouse holes can easily be spotted and the mice dug up. Fire is also regarded as a good way to burn off weeds, and the smaller fires started by mice hunters are left to burn. Fire is a culturally accepted land management tool, though most Malawians are unaware of the long term damage caused by constant fire.

Many areas of south central Malawi are distinctly blackened with evidence of fires in the dry season. Fire is so prevalent in some regions in Malawi that Total LandCare created a radio jingle, i.e., a short catchy song about not starting fire and about how damaging it can be.

Miombo ecosystems, which contain many fire adapted species, are quite resilient to fires. However, given that the fire return interval is so frequent due to arson, these ecosystems may be unable to recover. The miombo woodland that once existed over the majority of Malawi has been greatly reduced.

Figure 19. Fires are set to hunt mice, which are caught, cooked and sold along roadsides

2.4.4.4 Fires for Other Anthropogenic Reasons

Hunting for bush meat is illegal in Malawi. However, hunting for wild game often occurs - some on an as-needed basis - while other hunting is full time. Socially, hunting game is not widely accepted. Hunters are commonly equipped with a rifle and poorly made bullets, and must concentrate animals for increased accuracy. Fires used to concentrate animals must cover a very large area.

Hunters also burn areas to attract game to new shoots that regenerate after a burn. This is very prevalent in Nyika (Figure 20), where the presence of fire is common on the highlands, and the population of ungulates is fairly large. Arson fires affect both grasslands and burn into the surrounding forestlands. Deforestation caused by fire associated with hunting is present in all Protected Areas within the Kulera Project. Hunting is almost exclusively done within Protected Areas, as this is where most wildlife can be found.

Figure 20. Fires are often used to concentrate animals inside of protected areas, such as this roan antelope in Nyika National Park

2.4.4.5 Wood and Poles for Construction for Domestic Use (Including Tobacco Curing)

Wood and poles are used to construct houses, tobacco drying sheds, fencing, concession stands along roads, and pens for domestic animals (Figure 21). In general, Malawians prefer brick houses to houses built of wood and cob/clay, which are used by poorer communities and those building temporary houses. These temporary buildings are not of high quality, but the wood used lasts for many years. Wood used for building materials must be taller, straighter, and thicker than fuelwood to support the weight of construction. Wood used for construction and brick making accounts for 10% of wood consumption in Malawi.

Figure 21. Wood and poles used for domestic construction.

Figure 22. Wood used for tobacco curing shed

Included in this driver is also the wood used for tobacco curing. Tobacco is the major cash crop of Malawi, and is grown in many regions throughout the country. Much of the analysis on the returns of tobacco to the Malawian economy neglects inclusion of input costs of tobacco production. If all of the input costs of tobacco, such as labor, transport and taxes were taken into account, farmers might grow alternative crops. Tobacco is harvested from January to March/April by removing two to three leaves per plant every ten days, totalling twelve leaves per plant. The average size of a single-owner tobacco field is 0.2 ha or less. For proper storage and sale, tobacco leaves must be dried. Many tobacco farmers dry their leaves together in long drying sheds. This is done by hanging the leaves in an open shed, in which they are heated and smoked by wood-burning fires. Because tobacco is such a valued crop in Malawi, large quantities of fuelwood are needed for drying tobacco. A total of 10% of all wood consumed in Malawi is used for tobacco leaf curing and tobacco shed construction.

Figure 23. Tobacco leaf bundles that have been cured with fuelwood

2.4.4.6 Wood for Cooking and Heating Locally

Rural Malawians rely on fuelwood, often gathered by girls and women, for domestic cooking and heating. Due to the need for fuel, land surrounding villages that once supported *miombo* woodland are heavily harvested, and most trees are reduced to multiple shoots below two meters. Cooking is done on inefficient stoves that are usually made up of three rocks or clay mounds to balance a cooking pot. Fuelwood must be gathered, on average, every three days, sometimes at great distances.

Fuel-efficient stoves greatly reduce the need for fuel and improve lives of girls and women. Fuel-efficient woodstoves are desired by many Malawians, but they often lack the knowledge, incentives to overcome tradition and/or capital to cover the costs of stove creation. Wood used by rural communities for cooking and heating accounts for 57% of wood consumption in Malawi.

Figure 24. In rural areas, women are responsible for collecting fuelwood.

2.4.4.7 Hunters/Poachers

Game hunters and poachers inside park will light fires on all sides to concentrate the animals and make it easier to hunt. However, these activities do not happen in the populated areas are the parks, and they often happen deep (10km) within Protected Areas. However, in cases where the fire burns out of control and into a 5 km zone of the Project Area, this can cause forest loss in the Project Area.

Though this practice is generally undertaken by a small segment of the population, those hunters who do engage in this practice pass on the technique through generations and thus, the practice continues. This is particularly problematic in Nyika and Vwaza, in spite of local educational efforts on the part of DNPW and NVA that attempt to demonstrate the negative environmental and social impacts of this practice.

Hunters also set fires in order to reduce groundcover to expose mouse burrows, which are commonly sold boiled at roadside stands and provide a valuable source of animal protein.

2.4.4.8 Local Communities

Charcoal provides an important income source for many community members in rural areas. The overall cost of inputs associated with charcoal production is low, particularly as trees are viewed as a “free” resource. However, the consumption of charcoal by rural communities is minimal since it is viewed as a cash product. Rural communities instead produce this easy-to-transport product for use by urban dwellers.

Because of the ease of production and broad cultural acceptance of charcoal as a fuel source in Malawi, the government has been forced to restrict charcoal production, making this activity illegal unless produced from a sustainable source. Community members must receive a permit to engage in sustainable charcoal production, but institutional and enforcement capacity are limited such that no permits have yet been issued, making any standing tree a potential target for charcoal production.

2.4.4.9 Local Farmers

Local Farmers are one of the leading agents of deforestation and degradation. Local farmers clear areas of the forest for small-scale agriculture. Small scale agriculture is done by individual farmers on their land, as well as on village or community land with approval from the Chief. Likewise, settlements are established on forestland. If anyone outside of the community tried to encroach on community land without approval from the chief, they would be kicked off by community members.

Fuelwood collection is a large enterprise throughout many areas of Malawi. In addition to its domestic heating and cooking applications, fuelwood is in high demand as an input to the tobacco curing process. Tobacco is a major cash crop in Malawi, though it is clear that local farmers do not have ‘perfect information' regarding the real costs associated with tobacco production; if they were, they may choose to engage in a less costly livelihood activity. In order to cure the tobacco, large quantities of fuelwood are required to thoroughly dry the leaves. This activity undertaken by local farmers accounts for ten percent of all wood consumed.

Local farmers also rely on trees as a source of construction material, though the quality and maturity of wood produced often needs to be much greater than other applications of forest products in order to withstand the demands of construction and long-term exposure to the elements. Though houses constructed from brick, rather than wood, are most desired in Malawi, poorer farming communities, as well as farmers in transition, rely on wood to construct both permanent homes and temporary shelters.

2.4.4.10 Migrants

Migration in Malawi is somewhat atypical in comparison to other countries, and community members tend to belong to a village that is overseen by both a group village headman and a chief. Marriage and population growth are two contributors to migration in Malawi, as well as the movement of Chewa migrants from Central to Northern Malawi to work on tobacco farms. These migrants are often reliant on wood to construct both permanent and temporary housing, and the livelihood activities in which they become engaged in their new location, such as tobacco farming, may require fuelwood as an input.

2.4.4.11 Tobacco Farmers

Most of the tobacco Project Zone is dried in barns or sheds and requires large quantities of fuelwood to cure. Tobacco is a major cash crop in Malawi, though it is clear that local farmers do not have 'perfect information' regarding the real costs associated with tobacco production; if they were, they may choose to engage in a less costly livelihood activity. In order to cure the tobacco, large quantities of fuelwood are required to thoroughly dry the leaves. This activity undertaken by tobacco farmer's accounts for ten percent of all wood consumed within Malawi.

2.5 Additionality

The most current version of the VCS Additionality Tool ("VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities, Version 3") was used to determine additionality. This tool describes a step-wise approach to the demonstration of additionality without the revenue from the sale GHG credits. Results are presented in the subsections below, followed by a justification that the community and biodiversity benefits would not have occurred without the project.

2.5.1 Step 1: Identification of Alternative Land Use Scenarios to the AFOLU Project Activity without the Revenue from the Sale of GHG Credits

2.5.1.1 Sub-step 1a: Identify credible alternative land use scenarios

Given that the project is of the mosaic typology, no single alternative land use scenario can be identified. Instead, each of the drivers of deforestation interacts to create the alternative land use scenarios.

Realistic and credible land-use scenarios that would have occurred in the Project Area in absence of the Project activities are described below. These include only those scenarios that are feasible taking into account relevant national and sectoral policies and conditions, e.g. historical land uses, practices and economic trends.

The identified land use scenarios are:

- **Scenario 1 - Continuation of the pre-project land uses**, including unsustainable wood harvest to supply energy for cooking and heating, conversion of forest to small-scale agriculture and settlements, and setting fires for hunting and for territorial revenge. This is the most likely scenario given the observed pattern and rate of deforestation assessed for the Reference Region and proximity of deforestation drivers and agents to the Project Area. The specific drivers of both geographically constrained and non-spatial drivers of deforestation and their relative contribution to the alternative land use scenario are detailed in Section 2.4.4.

- **Scenario 2 - Increased protection in the Protected Areas through expanded enforcement and/or activities implemented to reduce Project Zone community wood needs.** Increased protection would be due to expanded enforcement by the DNPW who is responsible for enforcement and could be done in the absence of the Project being registered as a VCS AFOLU project. Activities aimed at reducing local community wood consumption needs could continue in the absence of the Project being registered as a VCS AFOLU project.

The first scenario represents the continuation of the pre-project land use, while scenario 2 represents the project activities taking place on the land within the Project Area and Project Zone without being registered as a VCS AFOLU project, i.e. in the absence of carbon financing from REDD. The Project Areas are protected areas and thus no other land uses (such as forest concessions) are considered credible. The implementation of scenario 2 would require significantly increased financial resources being made available to DNPW to increase their resources for protection. The budgetary history and the expectations for the future budget, provide no indication that without the VCS AFOLU project and carbon finance that these significant financial resources would be made available to the DNPW. The implementation of wood use reduction activities under Scenario 2 would require a significant change in numerous wood use practices by the communities in the Project Zone, including financial inputs and technological developments to increase agricultural productivity, technology to reduce need for wood for cooking and tobacco curing, and providing communities with the education and motivation to reduce fire and work productively with the DNPW in protection of the Project Area. These activities without the revenue from the sale of GHG credits, would not be possible.

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

- Under Scenario 1, none of the drivers of deforestation in the project violate any Malawian laws, statues, regulatory frameworks or policies, with the exception of illegal logging which is widespread and systematically uncontrolled in the Project Area, due to lack of enforcement capacity.
- Scenario 2 entails (a) expanded enforcement of Protected Area boundaries against illegal logging which currently occurs as a result of these laws not being systematically enforced and/or (b) reduction of wood harvesting needs through legal activities.

2.5.1.3 Sub-step 1c: Selection of baseline scenario

- The most plausible baseline scenario as described in Section 2.4 and in Sub-step 1a above, is the continuation of the mosaic pattern of deforestation in the Project Area.

2.5.2 Step 2: Investment Analysis

Barrier analysis was performed instead of investment analysis as allowed by the Additionality Tool.

2.5.3 Step 3: Barrier Analysis

This step assesses whether the proposed project activity faces barriers that:

a) Prevent the implementation of this type of proposed project activity without the revenue from the sale of GHG credits; and

b) Do not prevent the implementation of at least one of the alternative land use scenarios.

2.5.3.1 Sub-step 3a: Identify barriers that would prevent the implementation of the type of proposed project activity.

The Project faces a number of barriers that would prevent its implementation without the sale of carbon credits. Foremost, the Project faces a financial barrier to implementation due to the fact that the lack of financial resources makes enforcement of the protected areas difficult. Funding for carbon development and initial implementation of Project activities that reduce deforestation was secured from USAID in 2009. This grant was set to expire in September 2012, but received a one year no-cost extension so will now expire in December 2013. There is no additional funding to increase the resources for DNPW for Scenario 2 or for DNPW or NGOs to support the communities to implement Scenario 3 from Sub-step 1a above

While donor funding and direct investments by Project proponents have thus far been essential to enabling Project development, Project activities are unable to continue without revenues from the sale of carbon credits. Funds will enable the implementation of Project activities for the lifetime of the Project (Section 3.2.1) and will address technological barriers by providing alternative incomes, training, capacity development, workshops, and technical assistance to support reduction of deforestation in the Project Areas and the on-going monitoring of carbon stocks.

Additional barriers to Project implementation are institutional (lack of resources for governance) or related to poverty, local tradition and prevailing practice. These include a lack of enforcement of forest or land-use legislation in the Project Area, the long history of shifting agriculture, demographic pressure on the land, and the presence of illegal resource use practices that are difficult to regulate and control.

Without the revenues generated by the Project, these barriers would prevent the implementation of the proposed Project. Evidence of these barriers was confirmed through data gathered from social appraisals and household surveys carried out in the Project area and broader geographic area.

2.5.3.2 Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternative land-use scenarios.

None of the barriers identified in Sub-step 2a prevent the implementation of alternative land uses identified in Sub-step 1a. Rather the lack of funding for Project activities promotes continued mosaic deforestation and degradation in the Project Area. In addition, barriers have been identified that would perpetuate deforestation and degradation in the Project areas. For example, current customs (e.g. creating bush fires for hunting) would continue without the livelihood improvements offered by the Project. Illegal activities, such as collecting wood and establishing agriculture plots in Project Areas, would also likely continue given the lack of capacity for preventing these activities.

2.5.4 Step 4: Common Practice Analysis

The Project will undertake eight different activities to reduce deforestation and forest degradation in the Project area while also mitigating leakage. These activities are listed in detail in Section 3.2.2.

While the general concept of some of the planned Project activities is known and understood among Project stakeholders, the Project activities have not been implemented systematically or at scale in the Project Area and Project Zone. The financial resources that are generated by the Project will provide direct support for the implementation of, for example, the establishment of community-managed woodlots, systematic forest protection and delivery of fuel-efficient cookstoves. These activities require funding to support program development, purchase of required equipment, training, employment, etc. and as such, they cannot be implemented in the Project Area or Project Zone prior to the Project.

Other Project activities that establish the institutional arrangement for sustainable resource management, such as the establishment of Community Associations, the development of co-management agreements between communities and Department of National Parks and Wildlife, and the capacity to governance these entities and deliver on the agreements cannot be achieved without Project funding. This is corroborated by data gathered from social appraisals and household surveys carried out in the Project area and broader geographic area.

2.6 Methodology Deviations

Deviation 1: Two out of the three Project Area regions (Nyika and Vwaza) classified satellite images used for the first historic time period do not meet the 10-15 years prior to project start requirement. At the time of data acquisition there was a gap in available Landsat 5 imagery for the 10 to 15 year historic period. The closest available data was Landsat 5 from 1991 and Landsat 7, launched in 1999 with <20% cloud cover scenes beginning in 2000. The Landsat 7 year 2000 scenes were selected as the closest temporal match to the 1999 minimum requirement and used as the first historic period for the Nyika and Vwaza regions. The 1991 scenes were also classified and used as part of the temporal filtering process in which prior cover conditions enhance confidence of the 2000 land cover classifications. Due to the close proximity to the required minimum time period and to the weighting influence of forest classified prior to the maximum allowed time period, the resulting baseline starting date results in a marginal and conservative deviation from the minimum 10 year requirement.

Requirement: The methodology requires, that the minimum size of the Reference Region excluding the Project Area and Leakage Area must be 250,000 ha or the size of the Project Area at the start of the crediting period, whichever is greater.

Deviation 2: The Project's Exclusive Reference Region (without the Project Area or Leakage Area) is 232,782 hectares while the methodology requires a minimum size of 250,000 ha.. This Reference Region includes the 5 km boundary inside (the same definition used for the Project Area) all of the Protected Areas within the footprint of our satellite imagery (3 Landsat scenes) which includes all the Game Reserves, Forest Reserves and National Parks in the proximity of our Project Area. In addition, the forest use area surrounding three reference Protected Areas (Dwambazi Forest Reserve, Mndilandsadzu Forest Reserve, and Ntchisi Forest Reserve) was included in the Exclusive Refrence Region. This forest use area was calculated using the same methods and parameters used to produce the Leakage Area. Using these Protected Areas which are close to our Project Area ensures that the Reference Region conservatively reflects the historic deforestation rate and that it is similar from the point of view of deforestation drivers.

Deviation 3. Due to the Project Area location within Protected Areas while the communities and Leakage Areas are located directly outside of the Protected Areas, a methodological deviation was required to properly account for both the historic wood use of the project communities and to account for the influence of the protected status of the Project Areas.

The historic deforestation rate in the Inclusive Reference Region (defined as the Project Area, Leakage belt and other non-project protected areas near or connected to the Project Area) represents the wood needs of the communities living in the Project Zone. The Leakage Area is contained within the Project Zone and was calibrated with PRAs, HH surveys and demarcated with cost distance analysis. Deforestation in this Reference Region is from the wood use of communities who have access to the Project Areas. Thus, this deforestation rate is an accurate representation of the agents who have access to the Project Area and should be used in modeling future baseline deforestation in the Project Area and Leakage Area.

However, when using a deforestation rate in a Reference Region that includes both Protected Areas and non-Protected Areas, even when there is lack of enforcement in the Protected Areas, establishing the baseline should consider whether the agents have any relative difference in patterns of deforestation in Protected Areas and non-Protected Areas when modeling future deforestation. This can be done through the use of a model that captures the impact that spatial variables have on the location of deforestation. These spatial variables include the direct variables of the Protected Area locations and distance from Protected Area boundaries. Other variables used indirectly account for the historic influence of the Protected Area, such as towns and roads which are not inside most Protected Areas, but would capture the impact these variables have on location of deforestation.

The manner in which VM0006 specifies the calculation of the transition rates in the baseline, is that it does this first for only the Project Area using the statistical model for deforestation in Section 8.1.5.4 and then models transition rates within the Leakage Area. The process applies the deforestation rate to each area and then separately models baseline with the deforestation based on the deforestation rate and

Project Area size using the statistical model, which does capture the possible impact the agents. However, if the approach used the deforestation rate in the Reference Region and used the statistical model to create transitions across the combined Project Area and Leakage Area, then it would capture the impact the spatial variables have on deforestation in each area. Then the transitions for each area, are calculated. This approach ensures that if the dynamics of deforestation differ between the Leakage Area and the Project Area and is reflected in the baseline.

3 QUANTIFICATON OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

The Project methodology, Carbon Accounting for Grouped Mosaic and Landscape-Scale REDD Projects (revision of VM0006), sets out the procedures for quantification of baseline emissions and removals. The steps described here in Section 3.1.1 follow those in the Methodology Section 8.1 in the same ordered subsections.

3.1.1 Select Spatial and Temporal Boundaries

This step includes the demarcation of the Project Area and Reference Region. Three sub-steps specify the spatial and temporal boundaries of discrete Project Area parcels and present conditions for selecting the Reference Region.

3.1.1.1 Describe Spatial Boundaries of the Project Area

The project is located on the borders of three Protected Areas in Malawi (see project location maps in Section 1.9). Individual project parcels are listed in Table 12. Shapefiles KML format files of the discrete Project Area parcels are available to the validator.

Table 12. Size and geodetic coordinates of individual project parcels (WGS-84)

Protected Area Name	Project Area Hectares	Longitude	Latitude
Nyika	76,804	33.8475	-10.5676
Vwaza	22,140	33.4475	-11.0106
Nkhotakota	70,192	34.0348	-12.8740
Total	169,136		

3.1.1.2 Select a Valid Reference Region

A regional or national baseline is not available for the Project Area, therefore a stratified regional baseline (Sathaye and Andrasko, 2007) was developed using a Reference Region. The Exclusive Reference Region is 155,007 ha in size. The creation of the Exclusive Reference Region is described in Section 1.9.5.

The following conditions are required to ensure the Reference Area is representative and unbiased:

- **Minimum size**: As required by the methodology, the Reference Region excluding the Project Area and Leakage Area is 250,000 ha. The Exclusive Reference region is 232,782 ha, the size does not meet this requirement due to a lack of suitable area. See Deviation 2 in 2.6 Methodology Deviations.
- **Boundaries unbiased**: The boundaries of the Reference Region coincide with buffered Protected Area boundaries.
- **Accessible by agents of deforestation**: The Reference Region excludes the interior core of Protected Areas (areas with distances greater than 5 km inside the Protected Area boundaries)

where agents of deforestation have restricted access. Remaining areas are accessible by agents of deforestation.

- **Planned deforestation areas excluded**: No known planned deforestation areas contained within the Reference Region.
- **Natural deforestation areas excluded**: No historic causes of spatially constrained natural deforestation observed within the Reference Region.
- **Includes >15% Forest cover:** The Exclusive Reference Region contains 60.8% forest cover at the beginning of the crediting period in 2009 based on remote sensing analysis of land cover.
- **Comparable to Project Area across key variables:** The selected Reference Region and Project Area are similar across seven variables set out in Table 3 of the Methodology. Comparison procedures and results are presented in Table 13 followed by maps that illustrate comparisons of spatial variables.

Table 13. Comparison variables to demonstrate similarity between Project Area and Reference Region

Category	Variable	Comparison Procedure	Results
Drivers of deforestation	Drivers of deforestation	All drivers that were identified in the Project Area must also be present in the Reference Region.	The Reference Region is in close proximity of the Project Areas and contains the same communities and drivers of deforestation.
Landscape configuration	Distribution of native forest types	The proportion of each forest type within the Reference Region at the beginning of the historical reference period must be within 10% of forest type proportions within the Project Area.	Forest composition of the Project Area is 2.86% Evergreen Forest and 97.14% Miombo Forest. The forest composition of the Exclusive Reference Region is 1.53% Evergreen Forest and 98.47% Miombo Forest. Proportion of forest is highly similar and well within the 10% threshold.
	Elevation	The proportion of area contained within 500-m elevation classes of the Reference Region must be within 10% of these elevation class proportions in the Project Area	Using 500-m strata, the Reference Region and Project Area fall within 10% for each strata (see Table 14)
	Slope	The proportion of area contained within 5% slope classes of the Reference Region must be within 10% of these slope class proportions in the Project Area	Using 5% slope strata, the Reference Region and Project Area fall within 10% for each strata (see Table 14).
Socio-economic and cultural conditions	Land-tenure status	Demonstrate that the land-tenure system prevalent in the Reference Region is similar to the land-tenure system in the Project Area.	The Project Area is located within Protected Areas. However it is the premise of the Project that the protected status of the Project Area is not enforced and defaults to a similar land-tenure system as the surrounding communities.

Category	Variable	Comparison Procedure	Results
	Policies and Regulations	The Reference Region should be governed by an administrative unit that has comparable enforced policies, regulations, and capacities as the administrative unit of the Project Area.	The Exclusive Reference Region falls within the same administrative units as the Project Area.
	Degree of urbanization	Proportion of urbanized vs. agriculture-based population within the Reference Region shall be within 10% of this proportion in the Project Area.	Neither the Exclusive Reference Region nor the Project Areas contain any urbanized population.

Table 14. Comparison of required criteria between the Reference Region and Project Area.

Slope Class	Project	Reference
5%	21%	27%
10%	18%	19%
15%	13%	15%
20%	9%	11%
25%	7%	8%
30%	6%	6%
35%	5%	4%
40%	4%	3%
>45%	8%	4%

Elevation Class (m)	Project	Reference
200-700	19%	14%
700-1,200	49%	52%
1,200-1,700	24%	19%
1,700-2,200	7%	9%
2,200-2,700	2%	6%

Forest Type	Project	Reference
Miombo	97.14%	98.47%
Evergreen	2.86%	1.53%

3.1.1.3 Specify Temporal Boundaries of the Project

The temporal boundaries of the project are as follows:

- Historical reference period: 1998 - 2009
- Project crediting period: 30 years (2009 – 2039)
- Verification frequency: annual to periodic
- Frequency of baseline update: 10 years

3.1.1.4 Describe Data Sources

In total, 17 historical Landsat images were used, together with high-resolution images for validation and ground-truthing purposes. Of the 17 scenes, 9 were used for producing the historic baseline. The remaining scenes provided supplemental information for use in assessing temporal transitions. Historical Landsat images were downloaded from USGS using the GLOVIS data acquisition system. These were supplemented with Rapid Eye high resolution imagery as well as imagery from Google Earth (e.g. for validation of the medium-resolution Landsat images).

