PROJECT DESIGN DOCUMENT FORM FOR
AFFORESTATION AND REFORESTATION **CDM PROJECT ACTIVITIES (F-CDM-AR-PDD)**
Version 06.0

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Niassa Reforestation Project
Version number of the PDD	02
Completion date of the PDD	12 November 2013
Project participant(s)	Niassa Green Resources SA, Green Resources AS
Host Party(ies)	Mozambique
Sectoral scope and selected methodology(ies)	14; CDM methodology AR-ACM0003, "Afforestation and reforestation of lands except wetlands" (Version 01.0.0)
Estimated amount of annual average GHG removals by sinks	23,585 t CO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The A/R CDM project, Niassa Reforestation Project (NRP), is a 5,242 ha reforestation project being implemented on three discrete parcels of degraded land in the Niassa Province in the north of Mozambique. The project is being implemented by Niassa Green Resources SA (NGR), a subsidiary of Green Resources AS (GRAS).

Overall objective of the proposed A/R CDM project

The overall objective of the A/R CDM activity is to contribute to mitigating climate change while meeting the growing demand for quality wood products from well managed plantation forests and contributing to sustainable environmental management, community development and poverty alleviation in Mozambique.

Specific objectives of the proposed A/R CDM project activity

• To establish and manage forest plantations to meet the growing