Table 15. Overview and characteristics of remote sensing data.

Source	Date Range	No. Scenes	Type	Sensors	Processing Level
USGS Landsat Glovis	1991 – 2013	9	Satellite	TM, ETM+, (Landsat 5, Landsat 7,)	• Basic radiometric corrections • L1T

Source	Date Range	No. Scenes	Type	Sensors	Processing Level
Rapid Eye	2009 - 2010	38	Satellite	MS	• Ortho-rectified to UTM 36S using ground control points

Table 16. Bands and resolution of Landsat 4 TM, Landsat 7 ETM+.

Band nr.	Resolution (m)	Band name	Wavelength (µm)			
			TM		ETM+	
			from	to	from	to
1	30	Blue	0.45	0.52	0.45	0.52
2	30	Green	0.52	0.6	0.53	0.61
3	30	Red	0.63	0.69	0.63	0.69
4	30	Near infrared	0.76	0.9	0.78	0.9
5	30	Short-wave infrared	1.55	1.75	1.55	1.75
6	120	Thermal infrared	10.4	12.5	10.4	12.5
7	30	Mid infrared	2.08	2.35	2.09	2.35
8	15	Panchromatic	Not available		0.52	0.9

Table 17. Bands and resolution of RapidEye data.

Band nr.	Resolution (m)	Band name	Wavelength(µm)	
			from	to
1	2.5	Panchromatic	0.48	0.71
2	10	Green	0.5	0.59
3	10	Red	0.61	0.68
4	10	Near infrared	0.78	0.89

Table 18. Landsat scenes used for producing LULC classifications. Supporting scenes for evaluation of temporal cover transitions and not classified to the same degree of precision as the baseline scenes.

Date (YYYYMMDD)	Path/Row	Project Region	Satellite	Purpose
19950215	168/69	Nkhotakota	Landsat 5	Supporting
19980514	168/69	Nkhotakota	Landsat 7	Baseline
20010903	168/69	Nkhotakota	Landsat 7	Supporting
20030418	168/69	Nkhotakota	Landsat 7	Baseline
20090715	168/69	Nkhotakota	Landsat 5	Baseline
19910822	169/67	Nyika	Landsat 5	Supporting
20000907	169/67	Nyika	Landsat 7	Baseline
20020508	169/67	Nyika	Landsat 7	Baseline
20090604	169/67	Nyika	Landsat 5	Baseline
19910822	169/68	Vwaza	Landsat 5	Supporting
20000721	169/68	Vwaza	Landsat 7	Baseline
20020508	169/68	Vwaza	Landsat 7	Supporting
20030511	169/68	Vwaza	Landsat 7	Baseline
20090604	169/68	Vwaza	Landsat 5	Baseline

3.1.1.5 Define LULC Classes and Forest Strata

The methodology Section 8.1.2.2 requires that the LULC classification and stratification is applicable for both the Reference Region and the Project Area. Both regions were classified simultaneously using the same criteria. The LULC Classes are described in Section 1.10.3.

3.1.1.6 Define Land Transitions between LULC classes and Forest Strata

Deforestation (DF) is the transition of a forest class to a non-forest class (degraded land, cropland, or settlement). Upon **reforestation (RF)**, land can go from a non-forest class to the forest class with the lowest carbon density class. Reforestation is not allowed as a Project Activity under this methodology, and is not part of the Project. However, under the baseline, reforestation can occur and should be accounted for.

Table 19. LULC change category matrix showing all possible LULC transitions. MIO = Miombo Forest, EVG = Evergreen Forest, BAR = Conglomerate of Non-forest classes

From Class	To Class	Transition
MIO	BAR	Deforestation
EVG	BAR	Deforestation
BAR	MIO	Reforestation
BAR	EVG	Reforestation

3.1.1.7 Analyze Historical LULC Class and Forest Strata Transitions

A comprehensive and detailed log of all individual steps employed during remote sensing analysis and classification is available to the verifier. Briefly, the following steps were executed to obtain the historical time series of classified images. These steps follow those in the Methodology Section 8.1.1.7.

3.1.1.7.1 Pre-processing of Remote Sensing Data

1. First, all Landsat images were geographically corrected to a Level 1 Terrain correction (L1T). The Level 1T (L1T) data product provides systematic radiometric and geometric accuracy by incorporating ground control points, while also employing a Digital Elevation Model (DEM) for topographic accuracy. The ground control points used for Level 1 Terrain correction come from the GLS2005 data set. DEM data used for terrain correction include SRTM, NED, CDAD, DTED, and GTOPO 30. The Landsat images from 11/17/1990 and 11/04/2000 were obtained from NASA's decadal dataset and were already at an L1T correction. All other images were transformed into an L1T level correction by an external remote sensing firm using the same algorithm that was used in NASA's decadal dataset. The resulting RMS error was < 1 TM pixel. A Nearest Neighbor re-sampling was used during the geographical registration. Due to the great influence of seasonality on the spectral signature of different LULC classes, a separate classification for each image was conducted. Therefore, no radio-metric correction was applied on the images, and the digital numbers were used as input to the supervised classification algorithms.
2. After geographic registration, all bands were composited into one image and cropped to an Area of Interest.

3.1.1.7.2 LULC Classification and Forest Stratification

1. All Landsat images were uploaded to a web-based reference point collection system. Six analysts interpreted reference points based on the time series of Landsat images and high-resolution imagery from Google Maps and RapidEye. Only points for which there was a 70% consensus among analysts were retained. The reference points were randomly divided into 66% training points and 33% verification points. Additional reference points were collected as needed to address problems in the resulting classification.
2. All images in the historical reference period were classified using a machine learning algorithm.

3. After classification, the spatial coherence was improved by applying some morphological operations (clumping and sieving, and majority filtering).

Additional post processing corrections addressing phenology using additional training and machine learning statistical probability thresholds were applied.

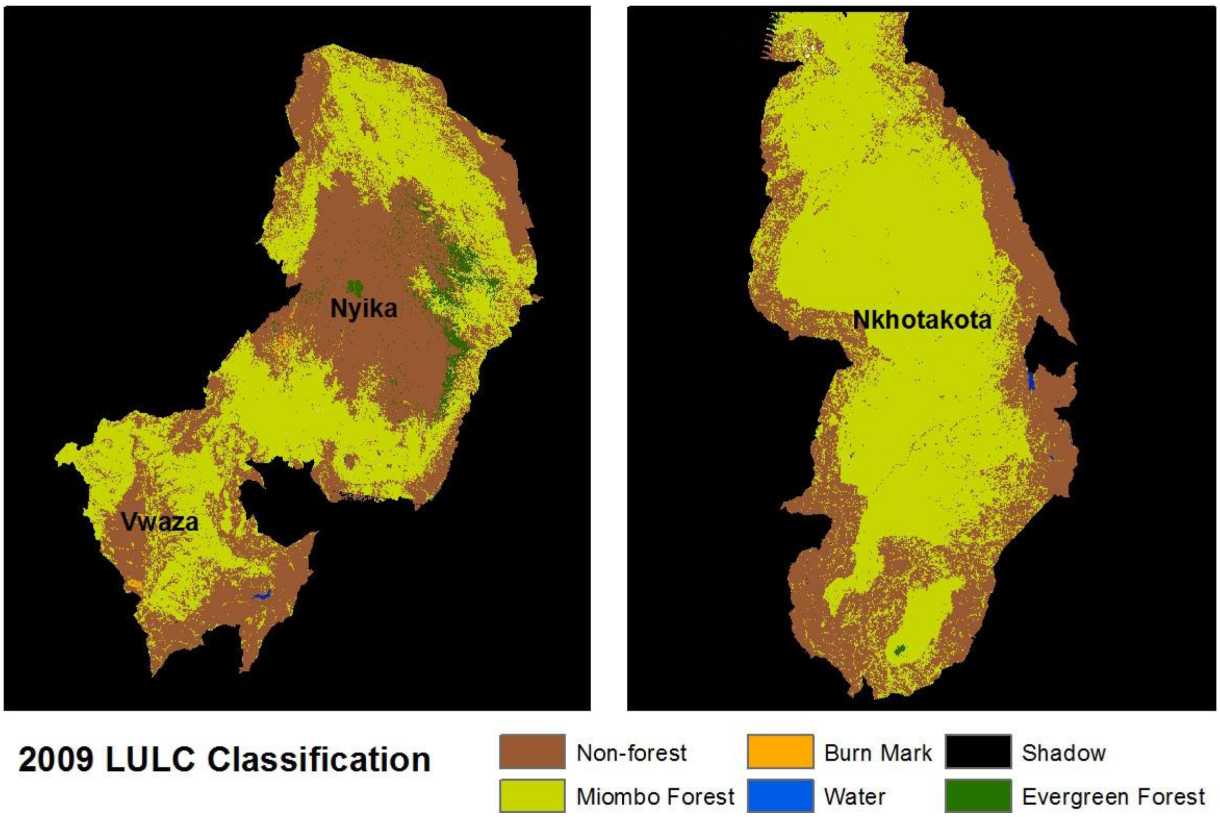


Figure 25. 2009 LULC Classification.

3.1.1.7.3 Map Accuracy Assessment and Discounting Factor Determination

Accuracy metrics were calculated based on the randomly selected verification points for each of the images in the historical Reference Region. The 30% of the reference points that were assigned as verification points were used to assess the accuracy of land use classification. Confusion matrices for each of the images were calculated. The classified images are classified with sufficiently high accuracy, as demonstrated by the confusion matrices (available to the verifier) and accuracy measures (Table 20). An attempt was made to stratify Miombo Forest into two strata, MI1 and MI2. However, due to spectral confusion, accuracy was insufficient so both classes were combined into a single Miombo Forest class.

Three time periods were used resulting in an overall discount factor of 90%.

Table 20. Nyika Region. Accuracy for the verification of the classification of the images in the historical reference period. Confusion matrices with omission and commission percentages provided below.

Image (YYYYMMDD)	Overall Accuracy	Accuracy Discount
20000907	93%	0
20020508	91%	0
20090604	90%	0

20000907	BAR	MI1	MI2	BRN	BCK	WTR	SHB	SHD	CLD	GRS	EVG
BAR	380	12	0	7	0	0	3	0	0	1	0
MI1	6	803	1	1	0	0	0	0	0	0	3
MI2	0	25	41	0	0	0	0	0	0	0	0
BRN	6	2	0	158	0	0	0	0	0	0	0
BCK	0	0	0	0	60	0	0	0	0	0	0
WTR	0	0	0	0	0	63	0	0	0	0	0
SHB	14	33	0	1	0	0	103	0	0	0	0
SHD	0	1	0	0	0	0	0	48	0	0	0
CLD	4	0	0	0	0	0	0	0	38	0	0
GRS	3	14	1	0	0	0	0	0	0	52	0
EVG	1	5	0	1	0	0	0	0	0	0	105
Omission	94%	99%	62%	95%	100%	100%	68%	98%	90%	74%	94%
Comission	92%	90%	95%	94%	100%	100%	97%	100%	100%	98%	97%

20020508	BAR	MI1	MI2	BRN	BCK	WTR	SHB	SHD	CLD	GRS	EVG
BAR	544	7	0	0	0	1	4	0	2	6	0
MI1	6	463	0	0	0	0	11	1	0	5	7
MI2	1	23	46	0	0	0	0	0	0	0	0
BRN	1	0	0	6	0	0	1	0	0	0	0
BCK	0	0	0	0	65	0	0	0	0	0	0
WTR	0	0	0	0	0	137	1	0	1	0	0
SHB	29	16	0	0	0	0	255	0	0	0	0
SHD	0	0	0	1	0	10	0	45	0	0	1
CLD	5	0	0	1	0	0	0	1	81	0	0
GRS	8	23	0	0	0	0	0	0	0	179	4
EVG	0	12	0	0	0	0	0	1	0	0	120
Omission	96%	94%	66%	75%	100%	99%	85%	79%	92%	84%	90%
Comission	92%	85%	100%	75%	100%	93%	94%	94%	96%	94%	91%

20090604	BAR	MI1	MI2	BRN	BCK	WTR	SHB	SHD	CLD	GRS	EVG
BAR	704	7	0	1	0	0	8	0	0	2	0
MI1	7	893	0	1	0	0	6	0	0	3	4
MI2	0	28	9	0	0	0	0	0	0	0	0
BRN	1	0	0	26	0	0	0	0	0	0	0
BCK	7	0	0	0	90	0	1	0	0	0	0
WTR	0	0	0	1	0	97	0	0	0	0	0
SHB	35	78	0	0	0	0	243	0	0	0	1
SHD	0	0	0	0	0	0	0	19	0	0	0
CLD	0	0	0	0	0	0	0	0	0	0	0
GRS	16	8	0	0	0	0	0	0	0	86	2
EVG	5	21	0	0	0	0	0	2	0	5	134
Omission	98%	98%	24%	96%	92%	99%	68%	100%	NA	77%	80%
Comission	91%	86%	100%	90%	100%	100%	94%	90%	NA	90%	95%

Table 21. Vwaza Region. Accuracy for the verification of the classification of the images in the historical reference period. Confusion matrices with omission and commission percentages provided below.

Image (YYYYMMDD)	Overall Accuracy	Accuracy Discount
20000721	92%	0
20030511	91%	0
20090604	90%	0

20000721	BAR	MI1	MI2	BRN	BCK	WTR	SHB	SHD	CLD	GRS	EVG
BAR	510	16	0	3	0	0	0	0	0	0	0
MI1	10	848	14	1	0	0	5	0	0	3	0
MI2	0	14	124	0	0	0	0	0	0	0	0
BRN	13	5	0	152	0	0	0	0	0	0	0
BCK	0	0	0	0	31	0	0	0	0	0	0
WTR	0	0	0	2	0	6	0	0	0	0	0
SHB	4	62	0	0	0	0	113	0	0	0	0
SHD	0	0	0	0	0	0	0	12	0	0	0
CLD	2	0	0	0	0	0	0	0	8	0	0
GRS	0	5	0	0	0	0	1	0	0	50	0
EVG	0	0	1	0	0	0	0	0	0	0	0
Omission	96%	96%	90%	89%	100%	75%	63%	100%	80%	89%	NA
Comission	95%	89%	89%	96%	100%	100%	95%	100%	100%	94%	NA

20030511	BAR	MI1	MI2	BRN	BCK	WTR	SHB	SHD	CLD	GRS	EVG
BAR	395	1	0	0	0	0	4	0	0	1	0
MI1	4	664	3	0	0	0	3	0	0	0	0
MI2	0	27	43	0	0	0	0	0	0	0	0
BRN	0	0	0	4	0	0	0	0	0	0	0
BCK	0	0	0	0	79	0	0	0	0	0	0
WTR	0	0	0	0	0	37	0	1	0	0	0
SHB	5	83	0	0	0	0	110	0	0	2	0
SHD	0	1	0	0	0	1	1	38	0	0	0
CLD	3	0	0	0	0	0	0	0	70	0	0
GRS	1	8	0	0	0	0	1	0	0	88	0
EVG	0	0	0	0	0	0	0	0	0	0	0
Omission	99%	99%	61%	100%	100%	97%	55%	93%	96%	90%	NA
Comission	97%	85%	93%	100%	100%	97%	92%	97%	100%	97%	NA

20090604	BAR	MI1	MI2	BRN	BCK	WTR	SHB	SHD	CLD	GRS	EVG
BAR	682	0	1	0	0	1	13	0	0	1	0
MI1	2	682	13	0	0	0	14	1	0	1	0
MI2	0	16	107	0	0	0	0	0	0	0	0
BRN	1	0	0	51	0	0	0	0	0	0	0
BCK	0	0	0	0	40	0	0	0	0	0	0
WTR	4	1	0	0	0	21	0	0	0	0	0
SHB	30	79	0	1	0	0	182	0	0	2	0
SHD	0	0	0	0	0	0	0	4	0	0	0
CLD	0	0	0	0	0	0	0	0	0	0	0
GRS	2	9	0	0	0	0	0	0	0	50	0
EVG	0	0	0	0	0	0	0	0	0	0	0
Omission	98%	96%	87%	98%	100%	81%	62%	100%	NA	82%	NA
Comission	95%	87%	88%	98%	100%	95%	87%	80%	NA	93%	NA

Table 22. Nkhotakota Region. Accuracy for the verification of the classification of the images in the historical reference period. Confusion matrices with omission and commission percentages provided below.

Image (YYYYMMDD)	Overall Accuracy	Accuracy Discount
19980514	91%	0
20030418	90%	0
20090715	93%	0

19980514	BAR	MI1	MI2	BRN	BCK	WTR	SHB	SHD	CLD	GRS	EVG
BAR	316	1	0	0	1	0	25	0	3	1	0
MI1	10	415	0	0	6	0	9	0	0	10	0
MI2	0	0	0	0	0	0	0	0	0	0	0
BRN	2	1	0	6	0	1	0	0	0	0	0
BCK	0	0	0	0	139	0	1	0	0	0	0
WTR	0	2	0	2	0	160	0	0	0	0	0
SHB	29	14	0	0	0	0	102	0	0	1	0
SHD	0	1	0	1	0	0	0	26	0	0	0
CLD	1	1	0	0	0	0	0	0	35	0	0
GRS	2	9	0	0	0	0	1	0	0	129	0
EVG	0	2	0	0	0	0	0	1	0	0	8
Omission	91%	92%	NA	60%	99%	98%	70%	93%	95%	91%	73%
Comission	88%	93%	NA	67%	95%	99%	74%	96%	92%	91%	100%

20030418	BAR	MI1	MI2	BRN	BCK	WTR	SHB	SHD	CLD	GRS	EVG
BAR	190	0	0	0	0	1	6	0	0	0	0
MI1	2	1000	11	0	0	0	10	0	0	2	0
MI2	0	117	62	0	0	0	0	0	0	0	1
BRN	0	0	0	0	0	0	0	0	0	0	0
BCK	0	0	0	0	168	0	0	0	0	0	0
WTR	0	0	0	0	0	278	1	0	0	0	0
SHB	17	32	0	0	0	0	116	0	0	1	0
SHD	0	0	0	0	0	0	0	53	0	0	0
CLD	1	0	0	0	0	0	0	0	39	0	0
GRS	0	9	0	0	0	0	1	0	0	87	0
EVG	0	0	0	0	0	0	0	0	0	0	3
Omission	96%	98%	34%	NA	100%	100%	70%	100%	98%	90%	100%
Comission	90%	86%	85%	NA	100%	100%	87%	100%	100%	97%	75%

20090715	BAR	MI1	MI2	BRN	BCK	WTR	SHB	SHD	CLD	GRS	EVG
BAR	269	5	0	0	0	0	11	0	1	0	0
MI1	0	1075	19	0	0	0	12	0	0	0	0
MI2	0	60	186	0	0	2	0	0	0	0	2
BRN	0	0	0	12	0	0	0	0	0	0	0
BCK	0	0	0	0	122	0	0	0	0	0	0
WTR	0	1	0	2	2	280	0	8	0	0	0
SHB	18	14	0	0	0	0	216	0	0	0	0
SHD	1	0	0	0	0	11	0	66	0	0	0
CLD	0	0	0	0	0	2	0	0	66	0	0
GRS	0	0	0	0	0	0	0	0	0	125	0
EVG	0	0	0	0	0	0	0	0	0	0	9
Omission	94%	97%	74%	100%	100%	96%	87%	85%	97%	100%	100%
Comission	93%	93%	91%	86%	98%	95%	90%	89%	99%	100%	82%

3.1.1.8 Summarize all Historical Land Transitions

Table 23. LULC transitions for the Nyika Inclusive Reference Region.

Periods (YYYYMMDD)		Transitions		
From	To	From	To	Hectares
20000907	20020508	BAR	BAR	93,681
20000907	20020508	BAR	MI1	2,413
20000907	20020508	BAR	WTR	7
20000907	20020508	BAR	SHD	5
20000907	20020508	BAR	EVG	167
20000907	20020508	MI1	BAR	4,628
20000907	20020508	MI1	MI1	119,644
20000907	20020508	MI1	WTR	34
20000907	20020508	MI1	SHD	93
20000907	20020508	MI1	CLD	2
20000907	20020508	MI1	EVG	54
20000907	20020508	BRN	BRN	1
20000907	20020508	BRN	WTR	3
20000907	20020508	BRN	SHD	5
20000907	20020508	SHD	BAR	2
20000907	20020508	SHD	MI1	4
20000907	20020508	SHD	SHD	30
20000907	20020508	SHD	EVG	10
20000907	20020508	EVG	BAR	435
20000907	20020508	EVG	MI1	129
20000907	20020508	EVG	SHD	64
20000907	20020508	EVG	EVG	7,763

Periods (YYYYMMDD)		Transitions		
From	To	From	To	Hectares
20020508	20090604	BAR	BAR	93,978
20020508	20090604	BAR	MI1	3,971
20020508	20090604	BAR	BRN	254
20020508	20090604	BAR	WTR	23
20020508	20090604	BAR	EVG	247
20020508	20090604	MI1	BAR	4,052
20020508	20090604	MI1	MI1	117,798
20020508	20090604	MI1	BRN	56
20020508	20090604	MI1	WTR	17
20020508	20090604	MI1	SHD	3
20020508	20090604	MI1	EVG	47
20020508	20090604	WTR	BAR	21
20020508	20090604	WTR	MI1	2
20020508	20090604	WTR	WTR	20
20020508	20090604	SHD	BAR	1
20020508	20090604	SHD	MI1	14
20020508	20090604	SHD	SHD	144
20020508	20090604	SHD	EVG	30
20020508	20090604	CLD	MI1	1
20020508	20090604	CLD	EVG	1
20020508	20090604	EVG	BAR	257
20020508	20090604	EVG	MI1	3
20020508	20090604	EVG	SHD	17
20020508	20090604	EVG	EVG	7,718

Table 24. LULC transitions for the Vwaza Inclusive Reference Region.

Periods (YYYYMMDD)		Transitions		
From	To	From	To	Hectares
20000721	20030511	BAR	BAR	55,902
20000721	20030511	BAR	MI1	2,696
20000721	20030511	BAR	WTR	118
20000721	20030511	MI1	BAR	6,951
20000721	20030511	MI1	MI1	56,170
20000721	20030511	MI1	WTR	55
20000721	20030511	MI1	SHD	4
20000721	20030511	BRN	BRN	2
20000721	20030511	BRN	WTR	17
20000721	20030511	WTR	BAR	4
20000721	20030511	WTR	MI1	2

Periods (YYYYMMDD)		Transitions		
From	To	From	To	Hectares
20000721	20030511	WTR	WTR	174
20000721	20030511	SHD	BAR	1
20000721	20030511	SHD	MI1	1
20000721	20030511	SHD	SHD	3
20030511	20090604	BAR	BAR	58,896
20030511	20090604	BAR	MI1	3,434
20030511	20090604	BAR	BRN	517
20030511	20090604	BAR	WTR	11
20030511	20090604	MI1	BAR	7,114
20030511	20090604	MI1	MI1	51,709
20030511	20090604	MI1	BRN	39
20030511	20090604	MI1	SHD	7
20030511	20090604	BRN	BRN	2
20030511	20090604	WTR	BAR	70
20030511	20090604	WTR	BRN	1
20030511	20090604	WTR	WTR	293
20030511	20090604	SHD	BRN	5
20030511	20090604	SHD	SHD	2

Table 25. LULC transitions for the Nkhotakota Inclusive Reference Region.

Periods (YYYYMMDD)		Transitions		
From	To	From	To	Hectares
19980514	20030418	BAR	BAR	88,743
19980514	20030418	BAR	MI1	347
19980514	20030418	BAR	WTR	9
19980514	20030418	BAR	EVG	2
19980514	20030418	MI1	BAR	20,976
19980514	20030418	MI1	MI1	198,987
19980514	20030418	MI1	WTR	195
19980514	20030418	MI1	SHD	7
19980514	20030418	MI1	CLD	6
19980514	20030418	MI1	EVG	214
19980514	20030418	BRN	WTR	6
19980514	20030418	WTR	BAR	19
19980514	20030418	WTR	MI1	9
19980514	20030418	WTR	WTR	538
19980514	20030418	WTR	SHD	1
19980514	20030418	SHD	MI1	1
19980514	20030418	SHD	SHD	2

Periods (YYYYMMDD)		**Transitions**		
From	**To**	**From**	**To**	**Hectares**
19980514	20030418	SHD	CLD	1
19980514	20030418	EVG	BAR	6
19980514	20030418	EVG	MI1	8
19980514	20030418	EVG	EVG	917
20030418	20090715	BAR	BAR	113,326
20030418	20090715	BAR	MI1	880
20030418	20090715	BAR	WTR	15
20030418	20090715	BAR	SHD	4
20030418	20090715	BAR	CLD	15
20030418	20090715	MI1	BAR	24,886
20030418	20090715	MI1	MI1	184,519
20030418	20090715	MI1	WTR	70
20030418	20090715	MI1	SHD	54
20030418	20090715	MI1	CLD	125
20030418	20090715	MI1	EVG	7
20030418	20090715	WTR	BAR	279
20030418	20090715	WTR	MI1	101
20030418	20090715	WTR	WTR	409
20030418	20090715	WTR	CLD	1
20030418	20090715	SHD	WTR	4
20030418	20090715	SHD	SHD	3
20030418	20090715	SHD	CLD	1
20030418	20090715	SHD	EVG	7
20030418	20090715	CLD	BAR	0
20030418	20090715	CLD	WTR	8
20030418	20090715	CLD	SHD	5
20030418	20090715	CLD	CLD	12
20030418	20090715	EVG	BAR	744
20030418	20090715	EVG	MI1	1
20030418	20090715	EVG	WTR	3
20030418	20090715	EVG	SHD	4
20030418	20090715	EVG	EVG	381

3.1.2 Analyze the Agents and Drivers of Deforestation

The analysis of deforestation agents and drivers follows four steps as required by the methodology: 1) identify agents and drivers, 2) assess their relative importance, 3) analyze the mobility of agents, and 4) analyze the geographic variables or "predisposing factors" (De Jong 2007) of deforestation agents and drivers. These steps are described in the following four sub-sections.

Of the 8 drivers of deforestation that were identified for Malawi (see Section 2.4.4), 7 anthropogenic drivers were found to contribute to the total deforestation and forest degradation in the Project Area.

Quantifying the relative importance of each of the drivers to the total deforestation and degradation is important to estimate how much the proposed Project Activities will reduce deforestation. Based on the remote sensing analysis, participatory rural appraisals and household's surveys the relative importance of each of these drivers was determined.

The agents and drivers of deforestation and forest degradation are identified and described in Section 2.4.4, including a qualitative narrative on the broader underlying forces of deforestation and degradation for specific drivers and agents.

3.1.2.1 Assess the Relative Importance of Deforestation Drivers

The relative contribution of each of the deforestation drivers to total historical deforestation and forest degradation is estimated in two steps: (1) estimating the absolute annual carbon loss per driver, and (2) estimating the relative contribution of each driver to the total carbon loss from deforestation and degradation. Methodology Sections 8.2.1 and 8.2.2 set out formulas for estimating annual carbon loss per driver, specific conditions for accounting carbon loss as deforestation vs. degradation, and formulas for quantifying the relative importance of deforestation and degradation drivers.

Table 26. Relative importance of different deforestation drivers to total deforestation rate

Drivers	DF [%]	DG [%]
Wood for cooking and heating locally	3.2%	57.3%
Wood and poles for construction and domestic use (including tobacco curing)	86.4%	0.0%
Forest fires for other anthropogenic reasons	0.5%	0.0%
Conversion of forest to small-scale agriculture	7.0%	0.0%
Forest fires by hunters (mice hunters)	0.5%	0.0%
Collection of wood for charcoal	2.4%	42.7%
Fire to contain animals inside the park	0.0%	0.0%

3.1.2.2 Analyze the Mobility of Each Deforestation and Forest Degradation Driver

Under the methodology used, it is assumed that leakage through activity shifting occurs within a set region close to the Project Area, defined as the Leakage Area. Since the geographical extent of leakage is, in part, dependent on the mobility of each deforestation agent, it must be determined how far each deforestation agent is willing to go to acquire forest resources or clear the land for cropland, grassland or settlement. The Methodology Section 8.1.3.3 sets out the requirements for assessing and documenting the mobility of deforestation agents.

To quantify the potential for leakage, the project analyzed possible responses when certain land uses in the Project Ares are disallowed or discouraged. This analysis included the size and location of the Leakage Area. The Transportation methods and percentages of households utilizing various mode of transportation are shown in Table 27.

Table 27. Different modes of transportation used by communities (%) for extraction of forest products.

Mode of transport	Fuelwood	NTFP	Timber	Crop Fields
Walking	97.60%	96.80%	86.48%	84.00%
Bicycle	1.67%	4.46%	9.78%	12.93%
Motorbike	0.00%	0.00%	0.00%	0.30%
Tractor	0.00%	0.00%	0.00%	3.00%
Ox cart	1.95%	1.00%	0.95%	8.62%
Car/Truck	1.00%	0.00%	10.75%	3.76%

Table 28. Distance of activity shifting by individual drivers of deforestation

Driver	Distance of Activity Shifting	Comments
Wood for cooking and heating locally	0 km	With sensitization and social fencing, along with reductions in demand or fuelwood due to introduction of cookstoves and an increase in supply of fuelwood due to an increase in household woodlots, the communities will have an adequate supply of fuelwood.
Wood and poles for construction and domestic use (including tobacco)	0.5 km	People living near the protected areas look for poles in the protected areas for building tobacco barns. The project will encourage regeneration of native species in woodlots to provide alternative sources of wood for building tobacco barns and other construction. With increased forest protection, including patrolling and social fencing, people will not go far into the protected areas.
Conversion of forest to small-scale agriculture	< 1 km	Most people living in the project communities have no motorized transport. It is therefore unlikely that they will clear land further than a few km away from their settlements for agriculture. Also, the project is undertaking conservation agriculture activities which are expected to increase productivity on existing agricultural lands, close to households. Therefore the activity shifting leakage is expected to be minimal.
Fires to hunt mice	0.5 km	Currently, communities go short distances into the protected areas for hunting mice, and will continue very short distances with increased forest protection and sensitization.
Collecting wood for charcoal	0.5 km	This activity is more prevalent in Nkhotakota area. With opportunities for increased income from enterprise development it is expected that this activity will be reduced although some charcoal production for commercial sale will continue. With increased controls on charcoal prices for charcoal will increase and people will continue to produce charcoal, although without motorized vehicles they will not travel a long distance because they will be caught by law enforcement.
Fires for other anthropogenic reasons	0.5 – 10 km	This driver includes fire set by people for numerous reasons and they are sometime very close to the protected area boundary and other times farther away but still within a 10 km distance from the boundary. These drivers have generally included; fires to concentrate/repel animals and fires to collect honey from the trunks of the trees, to smoke the bees.

3.1.2.2.1 Identify the Quantitative Driving Variables of Deforestation and Forest Degradation

For of the Kulera deforestation drivers, potential spatial explanatory variables were assessed. Spatial drivers analyzed for Kulera represent a subset of the potential spatial drivers listed in the Methodology that are relevant to project conditions and for which spatial data were available. In some cases, more than one variable was used to represent the spatial driver (ie. proximity to main town centers and proximity to town boundaries). In these cases multiple variables for the same driver were tested in models of deforestation (Section 3.1.5.3) since these represent different aspects of a spatial driver or levels of data quality, and therefore could have different effects on deforestation drivers and models. The drivers and variables that are likely influence deforestation in Kulera are presented in Table 29:

Table 29. Spatial Drivers and Variables Influencing Deforestation

Spatial Driver	Variables
Access to forests	elevation, proximity to roads (secondary, main, minor), proximity to rivers, proximity to town centers and town boundaries
Physiographic Conditions	(slope, aspect, elevation)
Proximity to settlements	(proximity to town centers and town boundaries)

The influence of spatial drivers and variables on deforestation drivers is presented in Table 30. Nine spatial driver variables representing tree broad spatial drivers were used in logistic regression models (Section 3.1.5.3) to assess their influence on deforestation. Deforestation model regression coefficients were then used to predict the likelihood of future deforestation in the Project Areas based on these spatial data layers and land cover classification at the project start.

Table 30. Potential Influence of Spatially Driven Variables on Deforestation Drivers

	Spatially Driven Variables					
Deforestation Driver	**Proximity to Roads (3 variables)**	**Proximity to Villages (2 variables)**	**Slope**	**Aspect**	**Elevation**	**Proximity to Rivers**
Wood for cooking and heating locally	●	●	●	●	●	
Wood and poles for construction and domestic use (including tobacco curing)	●	●	●	●	●	
Conversion of forest to small-scale agriculture		●				●
Fires to hunt mice	●	●	●	●	●	

3.1.3 Determine Emission Factors for All Included Transitions

Only the class transitions related to deforestation and consequently reforestation were included and emissions factors for those transitions were determined. These include transition from evergreen (EVG) forest types to non-forest and transition from Miombo (MI1) forest type to non-forest (BAR) classes. Like deforestation, transitions leading to increase in forest cover i.e. non-forests (BAR) to evergreen (EVG) and Miombo (MI1) to evergreen (MI1) were also included. As degradation was not included in emissions accounting, transitions related to degradation or enhancement of carbon stocks i.e., class transitions within forest classes (i.e., MI1 to EVG or EVG to MI1) were excluded. The estimated emissions factors represent the distribution of the emissions over 10 year period for belowground and dead wood pool and 20 year for soil carbon pool.

Above and below-ground biomass and carbon stock for each of the three cover classes included in the transitions namely evergreen (EVG), Miombo (MI1), and non-forest (BAR) were estimated from a network of forest inventory plots. Biomass and carbon stock density for soil carbon pool was estimated from sample plots from the Project Area for forest classes while a conservative default value was used for soil carbon stock density for non-forest classes. The sample plots based measurement followed a SOP that was developed based on the guidance provided in the methodology.

3.1.4 Identify the LULC Classes and Forest Strata for which Carbon Stocks are to be Quantified

Based on direct estimates, modeling and remote sensing studies, it was found that similar forest systems as the ones found in the project and Reference Region, contain carbon stock densities ranging from 32–75 Mg of aboveground biomass per hectare for *miombo* forests, and ranging around 123 – 513 Mg C ha^{-1}

for evergreen forests (Table 31). Due to the varying biomass densities in the miombo forest class, many biomass plots were required to meet the minimum accuracy level. Some miombo biomass plots were established out of the protected areas to verify that the overall biomass values for miombo forest were not bias between project area and leakage area. Deep within protected areas biomass is found to be significantly higher, while the project area is only the very border of the protected areas. Existing forests outside of protected areas are often community forests protected by communities, and although they meet the minim requirements for a forest, they have a low biomass. Through the biomass inventory it was found that forests at the boader of the parks have similar conditions to surrounding forest do to the highly porous border. The project area was defined using extraction distances from the communities themselves, hence further beyond 5km from the border (the extraction distance) a more dense forest biomass can be found. A gradient in increasing biomass can be seen from the protected area border due to extraction.

LULC classes identified in Section 3.1.1.5 are can be expected to transition from one class to another through deforestation and degradation as well as through reforestation. Though degradation a higher stocked forest stand may move to a lower forest stocked stand. To remain conservative this project only quantifies carbon stocks from forest to non-forest, and therefore only looks at transitions between forest to non-forest and forest classes.

From Class	To Class	Quantified in this Project
Miombo (MI1)	Non-Forest (BAR)	Allowable transition
Evergreen (EVG)	Non-Forest (BAR)	Allowable transition
Non-Forest (BAR)	Miombo (MI1)	Allowable transition
Non-Forest (BAR)	Evergreen (EVG)	Allowable transition
Miombo (MI1)	Evergreen (EVG)	Transition not allowable
Evergreen (EVG)	Miombo (MI1)	Transition not allowable

3.1.4.1 Review Existing Data of Biomass Stock Densities and Biomass Net Annual Increments

Table 31. Main parameters related to biomass and biomass growth in natural forest systems of 5 protected areas in Malawi

Forest	Significant Species	AG Biomass [$Mg\ DM\ ha^{-1}$]	AG Biomass Increment [$Mg\ DM\ ha^{-1}\ yr^{-1}$]	R:S [-]	Wood Density [$Mg\ m^{-3}$]	Description
Miombo and Mopane Woodland	*Brachystegia spp, Jubernardia spp, Acacia spp., Bauhinia spp, Combretum spp., Sclerocarya birrea, Strychnos cuccloides, Parinari curatellifolia, Vangueria infausta, Azanza garckean and Schinziophyton rautanenii*	33-45[3] 72[7]	1.4[1] 0.44-1.7[2,3,5]	0.42± 0.01[2], 0.48 ± 1.9[10] 0.27[6]	0.40-0.71[2], 0.52[13], 0.58[6]	Open Woodland
Evergreen forest	*Brachystegia spiciformis*	191[8] 123[9], 433[11], 513[12]	0.44-1.7[2,3,4]	0.42± 0.01[2] 0.24± 0.03[10]	0.63[2], 0.85[3], 0.52[13]	Evergreen tree species, moist forest

[1]Ryan, C.; Williams, M.; Grace, J. Above- and Belowground Carbon Stocks in a Miombo Woodland Landscape of Mozambique. Biotropica 2011, 43, 423–432.

[2] William, G., Tipper, R., Berry, N., Harley, R., Grace, J., Williams, M., Ryan, C., Flaherty, S., Goodman, L. 2009. Conservation of miombo woodland in Mozambique. Plan Vivo Technical Specification. Available online at http://planvivo.org.34spreview.com/wp-content/uploads/MOZavoided-deforestation-technical-specification.pdf.

[3] 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 7(2):230-242.

[4] FAO 1998. Woodfuel review and assessment in Zambia. Available online at: http://www.fao.org/docrep/004/X6802E/X6802E04.htm.

[5] IPCC, Good Pratice Guidance for Land Use, Land-use Change and Forestry. Table 3A.1.9-2 Basic Wood Densities (D) of Stemwood, for Tropical Species *Brachystegia spp*

[6] FAO 2005. Global Forest Resources Assessment Country Report Zimbabwe. FRA 2005 – Country Report 037.
[7] IPCC, Good Practice Guidance for Land Use, Land-use Change and Forestry. Table 3A1.2 Aboveground Biomass Stock in Naturally Regenerated Forests by Broad Category, Africa Dry Forest
[8] IPCC, Good Practice Guidance for Land Use, Land-use Change and Forestry. Table 3A1.2 Aboveground Biomass Stock in Naturally Regenerated Forests by Broad Category, Africa Moist with Short Dry Season Forest, Average
[9] IPCC, Good Practice Guidance for Land Use, Land-use Change and Forestry. Table 3A1.2 Aboveground Biomass Stock in Naturally Regenerated Forests by Broad Category, Africa Montane Moist Forest, Average
[10] IPCC, Good Practice Guidance for Land Use, Land-use Change and Forestry. Table 3.4.3 Default Expansion Factors, (Root-to-Shoot)
[11] IPCC, Good Practice Guidance for Land Use, Land-use Change and Forestry. Table 3A1.2 Aboveground Biomass Stock in Naturally Regenerated Forests by Broad Category, Africa Moist Forest with Short Dry Season, Maximum
[12] IPCC, Good Practice Guidance for Land Use, Land-use Change and Forestry. Table 3A1.2 Aboveground Biomass Stock in Naturally Regenerated Forests by Broad Category, Africa Wet Forest Wet, Maximum

We identified several forest biomass density classes within miombo and evergreen forest classes. Table 6 provides photographs illustrating the main forest strata. Table 31 gives an overview of the carbon density and associated basic statistical measures of each of the LULC classes and forest strata based on the Intergovernmental Panel on Climate Change’s 2006 Guidelines for National GHG Inventories for Agriculture, Forestry and Other Land Use (IPCC 2006). Carbon stock densities were calculated based on procedures described below.

3.1.4.2 Determine the Sampling Design, i.e. Number, Location and Layout of Plots

The Malawi forest inventory system varies greatly between projects and operators. Plot size and layout were selected based on most common practice and conditions suitable to the ecology of the area. Within each 25m x 25m plot, the following carbon pools were measured: every tree with a diameter at breast height (DBH) greater than or equal to 5 cm; lying deadwood; standing deadwood; non-tree biomass. In addition, the following properties are measured within the plot: the number of seedlings and DBH of saplings, canopy cover percentage, and dominant tree height. In addition, some permanent and non-permanent plots collected soil to measure SOC and bulk density. Forest areas were sub-divided into different strata/LULC class. A stratified random sampling approach was used to locate sample plots. At the time of the forest inventory, no consistent and accurate classification into appropriate LULC classes was available. As a consequence, a remote-sensing image-assisted stratified sampling design was employed, mainly based on the observed NDVIs and hand delineated observed classes using Google Earth of the forests in the Reference Region. This classification was less rigorous than the final classification, but sufficient for sample size determination.

The final number of samples collected was 85, with 68 within miombo woodland, five in evergreen forest and 12 in non-forest strata. Evergreen plots were only established within protected areas as evergreen only forest only can be found in the protected areas. Both non-forest plots and miombo plots were established inside and outside protected areas to show no bias between biomass levels inside and outside the park and to capture conditions both inside and outside the park. The sampling design and procedures to measure each of the biomass pools are described in detail in the Standard Operations Procedure for biomass inventories. Detailed biomass data is and the Standard Operating Procedure is available to the VVB.

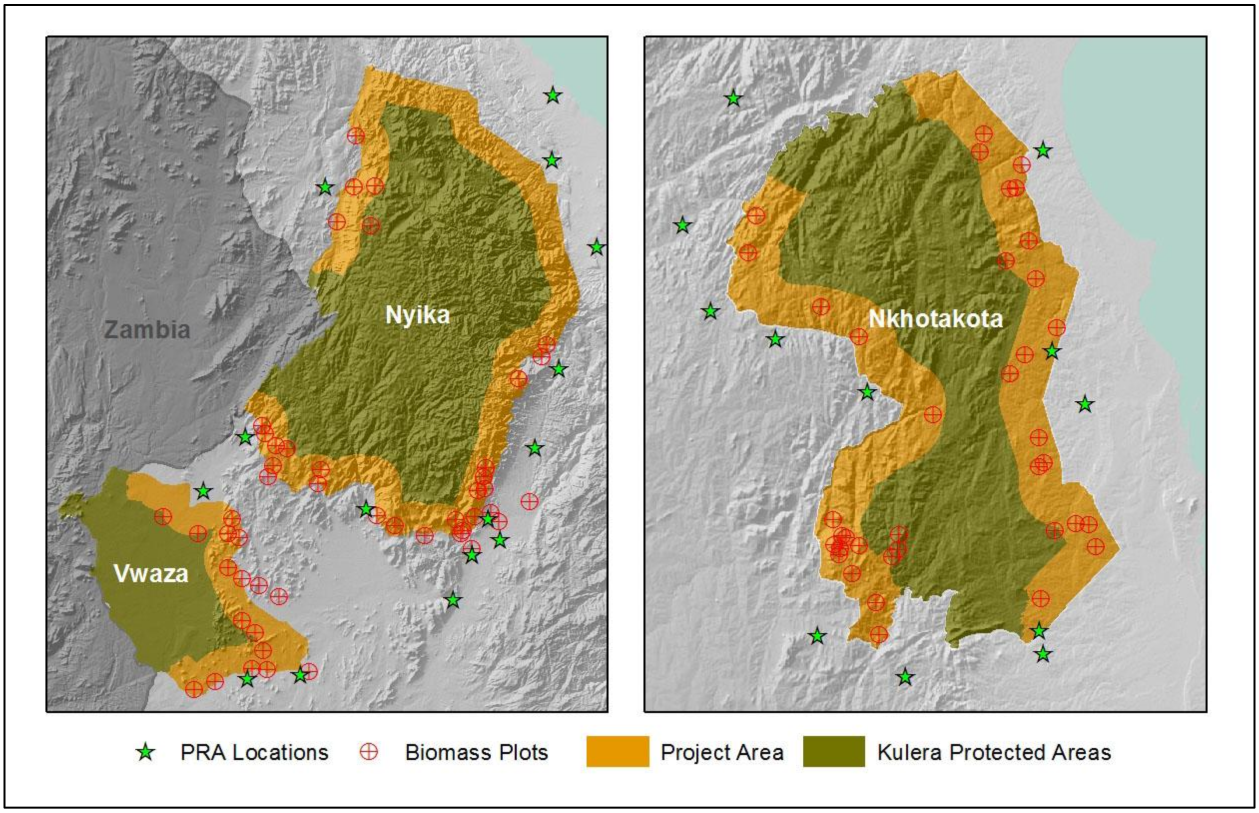


Figure 26. Location of biomass sampling plots and PRA locations

Data for biomass inventories were collected between April and September 2011, both inside and outside the three Protected Areas; Nyika, Vwaza and Nkhotakota. Additional plots were measured just before and into the wet season and were completed in December 2012.

Within each 25m x 25m plot, three subplots were demarcated as prescribed in the SOP and measurements were made on aboveground live tree biomass, standing and downed dead wood biomass, and non-woody living biomass. Parameters recorded included plant name up to genus level, dendrometric measurements such as diameter at breast height (DBH), tree height, canopy percentage cover, number of seedlings and DBH of saplings, as well as location and topographic characteristics (slope, aspect, latitude and longitude). For each species, trees with diameter >5 cm were identified, counted and diameter determined. Trees with <5 cm DBH were not recorded because they were regarded as saplings. Diameter of each tree was measured at breast height (taken at a standard 1.3m from base of tree) using a diameter tape. Plant names were recorded by a botanist technician from Forestry Research Institute of Malawi (FRIM) and verified by staff from National Herbarium & Botanic Gardens of Malawi (NHBGM). Apart from recording bio-physical characteristics, status/condition of plots and pressures due to anthropogenic activities were also noted. The criteria for assessing the condition of plots was based on DBH, ground cover, disturbance, number of seedlings and saplings.

Apart from recording bio-physical characteristics, pressures due to anthropogenic activities were also noted. Figure 27 depicts some of the field activities carried out during data collection.


Figure 27. Recording data within a plot at Nkhotakota Wildlife Reserve (left) and at Nyika National Park (Source: Mawaya et al 2011)

All trips within the Protected Areas necessitated the accompaniment of armed guards for protection from potential danger posed by wild animals.

The sample plots were established in the field such that (1) all of the Project Areas contained measurement plots, and (2) all of the identified forest LULC classes were included in the sampling design. A grid-based randomization of the sampling locations was used, in order to maximize the spatial representativeness of the samples.

3.1.4.3 Measure and Calculate Carbon Stock Density

The definition of a forest according to the IPCC is dependent on three criteria: (1) minimal tree height, (2) minimal forest cover, and (3) minimal area. Of these three, minimal forest cover is most crucial. Since the Malawian Designated National Authority (DNA) has not yet determined a definition of forest the minimal crown cover will be used of 10%. To verify that the land in the Project Areas met the minimal crown cover requirement, crown cover in each plots were also measured and tested for the applicable thresholds of 10%.

Table 32. Basic statistical measures of field measurements in different LULC classes

Biomass Stock Density	Unit	Miombo	Evergreen	Non-forest
Average	Mg DM ha^{-1}	167.15	683.00	52.40
Standard deviation	Mg DM ha^{-1}	46.69	71.24	18.29
Maximum	Mg DM ha^{-1}	334.89	771.36	104.02
Number of observations (n)	-	67.00	5.00	14.00
Standard error of the mean	Mg DM ha^{-1}	5.70	31.86	4.89
Lower Confidence Limit of the mean (LCL)	Mg DM ha^{-1}	155.76	601.11	41.92
Upper Confidence Limit of the mean (UCL)	Mg DM ha^{-1}	178.53	764.90	62.89
HWCI	Mg DM ha^{-1}	11.39	81.89	10.48

3.1.4.4 Calculate Emission Factors

Emission factors only include the carbon pool-related sources due to changes in carbon stock densities between the LULC classes and forest strata. Once the carbon stock densities are calculated, biomass carbon emission factors and their uncertainties for each LULC class or forest stratum transition are calculated according the formulas set out in Methodology Section 8.1.4.5.

Table 33. Emission factors.

From	To	Emission Factor for Above Ground Live pool [tCO_2 ha^{-1}]	Emission Factor for below ground live pool if t <= 10 [tCO_2 ha^{-1}]]	Emission Factor for above ground dead pool if t <= 10 [tCO_2 ha^{-1}]]	Emission Factor for SOM if t <= 20 [tCO_2 ha^{-1}]
MIO	BAR	-117.74	-61.69	-1.27	-41.39
EVG	BAR	-760.92	-178.12	-11.81	-242.60
BAR	MIO	117.74	61.69	1.27	41.39
BAR	EVG	760.92	178.12	11.81	242.60

The appropriate emission factors associated with the land cover transitions i.e. from one LULC class to another LULC class were calculated from the inventoried plots. The uncertainty is expressed as the half-width of the 95% confidence interval around the mean of the difference between the carbon stocks between the LULC classes. The applicable emission factors and uncertainty discounting factor for applicable LULC are shown in Table 34.

Table 34. Emission factors and discounting factors for LULC transitions.

From	To	Combined Error of Transition [-]	Discounting Factor [-]
EVG	MIO	0.21934	0.78
EVG	BAR	0.17801	0.82
MIO	EVG	0.21934	0.78
MIO	BAR	0.14160	1.00

3.1.5 Estimate Transition Rates under the Baseline Scenario

No regional or national baselines approved by the competent national authority are present. Therefore, the historical deforestation rates were analysed using remote sensing data. These historical deforestation rates are extrapolated to quantify future deforestation rates.

The goal of this section is to calculate all land transitions, including deforestation and increased forest cover, and forest degradation and regeneration under the baseline scenario. The procedure below calculates first the total deforestation and forest degradation rates, and also the relative regeneration and increased forest cover change rates per forest stratum and LULC class. Subsequently, the total rates of deforestation and forest degradation are split into LULC class and forest stratum specific rates using a geographical modeling approach, similar to the GEOMOD model[7]. Note that the exact location of future deforestation predicted by the model is not used as such for carbon accounting. Location-specific data on deforestation, forest degradation, and other LULC transitions are aggregated again into a land-use change transition matrix, which is the activity data on which the carbon accounting is based.

[7] This approach is conservative since upon exhaustion of one forest stratum, the deforestation will be displaced to the stratum with the greatest likelihood of being deforested. In case stratum-specific deforestation rates were calculated up front, the displacement of deforestation to other forest strata would have been more challenging.

3.1.5.1 Calculate Total Rates of Deforestation and Forest Degradation in the Project Area

The total future deforestation and degradation rates are interpolated from past trends as described in the Methodology Section 8.1.4.1. For each of the inclusive Reference Regions associated with each of the three Project Areas, the annualized, cloud-corrected transition rates were calculated for each historical period. In Kulera, three satellite image dates were used for transition analysis and two transition period rates accounted. In this case, the methodology requires the use of the average of the two historical time periods to represent future rates. A graph of the historical deforestation rates for each inclusive Reference Region versus time for the three areas is shown in Figure 28. The baseline deforestation annual rate deforestation rate for Nyika, Vwaza and Nkhotakota is in Table 35.

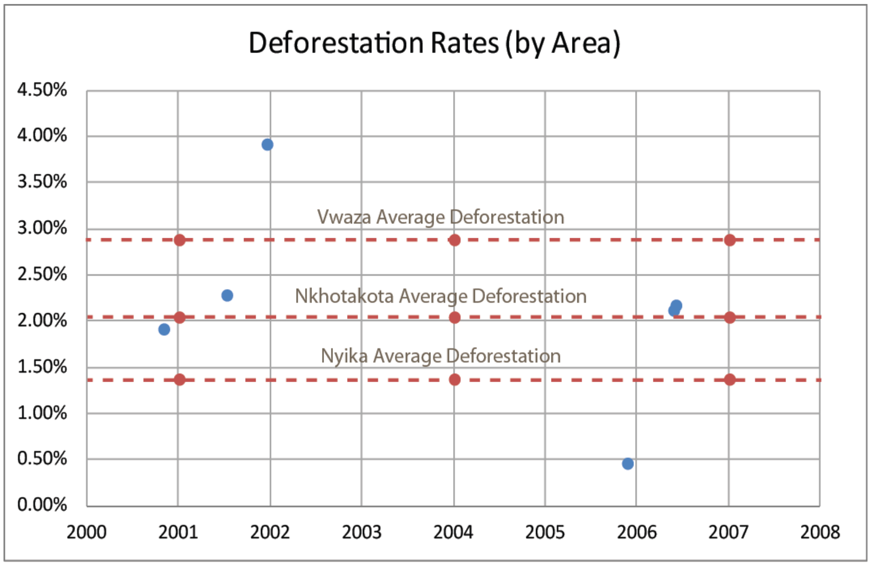


Figure 28. Historical deforestation rate in the Reference Region, and conservative deforestation rate projection.

3.1.5.2 Calculate LULC Class or Forest Stratum-Specific Relative forest cover increase and Regeneration Rates

Although reforestation is not allowed as a project activity in this Methodology, the baseline scenario must include potential increases in forest cover or forest biomass that would have happened without project activities. An overall downward trend in forest cover was observed, even though a significant number of pixels changed from non-forest to forest during the historical reference period. This indicated that some areas increased in forest cover under the baseline. A graph of the historical reforestation rates for each for the inclusive Reference Region for each area versus time is shown in Figure 29.

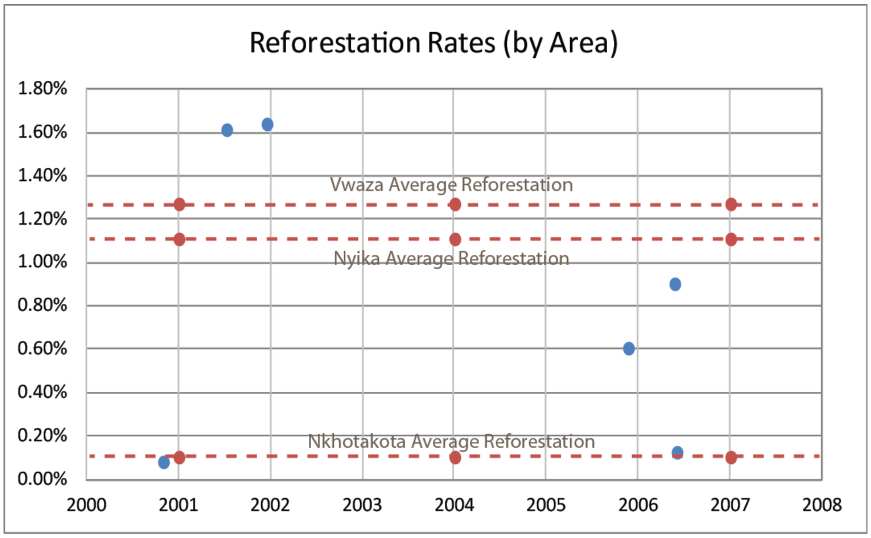


Figure 29. Historical reforestation rate in the Reference Region, and conservative reforestation rate projection.

Regeneration or forest cover increase rates were calculated for each stratum (i.e. miombo and evergreen forests) and for each pair of subsequent images in the historical reference period. The averages are deforestation and reforestation rates are reported in Table 35.

Table 35. Historical deforestation and reforestation rate in the Reference Region, and conservative deforestation rate projection.

	Nyika	Nkhotakota	Vwaza
Deforestation	**Annual DF Rate**	**Annual DF Rate**	**Annual DF Rate**
DF in MI1	1.35%	1.87%	2.89%
DF in EVG	1.77%	6.47%	0.00%
Historical DF	1.38%	1.89%	2.89%
Reforestation	**Annual DF Rate**	**Annual DF Rate**	**Annual DF Rate**
RF to MI1	1.05%	0.12%	1.30%
RF to EVG	0.07%	0.00%	0.00%
Historical RF	1.12%	0.12%	1.30%

3.1.5.3 Calibrate and Validate a Spatial Model to Predict the Suitability for Deforestation and Degradation

A logistic regression model was used to relate the occurrence of deforestation with a number of spatial drivers. Baseline deforestation model parameters are then used to predict the location of future deforestation. The model is calibrated based on data from the historical reference period. The model is re-calibrated during every baseline verification event

Logistic regression models started with all nine spatial variables with non-significant variables subsequently omitted in forward stepwise models. Logistic regression input derives from a data matrix representing the values of predictor variables and the transition class (DF or no DF) for 10,000 random points. A full list of all the spatial driver variables with a graphic representation can be found in Table 38.

Table 36. Overview of the significance of regression models for all areas

Model Nyika	- log ℓ	DF	Δ-2 log ℓ	P> χ2
Full Model	1476.50			
Reduced	1752.74			
Difference	276.24	9	552.48	<.0001

Model Vwaza	- log ℓ	DF	Δ-2 log ℓ	P> χ2
Full Model	3722.41			
Reduced	4516.03			
Difference	793.62	9	1587.23	0

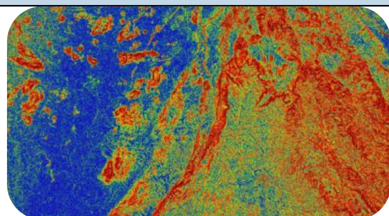
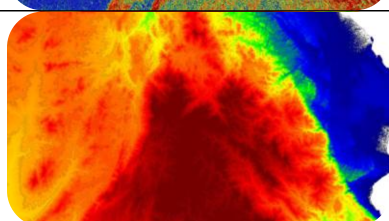
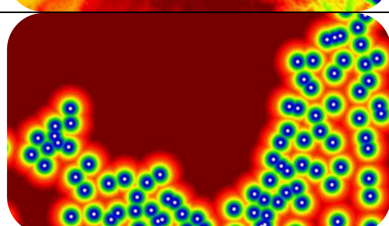
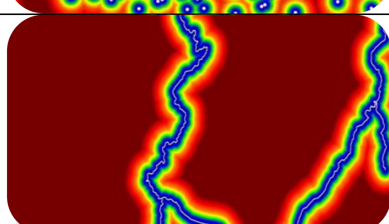
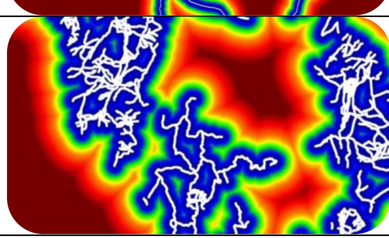
Table 37. List of significant spatial variables and ranking

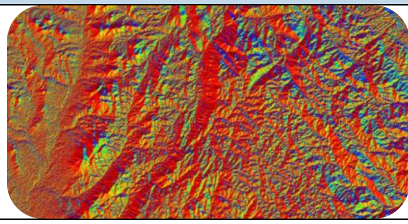
	Deforestation Nyika		
Variable	Δ-2 log ℓ	P> χ2	Rank
Forest Density	282.58	<.0001	1
Aspect	25.17	<.0001	2
Elevation	24.07	<.0001	3
Protected Area	23.50	<.0001	4
Rivers	21.45	<.0001	5
From Class	8.71	0.00	6
Village Centers	5.52	0.02	7
Town Boundaries	4.78	0.03	8
Minor/Dirt Roads	4.32	0.04	9

	Deforestation Nkhotakota		
Variable	Δ-2 log ℓ	P> χ2	Rank
Forest Density	382.35	<.0001	1
Protected Area	220.66	<.0001	2
Village Centers	39.62	<.0001	3
Transition Duration	38.40	<.0001	4
Highways	23.27	<.0001	5
From Class	22.05	<.0001	6
Minor/Dirt Roads	19.27	<.0001	7
Rivers	7.06	0.01	8
Slope	6.66	0.01	9
Aspect	5.97	0.01	10
Roads	4.15	0.04	11

	Deforestation Vwaza		
Variable	**Δ-2 log ℓ**	***P*> χ2**	**Rank**
Forest Density	296.07	<.0001	1
Town Boundaries	78.53	<.0001	2
Protected Area	36.47	<.0001	3
Elevation	26.07	<.0001	4
Slope	24.45	<.0001	5
Transition Duration	24.30	<.0001	6
Roads	19.09	<.0001	7
Protected Area	17.00	<.0001	8
Village Centers	10.49	0.00	9

Table 38. Graphic representation of spatial variables used for the deforestation model and their rank importance

Variable	**Graphic Representation**	**Importance**		
		Nyika	**Nkhotakota**	**Vwaza**
Slope		Not significant	9	5
Elevation		3	Not significant	4
Village Distance/ Town Boundaries		7 8	3 Not significant	9 2
Major Roads Distance		Not significant	5	Not significant
Secondary Roads/ Minor/Dirt Roads Distance		Not significant 9	11 7	7 Not significant

Variable	Graphic Representation	Importance		
		Nyika	Nkhotakota	Vwaza
Aspect		2	10	Not significant

3.1.5.4 Calculate All Class or Stratum-Specific Transition Rates

In this step, all land transitions are calculated using a cellular automata type model to predict future land use and land cover in each grid-cell and for each year of the crediting period. Even though the spatial model produces maps of the exact location of future deforestation, these maps are not used outside of the modeling step.

The land-use change model incorporates the "forest scarcity" hypothesis: a decrease in deforestation rate upon gradual depletion of forest area. Initial deforestation rates are multiplied with a "forest scarcity" factor, which is initially 1, but can be set to gradually decrease as the proportion of remaining forest decreases. In the Kulera land-use change model, forest scarcity is set to 1 for the duration of the crediting period since conditions suggest deforestation rates would be more likely to increase rather than decrease with decreasing forest area. These conditions include high demand for fuelwood for subsistence needs, increasing population growth, scarcity of land, absence of government policies to reforest land, relatively small and increasingly fragmented forest parcels where deforestation rates are expected to be sharply increased due to increased rates of tree mortality (Laurence et al. 2000) and the synergistic effects of forest fragmentation and fire (Cochrane 2001).

The main output of the modeling step is a land-use change transition matrix for the crediting period for the Project Areas and the Leakage Areas. This matrix (Table 39) is calculated for the Project Area by aggregating the LULC class and forest stratum maps that are produced by the spatial model.

Table 39. Land transitions under the baseline scenario for the total Nyika Project Area. All values are in hectares. MI1 = Miombo forest, EVG= Evergreen Forest BAR = Non-forest.

		Baseline Scenario - Project Area			
		DF		RF	
	From	MI1	EVG	BAR	BAR
YEAR	To	BAR	BAR	MI1	EVG
2009		921	91	0	0
2010		919	91	11	1
2011		904	94	23	2
2012		898	91	31	2
2013		901	91	43	3
2014		891	94	51	4
2015		892	85	62	4
2016		883	84	67	7
2017		872	91	78	6
2018		881	83	94	6
2019		871	90	106	5
2020		858	86	111	8
2021		848	88	118	8
2022		855	89	128	9

		Baseline Scenario - Project Area			
		DF		RF	
	From	MI1	EVG	BAR	BAR
YEAR	To	BAR	BAR	MI1	EVG
2023		852	80	133	9
2024		844	81	142	10
2025		848	87	149	9
2026		833	79	154	9
2027		836	79	166	12
2028		829	78	170	11
2029		826	77	179	12
2030		827	77	185	11
2031		821	77	195	13
2032		809	74	205	14
2033		802	75	213	14
2034		806	73	221	14
2035		797	76	225	16
2036		793	69	229	16
2037		792	70	239	15
2038		789	72	244	16
SUM		25498	2471	3969	266

Table 40. Land transitions under the baseline scenario for the total Nkhotakota Project Area. All values are in hectares. MI1 = Miombo forest, EVG= Evergreen Forest BAR = Non-forest.

		Baseline Scenario - Project Area			
		DF		RF	
	From	MI1	EVG	BAR	BAR
YEAR	To	BAR	BAR	MI1	EVG
2009		1185.57	0.45	0	0
2010		1212.48	1.08	0.99	0
2011		1205.19	0.9	1.71	0
2012		1196.64	1.08	3.87	0
2013		1212.84	0.45	5.58	0
2014		1199.88	1.17	7.02	0
2015		1205.1	0.72	9.99	0
2016		1195.83	0.72	11.25	0
2017		1200.6	0.72	12.78	0
2018		1199.25	0.54	13.86	0
2019		1201.77	0.45	15.48	0
2020		1186.2	0.54	15.57	0
2021		1192.05	0.54	18.18	0
2022		1189.8	0.63	18.99	0
2023		1191.33	0.27	21.69	0

		Baseline Scenario - Project Area			
		DF		RF	
	From	MI1	EVG	BAR	BAR
YEAR	To	BAR	BAR	MI1	EVG
2024		1182.6	0.81	22.59	0
2025		1183.05	0.27	25.74	0
2026		1179.45	0.45	26.37	0
2027		1168.38	0.81	27.54	0
2028		1172.25	0.54	29.07	0
2029		1178.37	1.17	30.78	0
2030		1169.55	0.27	30.51	0
2031		1178.01	0.18	34.83	0
2032		1171.44	0.36	35.01	0
2033		1173.33	0.45	35.91	0
2034		1172.16	0.18	37.35	0
2035		1175.58	0.36	38.52	0
2036		1175.49	0.36	41.13	0
2037		1166.67	0.36	42.84	0
2038		1157.22	0.45	41.85	0
SUM		35578.08	17.28	657	0

Table 41. Land transitions under the baseline scenario for the total Vwaza Project Area. All values are in hectares. MI1 = Miombo forest, EVG= Evergreen Forest BAR = Non-forest.

		Baseline Scenario - Project Area			
		DF		RF	
	From	MI1	EVG	BAR	BAR
YEAR	To	BAR	BAR	MI1	EVG
2009		622	0	0	0
2010		609	0	9	0
2011		602	0	17	0
2012		593	0	24	0
2013		587	0	31	0
2014		573	0	38	0
2015		563	0	43	0
2016		552	0	51	0
2017		548	0	63	0
2018		540	0	70	0
2019		527	0	68	0
2020		513	0	76	0
2021		506	0	82	0
2022		502	0	92	0
2023		494	0	87	0
2024		491	0	100	0

		Baseline Scenario - Project Area			
		DF		RF	
	From	MI1	EVG	BAR	BAR
YEAR	To	BAR	BAR	MI1	EVG
2025		482	0	101	0
2026		470	0	111	0
2027		471	0	111	0
2028		456	0	117	0
2029		456	0	122	0
2030		448	0	129	0
2031		439	0	130	0
2032		437	0	134	0
2033		434	0	138	0
2034		433	0	149	0
2035		424	0	145	0
2036		416	0	151	0
2037		407	0	149	0
2038		394	0	157	0
SUM		14990	0	2693	0

3.2 Project Emissions

3.2.1 Identify Project Activities and Estimate Total Deforestation and Degradation Rates under the Project Scenario

3.2.1.1 Expected Effectiveness of Project Activities

Section 0 describes the Project Activities in detail in Table 42 which provides the expected effectiveness of these activities to address deforestation and degradation and to prevent leakage.

Table 42. Annual implementation level of project activities.

Vintage Year	1. Strengthening of land-tenure and protected area governance.	2. Development and implementation of sustainable management plans.	3. Forest protection through patrolling, social fencing and maintenance of forest boundaries	4. Fire prevention and suppression activities	5. Reducing fuelwood consumption and increasing energy efficiency	6. Creation of alternative sources of fuelwood	7. Sustainable intensification of agriculture on existintural land	8. Development of local enterprises based on sustainably harvested NTFPs
2009	66%	66%	10%	30%	20%	10%	0%	5%
2010	66%	66%	30%	30%	40%	25%	0%	10%
2011	66%	66%	40%	50%	60%	35%	30%	15%
2012	90%	90%	50%	70%	80%	45%	40%	25%
2013	100%	90%	70%	70%	100%	50%	45%	35%

Vintage Year	1. Strengthening of land-tenure and protected area governance.	2. Development and implementation of sustainable management plans.	3. Forest protection through patrolling, social fencing and maintenance of forest boundaries	4. Fire prevention and suppression activities	5. Reducing fuelwood consumption and increasing energy efficiency	6. Creation of alternative sources of fuelwood	7. Sustainable intensification of agriculture on existintural land	8. Development of local enterprises based on sustainably harvested NTFPs
2014	100%	90%	70%	70%	100%	55%	50%	40%
2015	100%	100%	90%	90%	100%	60%	60%	50%
2016	100%	100%	90%	90%	100%	65%	70%	60%
2017	100%	100%	100%	90%	100%	70%	80%	70%
2018	100%	100%	100%	90%	100%	80%	90%	90%
2019	100%	100%	100%	90%	100%	90%	100%	100%
2020	100%	100%	100%	100%	100%	100%	100%	100%
2021	100%	100%	100%	100%	100%	100%	100%	100%
2022	100%	100%	100%	100%	100%	100%	100%	100%
2023	100%	100%	100%	100%	100%	100%	100%	100%
2024	100%	100%	100%	100%	100%	100%	100%	100%
2025	100%	100%	100%	100%	100%	100%	100%	100%
2026	100%	100%	100%	100%	100%	100%	100%	100%
2027	100%	100%	100%	100%	100%	100%	100%	100%
2028	100%	100%	100%	100%	100%	100%	100%	100%
2029	100%	100%	100%	100%	100%	100%	100%	100%
2030	100%	100%	100%	100%	100%	100%	100%	100%
2031	100%	100%	100%	100%	100%	100%	100%	100%
2032	100%	100%	100%	100%	100%	100%	100%	100%
2033	100%	100%	100%	100%	100%	100%	100%	100%
2034	100%	100%	100%	100%	100%	100%	100%	100%
2035	100%	100%	100%	100%	100%	100%	100%	100%
2036	100%	100%	100%	100%	100%	100%	100%	100%
2037	100%	100%	100%	100%	100%	100%	100%	100%
2038	100%	100%	100%	100%	100%	100%	100%	100%

3.2.2 Expected Level of Activity of Project and Leakage Mitigation Activities

The expected relative degrees of activity in Table 42 are relative measures, meaning that 100% activity represents the maximum possible effectiveness of a specific Project Activity within the limitations of the Project. All activities have conservative assumptions, the effectiveness of any Project activity should not be overestimated. A number of the Project Activities have no precedent in Malawi, at least insofar as they have been implemented together in a co-management approach at this landscape level. As such, the adoption rates for each Project Activity used to create the ex-ante carbon calculations in this PD were based on information gathered from social assessments conducted in the Project Area, literature review, expert opinions and (see Section 1.13.3). These adoption rates are only assumptions and are likely to differ from actual adoption rates observed after project implementation (ex-post). Ongoing project monitoring, including social appraisals and household surveys, and Project monitoring plans will ensure that the real adoption rates are accurately recorded.

3.2.2.1 Strengthening of land-tenure and protected area governance

This activity addresses the deforestation and degradation by facilitating the formation of democratically-elected Community Associations during the initial years of the project (Y1 – Y5) to provide the foundation for building capacity for co-management of the Protected Areas. This includes legitimizing these community-based NRM governance structures (constitution development, by-laws and registration). It also includes the development of a tri-party agreement (REDD+ Agreement) for the DNPW and the Community Associations to develop, implement and maintain the REDD+ Project. This will be 100% effective by year 5.

3.2.2.2 Support for the development and implementation of sustainable forest and land use management plans

In the initial years of the Project (Y1 – Y5), improved management of the Protected Areas is formalized through the development of revised management plans that increase community participation in management of Protected Area and, along with the REDD+ Agreement, provide for benefits sharing between the DNPW and Associations. This will be 100% effective by year 7.

3.2.2.3 Forest protection through patrolling, social fencing and maintenance of forest boundaries

This activity improves the capacity of DNPW and communities to participate in patrolling of park boundaries through training, awareness building, employment contracts, signage (for boundaries and NTFP areas), boundaries clearing, surveys, and on-going monitoring provided under the REDD+ process. These activities are critical to ensuring the communities are aware of Protected Area boundaries and that they are integral parts of the on-going enforcement in these areas. The activities involve a significant level of community engagement to build capacity and the relationships with the DNPW. This will take until year 9 to be fully adopted.

3.2.2.4 Fire prevention and suppression activities

Fires are common in Malawi due to anthropological reasons that are not completely understood. The Project provides training and education on the importance of fire reduction, and the DNPW develops fire management plans in collaboration with Associations to implement activities that reduce fire inside of Protected Areas, including controlled burns, fire breaks, weed control, and fire management based on sound ecological principles. The Project also implements a fire control and management campaign for communication and to increase awareness. The success of these activities in part requires a change in mind-set, which will only happen over time. The activity will reach full effectiveness by Year 12.

3.2.2.5 Reducing fuelwood consumption and increasing energy efficiency by introducing fuel-efficient woodstove

The Project includes the distribution of cookstoves to reduce fuelwood consumption and indoor smoke pollution. The stoves are constructed directly opposite the door and adoption rates are tracked as part of the quarterly Project monitoring. The Projects goal is to get 35,000 households using improved cookstoves. Once fully operationally, the program can distribute approximately 3,000 stoves per quarter and, given that the Project expects to reach full distribution capacity by year 3, this would mean that the 35,000 stoves would be adopted by year 5.

3.2.2.6 Creation of alternative sources of fuelwood through agroforestry, farm woodlots management

Along with the reduction of fuelwood accompanying the adoption of stoves, the Project activities promote improved capacity of villages to create and maintain nurseries to establish sustainable woodlots. Villages are actively planting trees to reduce fuelwood consumption from the Protected Areas. It is expected that 1 million trees planted on roughly 5,391 ha will be established for actively managed village woodlots, and natural regeneration of 2,794 ha of woodlots will be promoted. This is expected to reach full implementation by year 12.

3.2.2.7 Sustainable intensification of agriculture on existing agricultural

Increased agricultural efficiency and reduce agriculture land requirements for local communities Higher-yielding cassava bundles distributed leading to 300 ha of new fields being planted in the Project Zone.

Increase the length of growing season, diversify agricultural crop production, and reduced agriculture land requirements for local communities. Distribution of treadle pumps to irrigate 323 hectares (maize, bean, cabbage, lettuce, tomatoes, paprika, chilies, and other vegetable fields). These activities are expected to reach full efficiency by year 11.

3.2.2.8 Development of local enterprises based on sustainably harvested NTFPs such as honey, coffee, macadamia, fruit production, and livestock

The Project supported the development of small business with training, access to markets and finance and support with inputs such as small livestock, seeds and equipment. It is expected that these activities will reach their full effectiveness in year 11.

Table 43. Relative reduction (%) in the impact of drivers of deforestation and degradation due to Project Activities

Driver of Deforestation	1. Strengthening of land-tenure and protected area governance	2. Development and implementation of sustainable management plans	3. Forest protection through patrolling, social fencing and maintenance of forest boundaries	4. Fire prevention and suppression activities	5. Reducing fuelwood consumption and increasing energy efficiency	6. Creation of alternative sources of fuelwood	7. Sustainable intensification of agriculture on existintural land	8. Development of local enterprises based on sustainably harvested NTFPs	TOTAL REDUCTION
Wood for cooking and heating locally	10%	10%	25%	0%	20%	25%	0%	5%	10%
Wood and poles for constuction and domestic use (including tobacco curing)	10%	10%	40%	0%	0%	30%	0%	0%	10%
Forest fires for other anthropogenic reasons	0%	0%	50%	25%	0%	0%	0%	10%	0%
Conversion of forest to small-scale agriculture	10%	10%	20%	0%	0%	0%	50%	10%	10%

Driver of Deforestation	1. Strengthening of land-tenure and protected area governance	2. Development and implementation of sustainable management plans	3. Forest protection through patrolling, social fencing and maintenance of forest boundaries	4. Fire prevention and suppression activities	5. Reducing fuelwood consumption and increasing energy efficiency	6. Creation of alternative sources of fuelwood	7. Sustainable intensification of agriculture on existintural land	8. Development of local enterprises based on sustainably harvested NTFPs	TOTAL REDUCTION
Forest fires by hunters (mice hunters)	5%	5%	40%	25%	0%	0%	0%	20%	5%
Collection of wood for charcoal	10%	10%	40%	0%	0%	0%	0%	20%	10%
Fire to contain animals inside the park	5%	5%	40%	25%	0%	0%	0%	20%	5%

Figure 30 indicates that project activities are expected to reduce deforestation to 9% of the baseline deforestation rate.

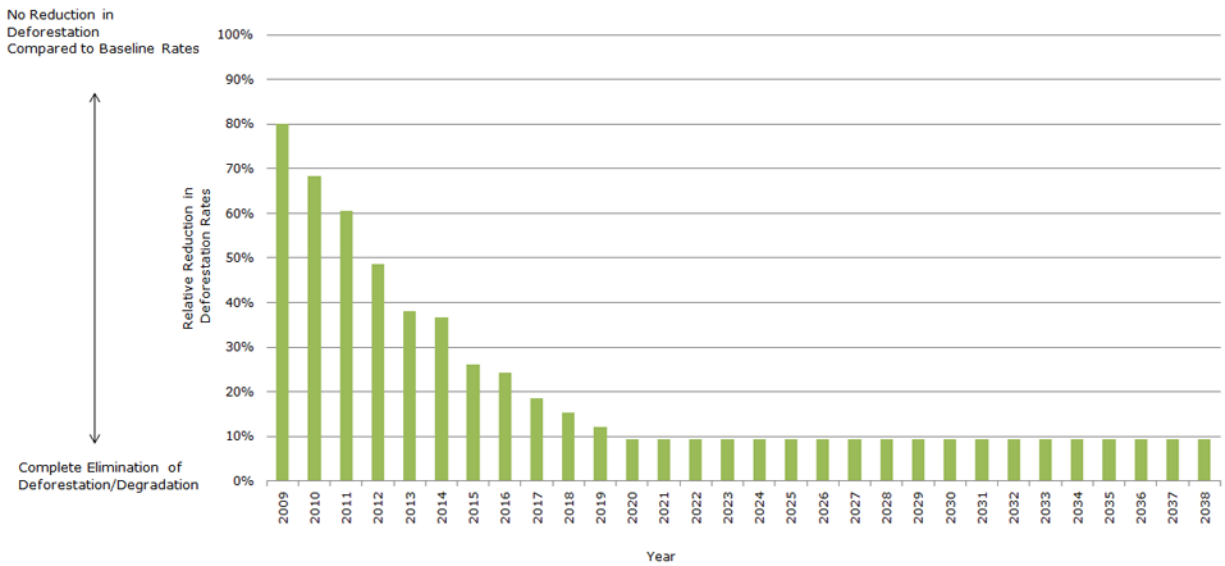


Figure 30. Estimated decrease in deforestation rate under the project scenario due to project activities; 100% = no decrease in deforestation compared to baseline conditions, 0% = absolute halting of deforestation

3.2.3 Calculate Forest Strata-specific Deforestation and Degradation Rates

The project deforestation rate relative to baseline conditions as shown in Figure 30 was multiplied by the deforestation rate under the baseline scenario to estimate the absolute deforestation under the project scenario. The land-use change simulation model was then run using these values to estimate the rates for each relevant transition under the project scenario. Table 44, Table 45, Table 46 summarize the transitions for under the Project scenario for each area.

Table 44. Expected land transitions under the project scenario for the Project Area for Nyika. All values are in hectares per year. MI1 = miombo forest, EVG= evergreen forest BAR = bare soil and agriculture.

		Project Scenario - Project Area			
		DF		RF	
	From	MI1	EVG	BAR	BAR
YEAR	To	BAR	BAR	MI1	EVG
2009		734	77	0	0
2010		624	66	9	1
2011		544	59	16	1
2012		437	43	22	1
2013		342	37	27	2
2014		325	35	30	2
2015		229	26	34	2
2016		211	23	36	2
2017		161	17	38	3
2018		134	13	40	3
2019		106	10	41	3
2020		81	7	41	3
2021		80	8	42	3
2022		82	7	42	3
2023		80	8	43	3
2024		79	8	43	3
2025		79	8	44	3
2026		79	6	44	3
2027		77	8	44	3
2028		78	7	45	3
2029		76	9	45	3
2030		78	7	46	3
2031		77	8	46	3
2032		75	7	46	3
2033		74	8	47	3
2034		76	6	47	3
2035		75	7	47	3
2036		72	9	48	3
2037		74	7	48	3
2038		73	8	48	3
SUM		5,314	548	1,148	77

Table 45. Expected land transitions under the project scenario for the Project Area for Nkhotakota. All values are in hectares per year. MI1 = miombo forest, EVG= evergreen forest BAR = bare soil and agriculture.

		Project Scenario - Project Area			
		DF		RF	
	From	MI1	EVG	BAR	BAR
YEAR	To	BAR	BAR	MI1	EVG
2009		949	1	0	0
2010		828	1	1	0
2011		729	1	2	0
2012		581	0	3	0

		Project Scenario - Project Area			
		DF		RF	
	From	MI1	EVG	BAR	BAR
YEAR	To	BAR	BAR	MI1	EVG
2013		462	0	4	0
2014		439	0	5	0
2015		314	0	5	0
2016		290	0	6	0
2017		223	0	6	0
2018		183	0	6	0
2019		145	0	6	0
2020		111	0	7	0
2021		112	0	7	0
2022		111	0	7	0
2023		112	0	7	0
2024		111	0	7	0
2025		111	0	7	0
2026		111	0	7	0
2027		110	0	8	0
2028		110	0	8	0
2029		111	0	8	0
2030		109	0	8	0
2031		110	0	8	0
2032		110	0	8	0
2033		110	0	8	0
2034		110	0	9	0
2035		110	0	9	0
2036		110	0	9	0
2037		109	0	9	0
2038		109	0	9	0
SUM		7,238	6	194	0

Table 46. Expected land transitions under the project scenario for the Project Area for Vwaza. All values are in hectares per year. MI1 = miombo forest, EVG= evergreen forest BAR = bare soil and agriculture.

		Project Scenario - Project Area			
		DF		RF	
	From	MI1	EVG	BAR	BAR
YEAR	To	BAR	BAR	MI1	EVG
2009		498	0	0	0
2010		416	0	6	0
2011		364	0	12	0
2012		288	0	16	0
2013		224	0	20	0
2014		209	0	23	0
2015		147	0	25	0
2016		134	0	27	0

		Project Scenario - Project Area			
		DF		RF	
	From	MI1	EVG	BAR	BAR
YEAR	To	BAR	BAR	MI1	EVG
2017		102	0	28	0
2018		82	0	29	0
2019		64	0	30	0
2020		48	0	30	0
2021		47	0	30	0
2022		47	0	31	0
2023		46	0	31	0
2024		46	0	31	0
2025		45	0	31	0
2026		44	0	31	0
2027		44	0	32	0
2028		43	0	32	0
2029		43	0	32	0
2030		42	0	32	0
2031		41	0	32	0
2032		41	0	32	0
2033		41	0	32	0
2034		41	0	32	0
2035		40	0	32	0
2036		39	0	33	0
2037		38	0	33	0
2038		37	0	33	0
SUM		3,341	0	817	0

3.2.4 Estimate GHG Emissions Sources from Firebreaks

The Project has yet to design the details on creating fire breaks, and thus has not estimated emissions.

3.2.5 Estimate the Net GHG Sequestration from Assisted Natural Regeneration Activities

The Project does not plan to claim credits from ANR activities separately, at least until the next verification. Therefore, no ANR management plan is included.

3.2.6 Estimate the New GHG Emissions Reduction from Cookstoves and Fuel Efficiency (CFE) Activities

We estimated that current consumption of fuelwood is about 27.12 t dry matter (DM) per household per year. According to CDM, the non-renewable fraction of woody energy for Malwai is about 81%. Reducing the demand for fuel through adoption of cookstoves will lead to a direct reduction in the unsustainable harvesting of fuelwood. Different types of cook stoves are in use in the Project area, and are being made by local communities. The thermal efficiency has been determined by TLC, in which they estimate that fuelwood consumption is reduced by 80% compared to traditional three stone stoves in Malawi with an efficiency of 25% compared to the 10% of thermal efficiency of three stone stoves used in the Project Area under the baseline. Less than 5% of the sampled households had the improved cookstove in the Project Area prior to this project activity. As of the writing of this document, the households continue to use and maintain the cook stoves. The Project expects (conservatively) that they will be able to achieve the adoption of 35,000 improved cook stoves in their households by year 6 of the Project. This will reduce of consumption of fuel-wood reduce the annual emissions by 3.49 tCO_2 per household per year. These cookstoves would be maintained throughout the project crediting period.

By applying the quantification approach in Section 8.2.6, Table 47 provides the estimated emission reductions from cookstoves.

Table 47. Estimated emission reductions from cookstoves

Year (t)	GHG emission reductions from cookstoves
1	22,268
2	33,402
3	44,537
4	77,939
5	100,207
6	111,341
7	111,341
8	111,341
9	111,341
10	111,341
11	111,341
12	111,341
13	111,341
14	111,341
15	111,341
16	111,341
17	111,341
18	111,341
19	111,341
20	111,341
21	111,341
22	111,341
23	111,341
24	111,341
25	111,341
26	111,341
27	111,341
28	111,341
29	111,341
30	111,341
Total	3,061,886

3.2.7 Estimate GHG Emissions from Harvesting

Wood harvesting is not allowed in the Project Area and therefore, estimation of the long-term average carbon stock, and emissions from harvesting, is not relevant.

3.3 Leakage

Describe the procedure for quantification of the leakage emissions. Include all relevant equations.

3.3.1 Leakage Definitions and Inclusions in this Methodology

Under the methodology used by this Project, leakage is estimated *ex-ante*, but actual NERs are based on actual leakage calculated with project monitoring data. Leakage, if it occurs, does not only occur on forest land outside of the Project Area, but also on non-forest land, such as woodlands or grassland.

The market leakage assessment only has to be included when illegal logging activities that supply timber to national or international markets as an identified driver. As provided in Table 7 there are not drivers such as timber to regional or international markets presence in the Project Area and thus there is no market leakage for this Project.

3.3.2 Estimate Leakage from Geographically Constrained Drivers

Leakage from geographically constrained drivers is may take place in areas adjacent to the Project Area i.e. in the leakage belts. All of the drivers identified as active in the Project Area in Section 2.4.4 are identified as drivers that could result in geographically constrained leakage within the Leakage Belt. A justification of each of the leakage cancellation rates is provided below. These estimates were derived from PRAs and meeting with local community leaders.

3.3.2.1 Wood for charcoal

Charcoal is mainly created by local communities and newly settling migrant communities to generate income by selling to people along the roads coming to and from towns. The income generating opportunities implemented within the Project will decrease the local production of charcoal as well as the adoption of improved cook stoves. The projects expects to reduce the demand by providing access to fuel wood efficient stoves which is expected to reduce the fuelwood consumption by 80%. However, this will challenging driver to address and it is estimated that some of the local charcoal producers with travel into the leakage belts to continue their practices and thus we conservatively estimate 20% leakage cancellation has been estimated.

3.3.2.2 Conversion of forest to small-scale agriculture

Local farmers and newly settling migrants that are coming to reside within the Project Zone that are converting forest to agricultural land are doing so for subsistence agriculture. These communities who either already reside or come to settle in the Project Zone will not move far from their villages to continue this practice as they are estimated to keep their activities within 1 km of the village. Additional Project activities include conservation agriculture, irrigation, and intensification to increase crop yields. It is estimated that the leakage cancellation will be zero.

3.3.2.3 Forest fires by hunters (mice hunters)

This driver is undertaken as an “opportunist” activity within the Project Areas by the mice hunters living near the Project Areas. Most Tumbuka people do not eat mice. This is mostly practiced by Chewa migrants who have come to the North from the Central part of the country to live and work on tobacco farms and other estates. Some local people have adopted this practice, but they are few. Given the opportunistic nature of this activity, these hunters will not likely travel far to set fires to extract mice. This is estimated to be as low as 5% leakage cancellation.

3.3.2.4 Forest fires for other anthropogenic reasons.

These fires are primarily from hunters and poachers to concentrate game animals deep in the Project Areas. This is a practice that is done by a limited number of people near Nyika and Vwaza Protected Areas, but it is passed down through generations. This occurs in spite of local efforts by DNPW and NVA to “civic educate” the people on the negative impacts of poaching to the environment and to the community, since it reduces the amount of benefits they receive from revenue-sharing with the DNPW. It is estimated that leakage cancellation would be 2% since fires were set by only a few individuals in specific locations.

3.3.2.5 Other

As these are non-anthropogenic and thus would not be removed into the leakage belt, the leakage cancellation is zero.

3.3.2.6 Wood and poles for construction and domestic use

The need for timber on a local level will not decrease as a result of Project implementation. Local communities will shift the location of their timber harvesting to the leakage belt surrounding the Project Areas to harvest wood. It is anticipated that timber harvesting for local use to continue, resulting in a 100% leakage cancellation rate.

3.3.2.7 Wood for cooking and heating locally

Adopting efficient cookstoves by the communities in the Project Zone will significantly reduce the amount of fuelwood use, and should not result in significant leakage. For example, the projects expects to reduce the demand by providing access to fuelwood efficient stoves which is expected to reduce the fuelwood consumption by 80%. In addition, the Project supports establishing for sustainable village woodlots, which will provide an alternative source of sustainable fuelwood versus communities unsustainably using wood from the Project Area There will not, however, be a 100% adoption rate for these new technologies, nor will the woodlots completely meet the wood requirements, so a 5% leakage cancellation rate has been conservatively estimated.

3.3.2.8 Wood for Tobacco Curing

There are numerous programs in addition to this Project that are working with tobacco farmers to encourage them to plant their own woodlots to meet their fuelwood needs to cure tobacco. These interventions have been successful. Now, programs are starting to introduce coal to cure the tobacco instead of firewood, which will reduce demand for wood, eliminating the need to move their activities into the Leakage Belt. The leakage cancellation is estimated to the zero.

3.3.3 Estimate Leakage from Un-geographically Constrained Drivers

Leakage from geographically unconstrained drivers can occur in areas beyond and far away from the Project Area. In the Project, there are no drivers and agents that would lead to geographically unconstrained leakage.

Table 48. Estimated leakage cancellation rates per deforestation driver.

	Deforestation			Forest Degradation		
Driver of Deforestation	**Geographically constrained**	**Geographically unconstrained**	**Market**	**Geographically constrained**	**Geographically unconstrained**	**Market**
Wood for cooking and heating locally	5%	0	0	0	0	0
Wood and poles for constuction and domestic use (including tobacco curing)	85%	0	0	0	0	0
Forest fires for other anthropogenic reasons	2%	0	0	0	0	0
Conversion of forest to small-scale agriculture	0%	0	0	0	0	0
Forest fires by hunters (mice hunters)	5%	0	0	0	0	0
Collection of wood for charcoal	20%	0	0	0	0	0

3.3.4 Demarcate the Leakage Belts

A full description of the demarcation of the leakage belts may be found in Section 1.9.6.

3.3.4.1 Calculate the Forest Strata-specific Deforestation and Degradation Rates in the Leakage Belts

The land transitions in the Leakage Area under both the project and baseline scenario for Nyika are summarized in Table 49.

Table 49. Land-use transitions in the Leakage Area under the baseline and ex-ante project scenarios for Nyika (hectares per year)

		Baseline - Leakage Area				Project - Leakage Area			
		DF		RF		DF		RF	
	From	MI1	EVG	BAR	BAR	MI1	EVG	BAR	BAR
YEAR	To	BAR	BAR	MI1	EVG	BAR	BAR	MI1	EVG
2009		683	9	695	46	830	12	697	46
2010		682	13	694	46	923	15	698	47
2011		695	13	692	46	984	15	700	47
2012		704	12	694	46	1073	18	702	47
2013		703	12	692	45	1149	19	706	47
2014		708	14	694	46	1161	21	710	47
2015		715	15	691	46	1240	23	715	48
2016		728	15	697	45	1257	23	720	48
2017		727	15	695	45	1292	24	725	48
2018		725	15	688	46	1304	32	731	49
2019		727	17	685	48	1328	31	737	49
2020		744	19	689	46	1359	28	743	50
2021		752	19	692	47	1360	29	749	50
2022		744	19	689	46	1356	30	755	50
2023		758	18	693	46	1356	34	761	51
2024		761	19	694	45	1356	33	768	51
2025		752	19	695	47	1351	36	774	52
2026		777	20	698	47	1361	35	779	52
2027		774	20	695	45	1359	34	785	52
2028		780	21	699	46	1355	38	791	53
2029		783	21	698	46	1354	39	797	53
2030		783	24	700	48	1356	39	803	54
2031		788	22	698	47	1355	38	808	54
2032		801	24	697	47	1352	44	814	54
2033		808	25	696	47	1359	41	819	55
2034		803	27	696	47	1350	45	825	55
2035		812	23	700	45	1350	45	830	55
2036		823	25	704	46	1353	46	836	56
2037		817	30	701	48	1346	50	841	56
2038		819	29	703	47	1346	47	846	56
SUM		22,678	571	20,853	1,389	38,274	963	22,967	1,531

Table 50. Land-use transitions in the Leakage Area under the baseline and ex-ante project scenarios for Nkhotakota (hectares per year)

		Baseline - Leakage Area				Project - Leakage Area			
		DF		RF		DF		RF	
	From	MI1	EVG	BAR	BAR	MI1	EVG	BAR	BAR
YEAR	To	BAR	BAR	MI1	EVG	BAR	BAR	MI1	EVG
2009		626	0	101	0	759	0	101	0
2010		599	0	102	0	836	0	102	0
2011		606	0	104	0	890	0	103	0
2012		614	0	104	0	979	0	104	0
2013		599	0	104	0	1040	0	105	0
2014		611	0	105	0	1,037	0	106	0
2015		606	0	104	0	1,090	0	108	0
2016		615	0	105	0	1,075	0	109	0
2017		610	0	106	0	1,078	0	110	0
2018		611	0	107	0	1,059	0	111	0
2019		608	0	108	0	1,035	0	113	0
2020		624	0	110	0	1,011	0	114	0
2021		617	0	109	0	960	0	115	0
2022		619	0	111	0	912	0	116	0
2023		617	0	110	0	864	0	117	0
2024		624	0	112	0	820	0	118	0
2025		623	0	111	0	775	0	119	0
2026		625	0	112	0	734	0	120	0
2027		635	0	113	0	696	0	121	0
2028		629	0	114	0	658	0	121	0
2029		620	0	114	0	622	0	122	0
2030		627	0	117	0	591	0	123	0
2031		616	0	114	0	560	0	123	0
2032		618	0	116	0	533	0	124	0
2033		612	0	118	0	507	0	124	0
2034		608	0	118	0	484	0	125	0
2035		598	0	119	0	461	0	125	0
2036		590	0	119	0	440	0	126	0
2037		590	0	119	0	421	0	126	0
2038		589	0	122	0	404	0	127	0
SUM		18,388	0	3,331	0	23,332	0	3,477	0

Table 51. Land-use transitions in the Leakage Area under the baseline and ex-ante project scenarios for Vwaza (hectares per year)

		Baseline - Leakage Area				Project - Leakage Area			
		DF		RF		DF		RF	
	From	MI1	EVG	BAR	BAR	MI1	EVG	BAR	BAR
YEAR	To	BAR	BAR	MI1	EVG	BAR	BAR	MI1	EVG
2009		563	0	611	0	640	0	611	0
2010		576	0	610	0	706	0	611	0
2011		583	0	609	0	740	0	612	0
2012		591	0	609	0	795	0	614	0
2013		597	0	609	0	842	0	616	0
2014		611	0	610	0	853	0	619	0
2015		621	0	611	0	898	0	622	0
2016		632	0	610	0	906	0	626	0

		Baseline - Leakage Area				Project - Leakage Area			
		DF		RF		DF		RF	
	From	MI1	EVG	BAR	BAR	MI1	EVG	BAR	BAR
YEAR	To	BAR	BAR	MI1	EVG	BAR	BAR	MI1	EVG
2017		636	0	605	0	926	0	630	0
2018		643	0	605	0	936	0	634	0
2019		656	0	613	0	948	0	637	0
2020		670	0	611	0	959	0	641	0
2021		676	0	612	0	956	0	646	0
2022		679	0	609	0	951	0	650	0
2023		687	0	620	0	948	0	653	0
2024		689	0	613	0	942	0	657	0
2025		698	0	618	0	939	0	661	0
2026		710	0	614	0	936	0	665	0
2027		708	0	620	0	928	0	668	0
2028		722	0	620	0	925	0	672	0
2029		722	0	621	0	918	0	675	0
2030		729	0	619	0	912	0	678	0
2031		736	0	624	0	907	0	681	0
2032		737	0	625	0	899	0	684	0
2033		739	0	627	0	892	0	687	0
2034		739	0	621	0	884	0	689	0
2035		747	0	630	0	879	0	692	0
2036		753	0	629	0	872	0	694	0
2037		761	0	637	0	867	0	697	0
2038		773	0	633	0	862	0	699	0
SUM		20,385	0	18,502	0	26,566	0	19,622	0

3.3.5 Estimate Leakage from Geographically Unconstrained Drivers

The analysis of drivers did not result in the identification of geographically unconstrained drivers. The Project Area is mostly surrounded by the communities living in the region for long time and most of the deforestation seemed partly caused by population growth as applicable for the entire country. For example, the net forest cover in Malawi was found to be inversely proportional to the population density (Figure 31) and this was found to be true in the case of Project Area due to absence of geographically unconstrained drivers.

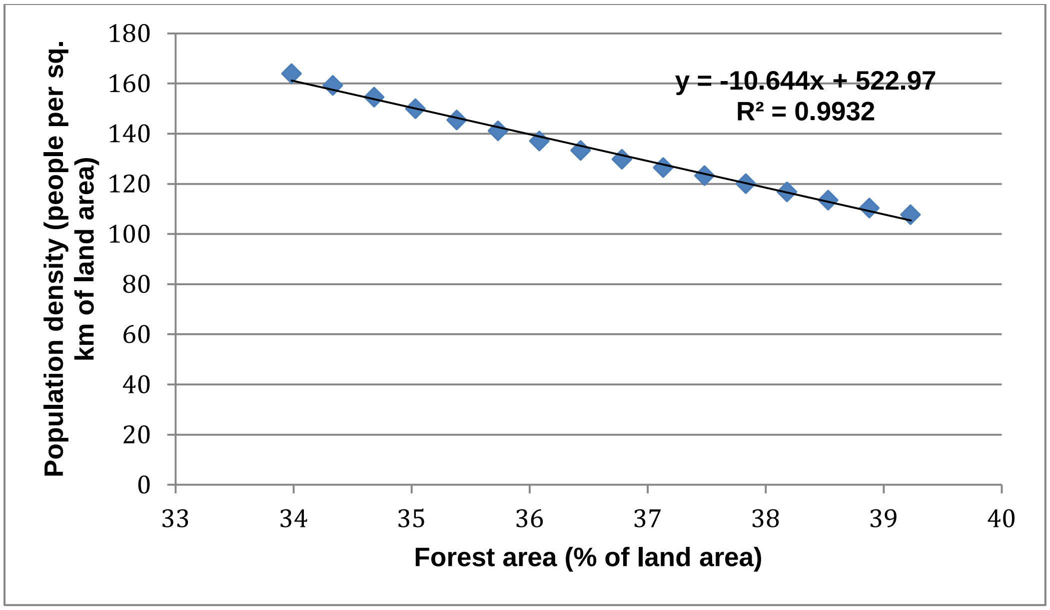


Figure 31. Relationship between forest cover and population density in Malawi

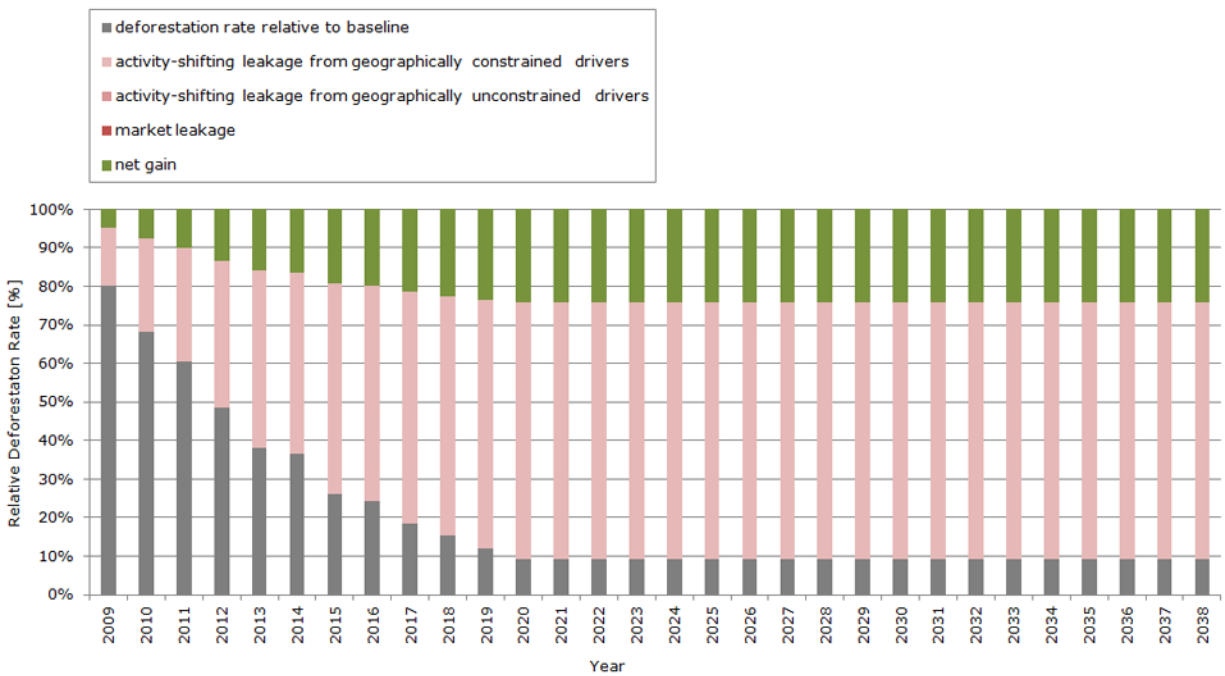


Figure 32. Summary of the anticipated (gross) decrease in deforestation rate in the Project Areas, the cancellation of a part of this avoided deforestation through activity-shifting leakage, and the net project gains. All values are scaled relative to the original baseline deforestation rate.

3.3.6 Estimate Applicability of and Emission Sources from Leakage Prevention Activities

3.3.6.1 Estimate Emissions from Introduction of Flooded Rice Production

3.3.6.1.1 Scope and Applicability

There are no flooded rice fields are part of the Project Activities.

3.3.6.1.2 Emissions

Emissions are zero from flooded rice production.

3.3.6.2 Estimate GHG Emissions from Increased Livestock Stocking Rates

3.3.6.2.1 Scope and Applicability

The Project Activities do not include increasing the cattle livestock stocking rates and therefore the GHG emissions from increased livestock stocking rates is not relevant. Small scale livestock such as poultry, rabbits, pigs and goats do not have any significant effect on GHG emissions.

3.3.6.2.2 Emissions

Emissions are zero from increased stocking.

3.4 Summary of GHG Emission Reductions and Removals

This section summarizes the ex-anti calculations of the GHG benefits. Baseline Emissions Project years are based on the project start date of October 1, 2009. Hence project year and vintage year 2009 starts 1 October 2009 and ends on 30 September 2010.

Table 52. Summary of baseline and ex-ante project GHG emissions/removals

Year	Baseline emissions or removals (tCO_2e)	Estimated (ex-ante) project emissions or removals (tCO_2e)	Ex-ante GHG from improved cookstoves	Estimated (ex-ante) leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2009	(374,742)	(303,139)	22,268	(68,542)	25,329
2010	(396,643)	(275,939)	33,402	(102,300)	51,807
2011	(415,637)	(258,885)	44,537	(126,067)	75,222
2012	(431,174)	(221,442)	77,939	(161,585)	126,086
2013	(451,949)	(195,033)	100,207	(192,225)	164,898
2014	(470,044)	(194,838)	111,341	(206,069)	180,479
2015	(482,514)	(162,814)	111,341	(237,818)	193,222
2016	(496,197)	(159,467)	111,341	(250,387)	197,685
2017	(518,748)	(143,031)	111,341	(269,146)	217,912
2018	(531,187)	(133,014)	111,341	(286,564)	222,949
2019	(536,500)	(110,298)	111,341	(294,925)	242,619
2020	(529,120)	(89,950)	111,341	(300,833)	249,678
2021	(531,273)	(81,388)	111,341	(301,315)	259,910
2022	(531,767)	(74,131)	111,341	(298,614)	270,364
2023	(527,036)	(69,339)	111,341	(297,645)	271,393
2024	(525,834)	(64,946)	111,341	(292,996)	279,232
2025	(531,872)	(62,324)	111,341	(289,415)	291,475
2026	(524,379)	(58,327)	111,341	(284,412)	292,981
2027	(522,866)	(57,979)	111,341	(277,575)	298,654

Year	Baseline emissions or removals (tCO_2e)	Estimated (ex-ante) project emissions or removals (tCO_2e)	Ex-ante GHG from improved cookstoves	Estimated (ex-ante) leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2028	(522,177)	(56,075)	111,341	(274,416)	303,028
2029	(516,800)	(51,783)	111,341	(267,188)	309,170
2030	(510,583)	(46,814)	111,341	(259,604)	315,506
2031	(504,076)	(43,470)	111,341	(251,044)	320,903
2032	(494,959)	(40,386)	111,341	(246,743)	319,172
2033	(490,287)	(38,503)	111,341	(236,747)	326,379
2034	(483,535)	(35,759)	111,341	(231,090)	328,028
2035	(479,304)	(34,371)	111,341	(222,727)	333,548
2036	(470,025)	(34,362)	111,341	(216,251)	330,753
2037	(464,966)	(32,234)	111,341	(210,534)	333,540
2038	(458,600)	(31,723)	111,341	(201,205)	337,013
Total	**(14,724,795)**	**(3,161,764)**	**3,061,886**	**(7,155,981)**	**7,468,935**

3.4.1 Estimate Change in Carbon Stocks in the Long-Lived Wood Product Pool

Long-lived wood products are not a carbon pool in this Project, see Section 2.3.1

Nearby 100% of the wood harvested in the Project Areas by different drivers were found to be short lived. For example, the harvested wood were used for generating household energy or for tobacco curing (Biran et al. 2004). The tobacco curing activities require woods be replaced every 2-3 years (Geist 1977) and thus no portion of the wood was found to be entering into long lived wood products in the Project Area under the baseline. Therefore, baseline emissions in long-lived wood product pool was assumed '0'. In Malawi, the production of timber that would last for long has declined or stayed the same while the production of fuel wood is continuously increasing Figure 33).

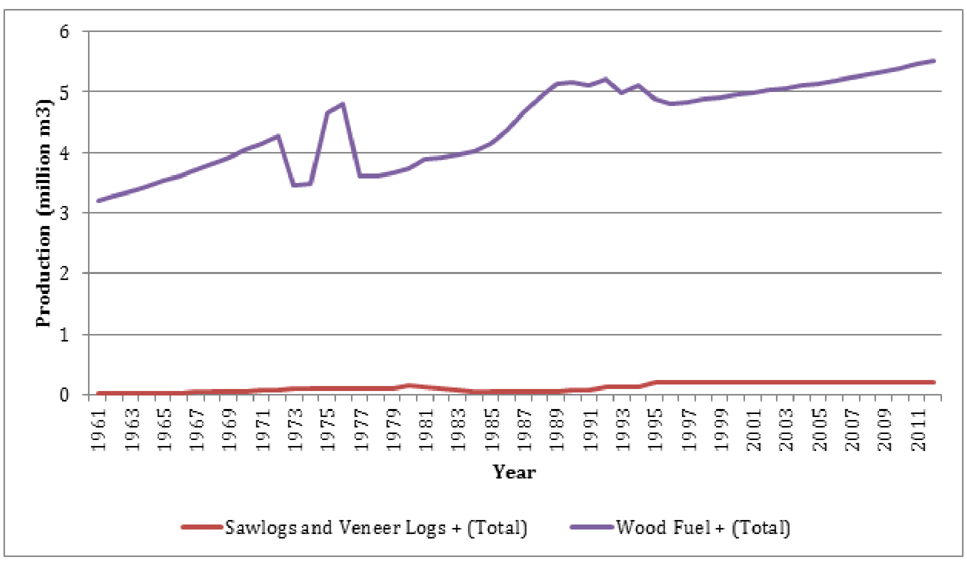


Figure 33. Wood production in Malawi during 1961-2011(Source: FAOSTAT 2013).

The project activity does not have plan undertake harvesting activities and therefore, carbon is long-lived product pool was estimated to be ‘0’.

3.4.2 Test the Significance of GHG Emissions

The project proponents are still planning the fire breaks. As of the date of validation, the firebreak has not been laid out in the Project Area therefore, emissions from fire break is estimated to be 0. All the applicable GHG emissions from the project activities were estimated to be ‘0’ and therefore these emissions were considered insignificant.

3.4.3 Estimate Ex-ante NERs

YEAR	ΔGHG from avoided deforestation	ΔGHG from deforestation due to leakage	GHG from improved cookstoves	GHG from emission sources	NER	Risk Buffer	Buffer	VCU
	[tCO_2e]	[tCO_2e]	[tCO_2e]	[tCO_2e]	[tCO_2e]	[%]	[tCO_2e]	[tCO_2e]
2009	71,603	-68,542	22,268	0	25,329	10.00	-7,160	18,169
2010	120,705	-102,300	33,402	0	51,807	10.00	-12,070	39,737
2011	156,752	-126,067	44,537	0	75,222	10.00	-15,675	59,547
2012	209,732	-161,585	77,939	0	126,086	10.00	-20,973	105,113
2013	256,916	-192,225	100,207	0	164,898	10.00	-25,692	139,207
2014	275,207	-206,069	111,341	0	180,479	10.00	-27,521	152,958
2015	319,699	-237,818	111,341	0	193,222	10.00	-31,970	161,252
2016	336,730	-250,387	111,341	0	197,685	10.00	-33,673	164,012
2017	375,717	-269,146	111,341	0	217,912	10.00	-37,572	180,340
2018	398,172	-286,564	111,341	0	222,949	10.00	-39,817	183,132
2019	426,202	-294,925	111,341	0	242,619	10.00	-42,620	199,999
2020	439,170	-300,833	111,341	0	249,678	10.00	-43,917	205,761
2021	449,884	-301,315	111,341	0	259,910	10.00	-44,988	214,922
2022	457,637	-298,614	111,341	0	270,364	10.00	-45,764	224,601
2023	457,697	-297,645	111,341	0	271,393	10.00	-45,770	225,624
2024	460,888	-292,996	111,341	0	279,232	10.00	-46,089	233,144
2025	469,548	-289,415	111,341	0	291,475	10.00	-46,955	244,520
2026	466,052	-284,412	111,341	0	292,981	10.00	-46,605	246,376
2027	464,887	-277,575	111,341	0	298,654	10.00	-46,489	252,165
2028	466,102	-274,416	111,341	0	303,028	10.00	-46,610	256,418
2029	465,017	-267,188	111,341	0	309,170	10.00	-46,502	262,669
2030	463,769	-259,604	111,341	0	315,506	10.00	-46,377	269,129
2031	460,606	-251,044	111,341	0	320,903	10.00	-46,061	274,842
2032	454,573	-246,743	111,341	0	319,172	10.00	-45,457	273,714
2033	451,784	-236,747	111,341	0	326,379	10.00	-45,178	281,200
2034	447,776	-231,090	111,341	0	328,028	10.00	-44,778	283,250
2035	444,933	-222,727	111,341	0	333,548	10.00	-44,493	289,054
2036	435,663	-216,251	111,341	0	330,753	10.00	-43,566	287,187
2037	432,732	-210,534	111,341	0	333,540	10.00	-43,273	290,266

YEAR	ΔGHG from avoided deforestation	ΔGHG from deforestation due to leakage	GHG from improved cookstoves	GHG from emission sources	NER	Risk Buffer	Buffer	VCU
	[tCO_2e]	**[tCO_2e]**	**[tCO_2e]**	**[tCO_2e]**	**[tCO_2e]**	**[%]**	**[tCO_2e]**	**[tCO_2e]**
2038	426,877	-201,205	111,341	0	337,013	10.00	-42,688	294,325
Total	**11,563,031**	**-7,155,981**	**3,061,886**	**0**	**7,468,935**	**0**	**-1,156,303**	**6,312,632**

4 MONITORING

4.1 Data and Parameters Available at Validation

The following data and parameters are defined for standalone projects. For projects that are nested within a jurisdictional REDD+ program, at the time of validation the project will identify any data or parameters in the project document, if any, that will be adopted from the jurisdictional REDD+ program.

Data/parameter [EA1]:	CF
Data unit:	[Mg C (Mg DM)$^{-1}$]
Description:	Carbon fraction of dry matter in wood
Sources of data:	Default value of 0.5 (IPCC GPG-LULUCF 2003)
Value applied:	0.5
Measurement procedures:	
Purpose of Data:	Partitions carbon from biomass data. Used in calculations of annual carbon loss per deforestation driver (VM0006 Section 8.1.3.2, EQ 1-10),calculations of carbon stock density from OM pools (VM0006 Section 8.1.4.4, EQ 24), and carbon accounting for harvested wood products (VM00066 Section 8.4.1.1, EQ 101)
Any comment:	

Data/parameter [EA2]:	E
Data unit:	[-]
Description:	Average combustion efficiency of the aboveground tree biomass
Sources of data (*):	• Project-specific measurements • Regionally valid estimates • Estimates from Table 3.A.14 of IPCC GPG LULUCF • If no appropriate combustion efficiency can be used, use the IPCC default of 0.5
Value applied:	0.5
Measurement procedures:	
Purpose of Data:	Used in calculations of carbon loss from biomass burning. In VM0006 this parameter is used in the deforestation drivers analysis to account carbon loss from forest fires (Section 8.1.3.2 EQ 10).
Any comment:	

Data/parameter [EA3]:	P
Data unit:	[-]
Description:	Average proportion of mass burned from the aboveground tree biomass.
Sources of data:	GPG-LULUCF Table 3A.1.12
Value applied:	
Measurement procedures:	

Purpose of Data:	Used in calculations of carbon loss from biomass burning. In VM0006 used to account carbon loss from forest fires in the deforestation drivers analysis to (Section 8.1.3.2 EQ 10).
Any comment:	

Data/parameter [EA4]:	GWP_{CH4}
Data unit:	[-]
Description:	Global Warming Potential for CH_4
Sources of data:	IPCC default value of 25
Value applied:	25
Measurement procedures:	
Purpose of Data:	Used to convert CH4 emissions to CO_2 emissions. Methane accounted in calculations that include prescribed burning for firebreaks (VM0006 Section 8.2.3 EQ 70) prescribed burning for ANR (VM0006 Section 8.2.4.5 EQ77) and flooded rice agriculture (VM0006 Section 8.3.4.2.2 EQ 100
Any comment:	

Data/parameter [EA5]:	ER_{CH4}
Data unit:	Proportion
Description:	Emission ratio for CH_4
Sources of data:	Table 3A.1.15 in IPCC GPG-LULUCF 2003
Value applied:	IPCC default value of 0.012
Measurement procedures:	
Purpose of Data:	Used in CH_4 calculations that include prescribed burning for firebreaks (VM0006 Section 8.2.3 EQ 70) and ANR (VM0006 Section 8.2.4.5 EQ77)
Any comment:	

Data/parameter [EA6]:	sc_1
Data unit:	[-]
Description:	First shape factor for the forest scarcity equation; steepness of the decrease in deforestation rate (greater is steeper).
Sources of data:	Statistical fitting procedure. Using remotely sensed forest cover data in heavily deforested areas close to the Project Area such as neighbouring provinces, states or countries
Value applied:	20
Measurement procedures:	
Purpose of Data:	Use model-fitting procedures described inVM0006 Section 8.1.5.4
Any comment:	Used in calculation of class/stratum transition rates. One of two parameters that determine the shape of the forest scarcity factor curve (VM0006 Section 8.1.5.4, EQ 40).

Data/parameter [EA7]:	sc_2
Data unit:	[-]
Description:	Second shape factor for the forest scarcity equation; relative deforested area at which the deforestation rate will be 50% of the initial deforestation rate.
Sources of data:	Statistical fitting procedure. Using remotely sensed forest cover data in heavily deforested areas close to the Project Area such as neighbouring provinces, states or countries
Value applied:	0.7
Measurement procedures:	Use model-fitting procedures described inVM0006 Section 8.1.5.4
Purpose of Data:	Used in calculation of class/stratum transition rates. One of two

	parameters that determine the shape of the forest scarcity factor curve (VM0006 Section 8.1.5.4, EQ 40).
Any comment:	Higher values of sc_2 result in lower deforestation and are therefore conservative.

Data/parameter [EA8]:	$\rho_{wood,j}$
Data unit:	[Mg DM m^{-3}]
Description:	Average basic wood density of species or species group j
Sources of data:	GPG-LULUCF Table 3A.1.9. or published data/literature.
Value applied:	0.6
Measurement procedures:	
Purpose of Data:	Used to calculate total tree carbon stock (VM0006 Section 8.4.1.1, EQ 101)
Any comment:	Average density value of African tree species

Data/parameter [EA9]:	BEF_2
Data unit:	[-]
Description:	Biomass expansion factor for converting volumes of extracted round wood to total aboveground biomass (including bark).
Sources of data:	IPCC GPG LULUCF Table 3A.1.10 or published data from scientific peer reviewed literature
Value applied:	3.4
Measurement procedures:	
Purpose of Data:	Converts wood volume to biomass. Used in calculations of annual carbon loss per deforestation driver for logging, wood collecting and fuelwood collecting (VM0006 Section 8.1.3.2, EQ 4,5,6,7),
Any comment:	Value 3.4 from IPCC GPG LULUCF Table 3A.1.10 for tropical, broadleaf forest for trees >10cm DBH

Data/parameter [EA9]:	$NCV_{biomass}$
Data unit:	[TJ (Mg DM) $^{-1}$]
Description:	Net calorific value of non-renewable biomass that is substituted.
Sources of data:	0.015 TJ (Mg DM) $^{-1}$ IPCC default value.
Value applied:	Used for cookstove efficiency.
Measurement procedures:	
Purpose of Data:	Parameter used to quantify emissions from CFE activities (VM0006 Section 8.2.5, WE 108)
Any comment:	

4.2 Data and Parameters to be Monitored

*: Lower-ranked options may only be used if higher-ranked options are not available

4.2.1 Sizes, Areas, and Transitions

Data/parameter [MN1]:	$size_{projectArea}$, $size_{leakageArea}$. $size_{referenceregion}$, $size_{referenceForest}$
Data unit:	[ha]
Description:	Size of Project Area, Leakage Area, Reference Region, and forest area in the Reference Region
Sources of data:	Project design
Measurement procedures:	GIS delineation of protected area boundaries based on official records, RS analysis of forest cover
Frequency of monitoring:	$size_{projectArea}$ and $size_{leakageArea}$ may be adjusted during crediting

	period per the rules for grouped projects and updated at verification, but only for the additional instances that were added after the project start date, and may be adjusted during crediting period per the rules for grouped projects and updated at verification, but only for the additional instances that were added after the project start date..
Value applied:	See Table 12. Size and geodetic coordinates of individual project parcels (WGS-84) and the description in 1.9.3.
Monitoring equipment:	n/a
QA/QC procedures to be applied:	Visual evaluation and comparison to Google Earth
Purpose of Data:	$size_{leakageArea} size_{projectArea}$ used to calculate the Forest Strata-specific Deforestation and Degradation Rates in the Leakage Belts (VM0006 Section 8.3.2.3, EQ 94, 95) $size_{projectArea}$ used to calculate forest scarcity factor (VM0006 Section 8.1.4.4, EQ 40. $size_{referenceForest}$ and $size_{projectArea}$ used to calculate baseline total deforestation and degradation rates (VM0006 Section 8.1.4.1, EQ 37, 38).$size_{referenceregion}$ used to test applicability conditions for the Reference Region
Calculation method:	GIS delineation of boundaries
Any comment:	Required for PD

Data/parameter [MN2]:	$\Delta area_{projectAreaEAH,projectScenario}(t,i)$
Data unit:	[ha yr^{-1}]
Description:	Area (ha) undergoing transition i within the Project Area, excluding the ANR area, and harvest areas, under the project scenario for year t.
Sources of data:	Land-use change modelling(ex-ante) Remote sensing analysis (ex-post)
Measurement procedures:	Calculate based on the LULC classification
Frequency of monitoring:	At least once before verification
Value applied:	For the ex-ante predictions see Table 44, Table 45 and Table 46.
Monitoring equipment:	Land-use classification
QA/QC procedures to be applied:	
Purpose of Data:	Used to predict LULC transitions in the baseline scenario
Calculation method:	Follow the procedures described in Section 8.1.5 of the methodology to calculate a land use change transition matrix, which summarizes all predicted LULC transitions
Any comment:	Required for M1

Data/parameter [MN3]:	$\Delta area_{projectAreaEAH,baselineScenario}(t,i)$
Data unit:	[ha yr^{-1}]
Description:	Area (ha) undergoing transition i within the Project Area, excluding the ANR area, and harvest areas, under the baseline scenario for year t.
Sources of data:	Historical LULC classification and land-use change modelling
Measurement procedures:	Calculate based on the LULC classification
Frequency of monitoring:	At least once before every baseline. For added instances, may be recalculated at verification.
Value applied:	See the land-use change transition maxtix.
Monitoring equipment:	n/a
QA/QC procedures to be applied:	

Purpose of Data:	Used to establish LULC transitions in the baseline scenario
Calculation method:	Follow the procedures described in Section 8.1.5 of the methodology to calculate a land-use change transition matrix, which summarizes all predicted LULC transitions.
Any comment:	Required for PD

Data/parameter [MN4]:	$\Delta area_{projectAreaWithANR,baselineScenario}(t,i)$
Data unit:	[ha yr^{-1}]
Description:	Hectares undergoing transition i within the ANR area under the project scenario for year t and in stratum *i*.
Sources of data:	Land-use change modelling
Measurement procedures:	Calculate based on the LULC classification, summarized in the transition rates analysis described in Section VCS PD 3.1.5.
Frequency of monitoring:	At least once before every baseline update. For added instances, may be recalculated at verification.
Value applied:	N/A
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	Used to predict LULC transitions in the baseline scenario
Calculation method:	Follow the procedures described in Section 8.1.5 of the methodology to calculate a land use change transition matrix, which summarizes all predicted LULC transitions.
Any comment:	N/A for this Project

Data/parameter [MN5]:	$\Delta area_{leakageArea,projectScenario}(t,i)$
Data unit:	[ha yr^{-1}]
Description:	Hectares undergoing transition i within the Leakage Area under the project scenario for year t
Sources of data:	Remote sensing analysis
Measurement procedures:	Calculate based on the LULC classification, summarized in the transition rates analysis described in Section VCS PD 3.1.5.
Frequency of monitoring:	At least once before verification
Value applied:	For the ex-ante predictions see Table 49, Table 50 and Table 51.
Monitoring equipment:	n/a
QA/QC procedures to be applied:	
Purpose of Data:	Used to predict LULC transitions in the Leakage Area under the project scenario
Calculation method:	Follow the procedures described in Section 8.1.5 of the methodology to calculate a land use change transition matrix, which summarizes all predicted LULC transitions.
Any comment:	Required for M1

Data/parameter [MN6]:	$\Delta area_{leakageArea,baselineScenario}(t,i)$
Data unit:	[ha yr^{-1}]
Description:	Hectares undergoing transition i within the Leakage Area under the baseline scenario during year t
Sources of data:	Land-use change modelling
Measurement procedures:	Calculate based on the LULC classification, summarized in the transition rates analysis described in Section VCS PD 3.1.5.
Frequency of monitoring:	Once every baseline update. May also be updated at the time of

	instance inclusion that requires new Leakage Area.
Value applied:	See Table 49, Table 50 and Table 51.
Monitoring equipment:	n/a
QA/QC procedures to be applied:	
Purpose of Data:	Used to predict LULC transitions in the Leakage Area under the baseline scenario
Calculation method:	Follow the procedures described in Section 8.1.5 of the methodology to calculate a land use change transition matrix, which summarizes all predicted LULC transitions.
Any comment:	Required for PD

Data/parameter [MN7]:	$\Delta area_{historical}(CS_1 \rightarrow CS_2, t_1 \rightarrow t_2)$
Data unit:	[ha yr^{-1}]
Description:	Area of transition from LULC class or forest stratum 1 to 2 from time 1 to 2 during the historical reference period
Sources of data:	Remote sensing analysis
Measurement procedures:	Calculate based on the LULC classification, summarized in the transition rates analysis described in Section VCS PD 3.1.5.
Frequency of monitoring:	At least once before every baseline update
Value applied:	See Gross Emission Workbooks sheet “2a. RR - Transition rates” for each Project Area
Monitoring equipment:	n/a
QA/QC procedures to be applied:	
Purpose of Data:	To calculate the baseline annualize deforestation rate
Calculation method:	Follow the procedures described in Section 8.1.5 of the methodology to calculate a land use change transition matrix, which summarizes all predicted LULC transitions.
Any comment:	Required for PD

Data/parameter [MN8]:	$RFRGrate(CS_1 \rightarrow CS_2)$
Data unit:	[yr^{-1}]
Description:	Relative annual forest cover increase and regeneration factor for the transition from class or stratum 1 to 2.
Sources of data:	Remote sensing analysis
Measurement procedures:	Calculate based on the remote sensing-based classification and stratification procedures detailed in section. Multiply with 100 to obtain a forest cover increase and regeneration rate in percentage per year.
Frequency of monitoring:	At least once before every baseline update
Value applied:	See Gross Emission Workbooks sheet “2a. RR - Transition rates” for each Project Area
Monitoring equipment:	n/a
QA/QC procedures to be applied:	
Purpose of Data:	To calculate the baseline annualized reforestation rate
Calculation method:	Follow the procedures described in Section 8.1.5 of the methodology to calculate a land use change transition matrix, which summarizes all predicted LULC transitions.
Any comment:	Required for PD

Data/parameter [MN9]:	$area_{historical}(CS_1, t_1)$
Data unit:	[ha]

Description:	Total area of LULC class or forest stratum 1 at time 1
Sources of data:	Remote sensing analysis
Measurement procedures:	Calculate based on the remote sensing-based classification and stratification procedures detailed in Section 1.10.3
Frequency of monitoring:	At least once before every baseline update
Value applied:	See worksheet 2c. RR - DF, RF, DG, RG in GER workbook for values.
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	Required for PD

Data/parameter [MN10]:	$area_{biomassLoss}(i)$
Data unit:	$[ha\ yr^{-1}]$
Description:	Total annual area of LULC class i that was cleared for creating firebreaks
Sources of data:	Records of implemented activities or management plan
Measurement procedures:	
Frequency of monitoring:	At least once before verification
Value applied:	Not estimated for the PD, as fire management plan has not been developed
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	Required for M1

Data/parameter [MN11]:	$area_{fireBiomassLoss}(i)$
Data unit:	$[ha\ yr^{-1}]$
Description:	Annual area of forest stratum i that was cleared by using prescribed burning
Sources of data:	Records of implemented activities or management plan
Measurement procedures:	
Frequency of monitoring:	At least once before verification
Value applied:	Not estimated for the PD, as fire management plan has not been developed
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	Required for M1

Data/parameter [MN12]:	$area_{fireBiomassLoss,ANR}(t,i)$
Data unit:	[ha]
Description:	Area of biomass removed by prescribed burning within ANR stratum i during year t
Sources of data:	Records of implemented activities
Measurement procedures:	Only to be included if ANR activities are implemented.
Frequency of monitoring:	At least once before verification
Value applied:	n/a

Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	N/A for this Project

Data/parameter [MN13]:	$area_{projectAreaWithANR,projectScenario}(t,i)$
Data unit:	[ha]
Description:	Amount of land on which ANR activities are planned under the project scenario for year t and in stratum i
Sources of data:	Records of implemented activities
Measurement procedures:	Only to be included if ANR activities are implemented.
Frequency of monitoring:	At least once before verification
Value applied:	n/a
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	N/A for this Project

Data/parameter [MN14]:	$area_{harvest}(t,i)$
Data unit:	[ha]
Description:	Area of forest in harvest stratum i that is harvested at time t.
Sources of data:	Project Design Document or Forest/Harvest Management Plan
Measurement procedures:	
Frequency of monitoring:	At least once before verification
Value applied:	n/a
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	N/A for this Project

Data/parameter [MN15]:	$area_{projectAreaWithHarvest,projectScenario}(t,i)$
Data unit:	[ha yr^{-1}]
Description:	Size of strata i within the Project Area with harvest activities during year t under the project scenario.
Sources of data:	Remote sensing analysis
Measurement procedures:	Follow the procedures described in Section 1.10.3
Frequency of monitoring:	At least once before verification
Value applied:	n/a
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	N/A for this Project

Data/parameter [MN16]:	$\Delta area_{projectAreaWithHarvest,baselineScenario}(t,i)$

Data unit:	[ha yr^{-1}]
Description:	Hectares undergoing transition i within the harvest areas under under the baseline scenario during year t.
Sources of data:	Land-use change modelling
Measurement procedures:	
Frequency of monitoring:	At least once before every baseline update
Value applied:	n/a
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	N/A for this Project

Data/parameter [MN17]:	$BetaReg_{DF}(t)$and $BetaReg_{DG}(t)$
Data unit:	[ha yr^{-1}]
Description:	Beta regression model describing the relationship between time and deforestation/degradation rate in the Reference Region during the historical reference period.
Sources of data:	Historic forest degradation and deforestation modelling
Measurement procedures:	Procedure described in Section 4 or similar approach from peer-reviewed scientific literature.
Frequency of monitoring:	At least once every baseline update
Value applied:	
Monitoring equipment:	n/a
QA/QC procedures to be applied:	
Purpose of Data:	To determine the future deforestation rate
Calculation method:	
Any comment:	Required for PD

4.2.2 Locations, Descriptions, Qualitative, and Social Data

Data/parameter [MN18]:	Area under agricultural intensification
Data unit:	[ha]
Description:	Size of the area of agricultural intensification separated for each agricultural intensification measure
Sources of data:	Participatory rural appraisals
Measurement procedures:	Calculate based on areas of cropland in the Leakage Areas
Frequency of monitoring:	At least once before verification
Value applied:	All the agriculture crop areas in the Leakage Areas.
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	To estimate amount of non-CO_2 emissions from increased crop intensification and qualitatively indicate the economic benefits to the local communities. See 1.8.7 for additional details.
Calculation method:	
Any comment:	The crop intensification activities does not result in additional GHG emissions and therefore, no attempt was made in demarcating agricultural intensification activities.

Data/parameter [MN19]:	Yields under agricultural intensification
Data unit:	[Mg ha^{-1}]

Description:	Harvested yield for agricultural intensification practices
Sources of data:	Participatory rural appraisals
Measurement procedures:	Literature
Frequency of monitoring:	At least once before verification
Value applied:	Double the amount of the non-project condition.
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	To estimate of the reduction of drivers impact on deforestation.
Calculation method:	Used literature values and expert knowledge. Recent studies have shown that maize yields averaged 1.59 t/ha, doubling the 0.76 t/ha of the drought-affected 2004–2005 season (Denning et al. 2009).
Any comment:	Maize is the primary crop in Malawi, nearly 97% of the cropping involves maize.

Data/parameter [MN20]:	NTFP harvest rate
Data unit:	[m^3 yr^{-1}] or [kg yr^{-1}]
Description:	Annual volumes of non-timber forest products extracted
Sources of data:	Participatory rural appraisals
Measurement procedures:	Estimate among participating communities and communities living in the Leakage Area.
Frequency of monitoring:	At least once before verification
Value applied:	Abosoluate values were not used. 20-30 kg of honey per year per bee hive (TTAL n/d, and FAO 1999).
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	Indicator of the role of NTFP in reducing the deforestation drivers' impact.
Calculation method:	Literature value)
Any comment:	Our PRA survey did not result in exact quantity of the NTFPs harvest rate. The survey however, reported that the NTFP collection trends have been increasing. This is an important livelihood support and project will continue to support such activities. <table><tr><td>Trend</td><td>% of respondent</td></tr><tr><td>Decreased</td><td>7.4</td></tr><tr><td>Increased</td><td>72.9</td></tr><tr><td>Stayed the same</td><td>19.7</td></tr></table>(Source PRA)

Data/parameter [MN21]:	Local NTFP price
Data unit:	Local currency
Description:	Price of non-timber forest products on local markets
Sources of data:	Participatory rural appraisals
Measurement procedures:	
Frequency of monitoring:	At least once before verification
Value applied:	MK700 per kg of honey (with farm gate price of MK 150 per kg) (TTAl n/d). MK200 (US$ 4.5 - 5 approximately) per bush meat (FAO 1999).
Monitoring equipment:	

QA/QC procedures to be applied:	
Purpose of Data:	Indicator of the role of NTFP in reducing the deforestation drivers' impact.
Calculation method:	
Any comment:	

4.2.3 Data on Drivers and Actions

Data/parameter [MN22]:	$CFW_{baseline}$
Data unit:	[m^3 yr^{-1}]
Description:	Annual volume of fuelwood gathering for commercial sale and charcoal production in the baseline scenario
Sources of data (*):	• Participatory rural appraisals • Recent (<10 yr) literature in the Reference Region • Recent (<10 yr) literature in an area similar to the Reference Region
Measurement procedures:	$CFW_{baseline}$ may only be measured using the first option, social assessments.
Frequency of monitoring:	At least once before every baseline update
Value applied:	71.339 Mg DM Yr^{-1}
Monitoring equipment:	n/a
QA/QC procedures to be applied:	
Purpose of Data:	Estimate the impact of drivers on GHG emissions.
Calculation method:	Energy statistics (GOM 2009) showed that average per-capita charcoal consumption for northern and southern region was estimated to be 5.58 kg per year per person. The average per capita value for the northern region was 5.22 kg per year and for the southern region, 5.93 kg per year. The household surveys showed that about 2.8% of the total households use charcoal. Thus, an average charcoal use value was multiplied with the total number of household using charcoal to estimate the annual fuelwood used for charcoal.
Any comment:	1. GER Workbook sheet "0. Drivers and parameters". Value is estimated in Mg DM per year.

Data/parameter [MN23]:	$DFW_{baseline}$
Data unit:	[m^3 yr^{-1}]
Description:	Annual volume of fuelwood gathered for domestic and local energy in the baseline scenario
Sources of data (*):	• Participatory rural appraisals • Recent (<10 yr) literature in the Reference Region • Recent (<10 yr) literature in an area similar to the Reference Region
Measurement procedures:	If emission reductions from avoided degradation were excluded due to insufficient accuracy, in which case $u_{classification} = 0$, and emission reductions from fuel-efficient woodstoves are included, $DFW_{baseline}$ may only be measured using the first option, social assessments.
Frequency of monitoring:	At least once before every baseline update
Value applied:	2717.21 kg per household for 88,740 households.
Monitoring equipment:	
QA/QC procedures to be applied:	

Purpose of Data:	To estimate amount of GHG emissions from driver – fuelwood gathering.
Calculation method:	
Any comment:	See GER Workbook sheet “0. Drivers and parameters.

Data/parameter [MN24]:	$DFW_{project}$
Data unit:	[m^3 yr^{-1}]
Description:	Biomass (dry matter) of fuelwood collected by project participants under the project scenario.
Sources of data (*):	• Participatory rural appraisals • Recent (<10 yr) literature in the Reference Region • Recent (<10 yr) literature in an area similar to the Reference Region
Measurement procedures:	Project design
Frequency of monitoring:	At least once before verification
Value applied:	95% of the $DFW_{baseline}$
Monitoring equipment:	
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	Required for M1

Data/parameter [MN25]:	$DFW_{allowed}$
Data unit:	[m^3 yr^{-1}]
Description:	Biomass (dry matter) of allowed fuelwood collection in the Project Area under the project scenario. This amount is typically fixed in a management plan. [m3 yr-1]
Sources of data (*):	Forest management plan
Measurement procedures:	
Frequency of monitoring:	At least once before every baseline update
Value applied:	Equivalent to $DFW_{project}$
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	Required for PD

Data/parameter [MN26]:	$VG_{baseline}$
Data unit:	[m^3 yr^{-1}]
Description:	Biomass (dry matter) of understory vegetation extraction by project participants under the baseline scenario. [Mg DM yr-1]
Sources of data (*):	• Participatory rural appraisals • Recent (<10 yr) literature in the Reference Region • Recent (<10 yr) literature in an area similar to the Reference Region
Measurement procedures:	Calculate by multiplying the number of households involved in extraction of vegetation with the average annual extraction rate by household for different vegetation types
Frequency of monitoring:	At least once before every baseline update

Value applied:	n/a
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	Estimate amount of GHG emissions from understory vegetation collection.
Calculation method:	
Any comment:	The driver related to this parameter was found to cause a small fraction of total GHG emissions loss in the baseline. Thus, was not included in the project design. All carbon loss associated with thatch grass collection is associated with forest degradation not deforestation (see Table 3 below). Forest degradation is not accounted in the Kulera project, therefore the carbon loss associated with this driver assumed zero.

Data/parameter [MN27]:	$VG_{project}$
Data unit:	[Mg DM yr-1]
Description:	Biomass (dry matter) of understory vegetation extraction by project participants under the project scenario.
Sources of data (*):	• Participatory rural appraisals • Recent (<10 yr) literature in the Reference Region • Recent (<10 yr) literature in an area similar to the Reference Region
Measurement procedures:	Calculate by multiplying the number of households involved in extraction of vegetation with the average annual extraction rate by household for different vegetation types
Frequency of monitoring:	At least once before verification
Value applied:	n/a
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	The driver related to this parameter was found to cause a small fraction of total GHG emissions loss in the baseline. Thus, was not included in the project design. Communities re allowed to use the understory at the same rate as baseline.

Data/parameter [MN28]:	$VG_{allowed}$
Data unit:	[Mg DM yr-1]
Description:	Biomass (dry matter) of allowed as understory vegetation extraction under the project scenario. This amount is typically fixed in a management plan
Sources of data (*):	Forest management plan
Measurement procedures:	
Frequency of monitoring:	At least once before every baseline update
Value applied:	n/a
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	The driver related to this parameter was found to cause a small fraction of total GHG emissions loss in the baseline. Thus, was

	not included in the project design. Communities re allowed to use the understory at the same rate as baseline.

Data/parameter [MN29]:	$CT_{baseline}(h, j, ty, t)$
Data unit:	[m^3 yr^{-1}]
Description:	Annually extracted volume of harvested timber round-wood for commercial on-sale under the baseline scenario during harvest h by species j and wood product class ty during year t
Sources of data (*):	• Participatory rural appraisals conducted by project proponents. • Recent (<10 yr) literature in the Reference Region • Recent (<10 yr) literature in an area similar to the Reference Region • Recent (<10 yr) non peer-reviewed reports by local organizations
Measurement procedures:	PRA
Frequency of monitoring:	At least once before every baseline update
Value applied:	0
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	N/A for this Project

Data/parameter [MN30]:	$CT_{allowed}$
Data unit:	[m^3 yr^{-1}]
Description:	Annually allowed volume of harvested timber round-wood for commercial on-sale under the project scenario
Sources of data (*):	Project document and/or management plan
Measurement procedures:	
Frequency of monitoring:	At least once before every baseline update
Value applied:	0
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	Estimate volume for mixture of species
Calculation method:	
Any comment:	Commercial timber harvesting is not allowed under the project.

Data/parameter [MN31]:	$CT_{project}(h, j, ty, t)$
Data unit:	[m^3 yr^{-1}]
Description:	Annually extracted volume of harvested timber round-wood for commercial on-sale inside the Project Area under the project scenario during harvest h by species j and wood product class ty during year t.
Sources of data (*):	Project design, surveys, and statistical records.
Measurement procedures:	
Frequency of monitoring:	At least once before verification
Value applied:	0
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	

Calculation method:	
Any comment:	Commercial timber harvesting is not allowed under the project.

Data/parameter [MN32]:	$DT_{baseline}(h, j, ty, t)$
Data unit:	[m^3 yr^{-1}]
Description:	Annually extracted volume of timber for domestic and local use, round wood under the baseline scenario during harvest h by species j and wood product class ty during year t.
Sources of data (*):	• Participatory rural appraisals conducted by project proponents • Recent (<10 yr) literature in the Reference Region • Recent (<10 yr) literature in an area similar to the Reference Region • Recent (<10 yr) non peer-reviewed reports by local organizations
Measurement procedures:	
Frequency of monitoring:	At least once before every baseline update
Value applied:	77,538.8 Mg DM Per Year.
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	shown in MG DM per year.

Data/parameter [MN33]:	$DT_{allowed}$
Data unit:	[m^3 yr^{-1}]
Description:	Annually allowed volume of harvested timber round-wood for domestic and local use under the project scenario
Sources of data (*):	Project document and/or management plan
Measurement procedures:	
Frequency of monitoring:	At least once before every baseline update
Value applied:	77,538.8 Mg. DM per year
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	The harvested timbers for round-wood are for poles. The communities are expected to continue extracting these amount as in the baseline.

Data/parameter [MN34]:	$DT_{project}(h, j, ty, t)$
Data unit:	[m^3 yr^{-1}]
Description:	Annually extracted volume of timber for domestic and local use, round wood inside the Project Area under the project scenario during harvest h by species j and wood product class ty during year t.
Sources of data (*):	Project design, surveys, and statistical records.
Measurement procedures:	
Frequency of monitoring:	At least once before verification
Value applied:	
Monitoring equipment:	

QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	The harvested timber for round-wood are for poles. The communities are allowed to extract amount as in the baseline.

Data/parameter [MN35]:	$contribution_{DF}(d)$ and $contribution_{DG}(d)$
Data unit:	[-]
Description:	Relative contribution of driver i respectively to total deforestation and forest degradation.
Sources of data:	Calculated using procedure described in 3.1.2
Measurement procedures:	
Frequency of monitoring:	At least once before baseline update.
Value applied:	See Table 26. Relative importance of different deforestation drivers to total deforestation rate
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	Required for PD

Data/parameter [MN36]:	$RelativeDriverImpact_{DF}(t,d)$ and $RelativeDriverImpact_{DG}(t,d)$
Data unit:	[-]
Description:	Relative impact of the geographically unconstrained driver d at time t of the crediting period respectively on deforestation and forest degradation.
Sources of data:	Calculated using procedure described in 3.3.5
Measurement procedures:	
Frequency of monitoring:	At least once before baseline update.
Value applied:	See Section 3.3.5.
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	Required for PD

Data/parameter [MN37]:	$leakage_{unconstrained}(d)$
Data unit:	[-]
Description:	Leakage cancellation rate for avoiding deforestation/degradation from geographically unconstrained drivers.
Sources of data:	Valid sources to substantiate a smaller leakage rate include social assessments, scientific literature, and reports from civil society or governments. Sources have to be reliable and based on scientific methods and a good statistical design.
Measurement procedures:	
Frequency of monitoring:	At least once before baseline update.
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	

Purpose of Data:	Unless a lower rate can be justified, a default rate of 100% must be used.
Calculation method:	
Any comment:	There is no geographically unconstrained driver applicable in the Project Area.

Data/parameter [MN38]:	$effectiveness(a,d)$
Data unit:	[-]
Description:	Effectiveness of every project activity a in decreasing any deforestation driver d relative to that driver's contribution to deforestation and forest degradation,
Sources of data:	Literature or expert opinion.
Measurement procedures:	
Frequency of monitoring:	At least once before baseline update.
Value applied:	See Table 43. Relative reduction (%) in the impact of drivers of deforestation and degradation due to Project Activities
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	The $effectiveness(a,d)$ factor represents the maximal effectiveness during the crediting period.

Data/parameter [MN39]:	$\mathrm{GR}_{\mathrm{allowed}}$
Data unit:	[-]
Description:	Number of grazing animals of type g allowed for grazing within the project boundary in the project scenario
Sources of data:	Project management plan
Measurement procedures:	Calculate by multiplying the number of animals taking into account different types of grazing animals.
Frequency of monitoring:	At least once before verification
Value applied:	n/a
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	N/A for this Project

Data/parameter [MN39]:	$Fuelwood(t)$, $Fuel(t)$
Data unit:	[Mg DM yr^{-1} HH^{-1}]
Description:	Average annual volume of biomass fuel consumed by households in the absence of the project activity in year t for cooking purpose.
Sources of data:	Social assessments results or wood energy statistics applicable to the project
Measurement procedures:	
Frequency of monitoring:	At least once every baseline update
Value applied:	2.72 [MG DM yr-1 HH-1] . See 2. Calculate emissions sources workbook and sheet "S_Cookstove" for details.

Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	Required for PD

Data/parameter [MN40]:	$HH_{non-CFE}(t)$
Data unit:	[-]
Description:	Total number of household in the Project Area that collect biomass fuel from the Project Area and do not use CFE in year t.
Sources of data:	Social assessments results or wood energy statistics applicable to the project
Measurement procedures:	*Ex-post,* this value must be obtained from socio-economic survey.
Frequency of monitoring:	At least once before verification
Value applied:	(see table below)
Monitoring equipment:	
QA/QC procedures to be applied:	

Value applied:

Year (t)	Number of stoves maintained 〚HH〛_(non-CFE) (1,t)
	[-]
1	7,000
2	10,500
3	14,000
4	24,500
5	31,500
6	35,000
7	35,000
8	35,000
9	35,000
10	35,000
11	35,000
12	35,000
13	35,000
14	35,000
15	35,000
16	35,000
17	35,000
18	35,000
19	35,000
20	35,000
21	35,000
22	35,000
23	35,000
24	35,000
25	35,000
26	35,000
27	35,000
28	35,000
29	35,000
30	35,000

Purpose of Data:	
Calculation method:	
Any comment:	See 2. Calculate emissions sources workbook and “S_Cookstove” worksheet for details.

Data/parameter [MN41]:	η_{old}
Data unit:	[-]
Description:	Efficiency of the project cook stoves or appliances.
Sources of data:	Default value of 0.10 for three stone stove or conventional stove that lacks improved combustion air supply mechanism and flue gas ventilation systems i.e., without a grate as well as a chimney; for rest of the systems 0.2 default value may be used.
Measurement procedures:	Methodology default for three stone cook stove.
Frequency of monitoring:	At least once every baseline update
Value applied:	0.10. See 2. Calculate emissions sources workbook, and sheet “S_Cookstove” for details.
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	Required for PD

Data/parameter [MN42]:	η_{new}
Data unit:	[-]
Description:	Efficiency of the baseline cook stoves or appliances.
Sources of data:	
Measurement procedures:	Measured using representative sampling method or based on referenced literature values. Use weighted average values if more than one type of systems is used.
Frequency of monitoring:	Since the stoves used are manufactured by recognized industry (i.e., TLC) that is still in business and provides assures the functional integrity of the product by providing warranty for the stoves stated life, then the monitoring must be done once every baseline update.
Value applied:	0.25
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	Conservative value for thermal efficiency determined by TLC. It was stated by TLC that the fuelwood consumption is reduced by 80% compared to traditional three stone stoves in Malawi.
Any comment:	Required for PD

Data/parameter [MN43]:	$U_{CFE}(t)$
Data unit:	[-]
Description:	Fraction of cumulative usage rate for technologies in project scenario in year t. [-]
Sources of data:	Social assessments or wood energy statistics applicable to the project
Measurement procedures:	Cumulative adoption rate and drop off rate revealed by usage surveys [-].

Value applied:	1, the stoves are built in and thus the usage rate is 100%
Monitoring equipment:	
Frequency of monitoring:	Annual
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	Project records.
Any comment:	

Data/parameter [MN44]:	$DF_{LeakageCFE}(t)$
Data unit:	[-]
Description:	Leakage discount factor applicable to GHG emissions reduction benefits from CFE activities [-]
Sources of data:	Default value of 0.95 following AMS.II.G CDM methodology. Social assessments or wood energy statistics applicable to the project.
Measurement procedures:	Leakage related to the non-renewable woody biomass saved by the project activity must be assessed based on surveys of users and the areas from which woody biomass saved under the project by non-project households that previously used renewable energy or efficient appliances must be considered. If this leakage assessment quantifies an increase in the use of non-renewable woody biomass, that is attributable to the project activity, then biomass used in the baseline must be adjusted by a factor ($\mathrm{DF_{LeakageCFE}}$) to account for the leakage.
Frequency of monitoring:	None. The default value was used and thus monitoring requirement is waived.
Value applied:	0.95.
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	Since a default value was used, no survey was required. See 2. Calculate emissions sources workbook, and sheet “S_Cookstove”.

Data/parameter [MN45]:	$EF_{non-CO2,fuel}$, $EF_{CO2,fuel}$
Data unit:	[t CO_2 TJ^{-1}]
Description:	Respectively, non--CO_2 emission factor of the fuel that is reduced and CO_2 emission factor for the substitution of non-renewable woody biomass by similar consumers.
Sources of data:	Social assessments or wood energy statistics applicable to the project
Measurement procedures:	Emission factor can include a combination of emission factors from fuel production, transport, and use. Both CO_2 and Non-CO_2 of the fuel such as emissions factors for charcoal can be estimated from project specific monitoring or alternatively by researching a conservative wood to charcoal production ratio (from IPCC, credible published literature, project-relevant measurement reports, or project-specific monitoring) and multiplying this value by the pertinent emission factor of wood.
Frequency of monitoring:	At least once before verification
Value applied:	30.3 [Mg CO_2 TJ-1] for EF_Non-CO_2, and 112. MG CO_2 TJ-1

	for EF_ CO_2
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Purpose of Data:	
Calculation method:	
Any comment:	See 2. Calculate emissions sources workbook, and sheet "S_Cookstove"

Data/parameter [MN47]:	EF_{forest}
Data unit:	[t CO_2e]
Description:	Emission factor related to leakage.
Sources of data:	If comprehensive national-level statistics on biomass densities are available, EF_{forest} must be calculated based on the average biomass of the country, if local data is not available. Sources of the data allowed are (1) academic research papers and (2) studies and reports published by the forestry administration or other organizations, including the FAO's Forest Resource Assessment reports, (3) the upper range of biomass in the GPG-LULUCF (2003) Table 3A.1.2.
Measurement procedures:	
Frequency of monitoring:	At least once before verification
Value applied:	n/a
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	To estimated emission factor for unconstrained leakage.
Calculation method:	
Any comment:	See parameter 'Maximum biomass emissions' in worksheet "8. Emissions factor' in workbook '1. Gross Emissions Reductions"

4.2.4 Data on Organic Matter and Carbon Densities

Data/parameter [MN48]:	$OM_o(i)$
Data unit:	[Mg DM ha^{-1}]
Description:	Plant-derived organic matter of LULC class or forest stratum i in pool o. [Mg DM ha^{-1}]
Sources of data:	Field measurements using sampling plots in forest strata or LULC classes.
Measurement procedures:	The average biomass stock density in applicable organic matter pools: aboveground tree - $OM_{AGT}(i)$, aboveground non-tree - $OM_{AGNT}(i)$, lying dead wood - $OM_{LDW}(i)$, standing dead wood $OM_{SDW}(i)$, belowground $OM_{BG}(i)$, and soil organic matter $OM_{SOM}(i)$
Frequency of monitoring:	At least once before every baseline update
Value applied:	See Table 32. Basic statistical measures of field measurements in different LULC classes
Monitoring equipment:	
QA/QC procedures to be applied:	Follow uncertainty deduction procedures described in methodology. Re-measure plots by independent teams.
Purpose of Data:	
Calculation method:	

Any comment:	Summed across multiple pools and divided into $OM_{plant}(i)$ and $OM_{soil}(i)$ Required for PD

Data/parameter [MN49]:	$proportion_{DF}(d)$ and $proportion_{DG}(d)$
Data unit:	[-]
Description:	Proportion of the gradual carbon loss that leads to deforestation or forest degradation, respectively, due to driver d
Sources of data:	Estimate using the procedure detailed in Table 8 in Section 8.1.3.2 of the methodology.
Measurement procedures:	
Frequency of monitoring:	At least once before every baseline update
Value applied:	(see table below)
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	See Section 3, in worksheet ‘0. Drivers and Parameters’ in workbook ‘1. Gross Emission Reduction.’

Drivers	Proportion _DF(i)	Proportion _DG(i)
Wood for cooking and heating locally	5	95
Wood and poles for construction and domestic use (including tobacco curing)	100	0
Forest fires for other anthropogenic reasons	100	0
Conversion of forest to small-scale agriculture	100	0
Forest fires by hunters (mice hunters)	100	0
Collection of wood for charcoal	5	95
Fire to contain animals inside the park	100	0

Data/parameter [MN46]:	$C(t,i)$
Data unit:	[Mg C ha^{-1} yr^{-1}]
Description:	Carbon stock density at time t in stratum i.
Sources of data:	Estimate within the biomass inventory plots
Measurement procedures:	
Frequency of monitoring:	At least once before verification
Value applied:	See Table 32. Basic statistical measures of field measurements in different LULC classes
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	Used in estimating change in carbon stock density such as in ANR areas. Required for PD

Data/parameter [MN47]:	$f_{allometric}(y)$
Data unit:	Equation
Description:	Allometric relationship to convert a tree metric such as DBH or

	tree height into biomass
Sources of data (*):	Allometric equations developed locally by groups other than project proponents
Measurement procedures:	
Frequency of monitoring:	May be updated at baseline update
Value applied:	For trees in evergreen plots >= 5 cm DBH: AGB = DENSITY * exp(-0.667 + 1.784 * ln(D) + 0.0207 (Ln(D))^2-0.0281(lnD))^3) For trees in miombo plots >= 5 cm DBH: 0.1027*(D)^2.4798)For trees <5 cm dbh: AGB=DENSITY * EXP(-1.32+1.893*LN(D))Where, AGB above ground biomass in kg, Density is in g/cm3, and D is dbh in cm.
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	Equation applicable for tropical dry forest from Chave et al. 2005 was used for trees larger than or equal to 5 cm dbh in evergreen plots, while the Mugasha et al. (2013) equation specific to miombo was used for miombo. Malimbwi et al. 1994 was used for trees smaller than 5 cm dbh.

Data/parameter [MN48]:	$f_{belowground}(y)$
Data unit:	Equation
Description:	Relationship between aboveground and belowground biomass, such as a root-to-shoot ratio
Sources of data (*):	A relationship obtained from the local/national studies that closely reflect the conditions of the project activity
Measurement procedures:	
Frequency of monitoring:	May be updated at baseline update
Value applied:	For evergreen forest - BGB = Exp(-1.0587+0.8836*LN(AGB)) For miombo forest – BGB = 0.54 * AGB For non-forest - BGB = 2.8 * AGB Where BGB is belowground biomass in kg and AGB is above ground biomass in kg
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	Estimated based on allometric equation by Cairns et al. 1997 for evergreen forest strata (tropical moist forest), and Chidumayo 2013 for miombo forest, and IPCC default value for non-forest (i.e. for grass and shrubs).
Any comment:	Required for PD

Data/parameter [MN49]:	$u_{classification}$
Data unit:	[-]
Description:	Discounting factor for NERs from avoided deforestation, based on the accuracy of classification, i.e. dividing land into broad land use types.
Sources of data:	
Measurement procedures:	Statistical analysis
Frequency of monitoring:	At least once before verification

Value applied:	See Table 20, Table 21, and Table 22
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	Required for PD

Data/parameter [MN54]:	$u_{transition}(i)$
Data unit:	[-]
Description:	Discounting factor for the emission factor for the transition from LULC class or forest stratum 1 to class 2 according to the uncertainty of the biomass inventory.
Sources of data:	
Measurement procedures:	Section 8.1.2.4.3
Frequency of monitoring:	At least once before verification
Value applied:	See Table 34. Emission factors and discounting factors for LULC transitions.
Monitoring equipment:	
QA/QC procedures to be applied:	
Purpose of Data:	
Calculation method:	
Any comment:	Required for PD

4.3 Description of the Monitoring Plan

This project will monitor all required components according to the methodology. In general, the following components for calculating actual GHG benefits generated by the REDD+ project, or Net anthropogenic Emission Reductions (NERs) are included in the monitoring plan.

- Monitoring of deforestation drivers, project activities and emission sources related to REDD+ project activities inside and outside of the Project Area.
- Monitoring LULC class and forest strata transitions in the Project Area, Leakage Area and Reference Region using remote-sensing technologies and validated with ground-truthing data.
- Monitoring carbon stock densities in LULC classes and forest strata.
- Monitoring carbon stock increases in the area on which ANR is performed.
- Monitoring of any natural disturbances regardless of the cause of the loss.

Before every verification event, a monitoring report will be produced which contains all of the information above, and which outlines the calculations for actual NERs generated. At every verification event, project proponents will attest that no other land-based carbon projects registered under any other carbon trading scheme (both voluntary and compliance-oriented) are present in the Project Area.

Note that any natural disturbance is fully accounted as part of the on-going monitoring during the crediting period. Any loss of biomass during the credited period is monitored and accounted for regardless of the cause of the loss.

4.3.1 Organizational Structure, Responsibilities and Competencies

- **Total LandCare**. During the first five years after validation of the project, the implementing partner (TLC) is responsible for managing, outsourcing and collecting the results of (1) biomass inventory measurements, (2) social assessments, (3) recording action activity implementation, and (4) any other data required to be monitored under this methodology. TLC will execute first-pass of quality assurance and quality control (QA/QC) checks on all of the data collected by them or any other partner. TLC will keep records of all field inventory and social appraisal data sheets and all other evidence demonstrating the correct execution of project implementation.

- **Department of Parks and Wildlife**. During the first five years of the project, the DPW will provide assistance in the field inventory measurements, and review the monitoring reports. The DPW will be trained to become the responsible party for all monitoring requirements five years after validation of the project.
- **Terra Global Capital**. During the first five years after validation of the project, Terra Global Capital is responsible for verifying that the required elements are monitored, overseeing or executing all modeling and calculations, and performing second-pass QA/QC checks. In addition, Terra Global Capital is responsible for developing the monitoring reports during the first five years after validation of the project.
- **Nawira and the Nyika-Vwaza Associations**. Report natural disasters and challenges related to forest protection, reports drivers of deforestation and suggested changes to project actions. The communities of the Nawira and the Nyika-Vwaza Associations have the responsibility to carry our project actions where appropriate.

4.3.2 Managing Data and Data Quality

The data quality will be maximized and ensured during all aspects of the monitoring process by quality assurance and quality control (QA/QC) procedures. To monitor field inventory data, data analysts, and involved individuals/institutions in evaluating the quality of analytical data, rigorous QA/QC procedures are developed relevant to this project. The QA/QC procedures include specific criteria to evaluate the quality of analytical data that has been gathered. The QA/QC procedures are therefore an absolutely essential part of monitoring.

Terra has created a cloud-based online system Terralytics, one of its many features is a document repository to share and store data and documents for the short or long-term. The repository is used and shared with Project Partners and is ideal for countries with low-bandwidth. In addition, hard copies of documents of interest are stored at the TLC office in Lilongwe and digital scans are stored on the Terra server. These two entities have committed to the project, and will be involved through the longevity period.

4.3.2.1 Procedures for Handling Internal Auditing and Non-conformities

The Kulera Biodiversity Project involves a wide range of stakeholders at village, community, zone, and national levels. The success of this long-term project depends on the ability of the stakeholders to effectively and amicably resolve any problems and issues that arise during implementation. As such, the project has developed policies and procedures providing guidance to project stakeholders on how to resolve resolving complaints and grievances.

The Project Stakeholders are defined as any individual with a stake in the implementation and outcomes of the Kulera Biodiversity Project. These include community members, local authorities, and NGOs.

The Project Team is defined as the core project management group composed of Total LandCare, Department of Parks and Wildlife, and the Nawira and Nyika-Vwaza Associations. Each institution shall assign one individual as its focal point member. In addition, one Project Team member shall be designated as the group’s Secretary responsible to keep and track records of meetings and correspondence.

Project Stakeholders may raise complaints and grievances to the Project Team or its member either verbally or in writing. The Project Team’s Secretary is obliged to (1) record every complaint and keep track of the status, and (2) keep complaints and grievances confidential unless otherwise directed by the Project Stakeholder.

4.3.2.2 Monitoring Grouped Projects

Additional project parcels may be added during crediting period and updated at each verification event given that they are applicable to the conditions listed in the methodology. It is expected that additional project parcels will be added in the future. The addition of these future parcels was taken into account when creating the Reference Region, as anticipated new parcels will have similar conditions to the Reference Region and leakage belt.

4.3.2.3 Monitoring Reporting

Monitoring will take place continually through the life of the Kulera REDD+ project. During each verification event a Monitoring Report will contain the *ex-post* values of the actual net GHG emission reductions. Actual net NERs must be based remote sensing, biomass inventories, and social surveys, and must follow steps in the methodology. Social data and biomass inventories gathered at Validation can be used for the first Monitoring Report.

5 ENVIRONMENTAL IMPACT

Legislation requiring an EIA is contained in the National Environment Management Act (EMA), No. 23 of 1996. The Environmental Management Act outlines the EIA process and requires project developers to comply with that process. The process is managed by the Director of Environmental Affairs (DEA) in the Environmental Affairs Department. The EIA requirement criteria specified under the EMA are based on project type, size and location.

According the EMA, a formal environmental impact assessment (EIA) was not required for the Project due to the nature and scale of the project activities. In general, EIAs must be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority. Additionally, only irrigation schemes above 10ha are required to submit an EIA (the Project’s treadle pump irrigation is much smaller scale).

Nonetheless, as a recipient of donor funds, the Project has to do an environmental screening of all activities to identify possible environmental impacts--rated as low, medium and high. For the medium to high impacts, an environmental management plan was developed to identify the risks and mitigation measures and to develop monitoring indicators based on project interventions (Table 53).

Table 53. Environmental management plan

Interventions	Likely Negative impacts	Mitigation measures	Mitigation monitoring indicators
Livestock Production	Deforestation due to timber used for kraal construction.	Encourage all participating farmers to plant trees around homesteads and in the fields	At least 3 million trees planted in communities where livestock production is being promoted
	Spread of zoonotic diseases (eg tapeworms from animals to humans can cause diseases)	Train farmers in proper livestock health and management	1000 community vaccinators trained in livestock health and management
	Improper usage of drugs by farmers which can have a health hazard.	Train farmers on safe drug use including dosage, container washing and disposal of used containers and other materials	All 50 vaccinators trained in drug handling and usage.
	Destruction of crops/trees due to livestock activities (especially in goats: eating young trees/seedlings and crops)	Train farmers on proper goat management; Encourage community participation in management of goats through the formation of community groups	200 participating farmers trained in goat management; At least 5 community groups formed
Improved cook stoves	Indoor smoke pollution if constructed in a poorly ventilated kitchen	Promote well ventilated kitchens; The stove must be constructed directly opposite the door.	5,000 HHs having well ventilated kitchens.
Conservation Agriculture	Introduction of herbicides to suppress weed growth may have negative effect on people during spraying	Train farmers on handling of herbicides (safety measures); Procure recommended pesticides	1,000 farmers trained on herbicides safety measures; Round-up (1liter bottles) procured
	Too much herbicide can damage emerging plants	Train farmers on recommended methods of mixing and spraying	1,000 farmers trained in recommended methods of mixing and spraying

Interventions	Likely Negative impacts	Mitigation measures	Mitigation monitoring indicators
Irrigation	Reduction of water downstream causing social conflict;	Leaving a buffer zone from the river. (Protection of stream banks); Formation of water users groups.	200 of farmers sensitized in proper use of streams; # of functioning water users groups
	Runoff water pollution by herbicides and fertilizers.	Proper canal alignment to avoid water seepage	200 of farmers trained and sensitized
	Excess use of treadle pump irrigation can cause the water table to be lowered	a) Sensitize farmers on proper usage of wetlands; b) Practice Conservation Agriculture to help recharge ground water table.	a) 200 farmers sensitized during irrigation campaigns; b) 50% of irrigation farmers practicing Conservation Agriculture
Tree planting	Disposal of polythene tubes	Sensitize communities on proper storage and reuse of polythene tubes	1,500,000 tubes recycled.
	Potholes caused by tapping of soil for filling polythene tubes	Scraping topsoil than digging	15,000 households sensitized
	Loss of other species by clearing the area	Encourage enrichment planting without bringing invasive species	15, 000 of households sensitized
Coffee and Macadamia production	Spraying of Herbicides and pesticides may cause harm to human body due to unsafe handling	Train farmers in proper handling of herbicides and pesticides.	420 macadamia growers trained in pesticide use and handling; 557 Coffee growers trained in pesticide use and handling
Coffee production	Pulps going into rivers and streams causing harm to marine life.	Pulp pit construction; Compost the pulps	3 pulp pits constructed and functional; # of heaps of compost made from pulp
	Effluent water discharging into rivers and streams causing harm to aquatic life.	Effluent water pit construction	2 effluent water pits constructed and functional.
Macadamia production	Soil erosion and water loss caused by clearing of fields.	Practice minimal tillage and promote maximum soil cover- either with mulch or other crops.	# of farmers trained in conservation farming.

6 STAKEHOLDERS COMMENTS

The Project was developed through a highly collaborative process, involving senior technical staff from all TLC Team Partners. This process included extensive consultations with officials from all relevant GOM Ministries and Departments to incorporate their respective visions into our approach and to ensure alignment with key national and international policies and strategies. Consultations also involved leaders of community-based organizations around Protected Areas and local private sector firms to better understand the challenges and opportunities from their perspective. Assessments of development initiatives in Malawi and elsewhere were undertaken to document key accomplishments, successes, and lessons as a foundation for the Project's strategic focus.

Additionally, during the first four years of the Project, TLC and extension workers conducted a variety of community consultation activities aimed at training, information sharing, and learn-by-doing on topics related to the Project activities. Topics of focus for these consultations included but were not limited to: agricultural extension and training, monitoring and evaluation, nurseries and tree planting, improved cookstoves, crop diversification, irrigation, enterprise development, and business skills and marketing.

Community Association officials engaged with village-level natural resource management committees (VNRMCs), who have committed to ensuring implementation of co-management agreements. Community Associations are also committed to maintaining agreements with community members to ensure that communities have given informed consent and support the Project, which will require on-going community consultations by the Association officials.

Table 54 represents a partial listing of community consultation activities that have taken place through March 2013 across the Rumphi, Kasungu, and Nkhotakota zones.

Table 54. Community consultations through March 2013

	Community consultation type				
Period	Staff training	Community sensitization meetings	Community training/ demonstrations	Field days	Field tours
Year 1 (November 2009 - September 2010)	Initial project implementation took six months; no notable community consultation progress in Year 1				
Year 2 (October 2010 - September 2011)	119	2,291	872	20	7
Year 3 (October 2011 - September 2012)	39	4,296	1,751	113	28
Year 4 (October 2012 - September 2013)*	53	1,176	909	70	0
Total (through March 2013)	211	7,763	3,532	203	35

**Data on community consultations not available after March 2013 at the time of this report*

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8 APPENDIX A. ABBREVIATIONS

ADP	Agriculture Development Program
AFOLU	Agriculture, Forestry and Other Land Use
ANR	Assisted Natural Regeneration
AUMDD	Avoiding Unplanned Mosaic Deforestation and Degradation
BAR	Bare Ground
BRN	Burned land
C	Carbon
CCB	Climate, Community and Biodiversity Alliance
CDA	Children's Development Association
CDM	Clean Development Mechanism
CFE	Cookstove and Fuel Efficiency
CISANET	Civil Social Agricultural Network
CLD	Cloud
CO_2e	Carbon Dioxide Equivalent
DBH	Diameter at Breast Height
DEA	Director of Environmental Affairs
DEM	Digital Elevation Model
DF	Deforestation
DNA	Designated National Authority
DNPW	Department of National Parks and Wildlife
DTED	Digital Terrain Elevation Data
EIA	Environmental Impact Assessment
EMA	National Environmental Management Act
EVG	Evergreen
FAO	Food and Agriculture Organization
FR	Forest Reserve
GER	Gross Emission Reductions
GHG	Green House Gas
GIS	Geographic Information System
GLOVIS	Global Visualization Viewer
GOM	Government of Malawi
GPS	Global Positioning System
GRS	Grassland
GVH	Grouped Village Headman
ha	hectares

IPCC	Intergovernmental Panel on Climate Change
KBP	Kulera Biodiversity Project
km	kilometer
LCL	Lower Confidence Limit
LULC	Land Use / Land Cover
LULUCF	Land use, Land-Use Change, and Forestry
MACC	Management for Adaptation to Climate Change
MIO	Miombo
NAWIRA	Nkhotakota Wildlife Reserve Association
NED	National Elevation Dataset
NER	Net Emission Reductions
NGO	Non-Governmental Organization
NKK	Nkhotakota
NP	National Park
NRM	Natural Resource Management
NTFP	Non-Timber Forest Products
NV	Nyika-Vwaza
NVA	Nyika-Vwaza Association
PA	Protected Area
PD	Project Description
PRA	Participatory Rural Appraisal
QA/QC	Quality Assurance / Quality Control
REDD	Reduced Emissions from Deforestation and Degradation
RF	Reforestation
SHB	Shrubland
SHD	Shadow
SRTM	Shuttle Radar Topography Mission
TGC	Terra Global Capital
TLC	Total LandCare
TRI	Terrain Ruggedness Index
UCL	Upper Confidence Limit
UNDP	United Nations Development Program
USAID	United States Agency for International Development
USGS	United States Geological Survey
VCS	Verified Carbon Standard
VCU	Verified Carbon Unit
WTR	Water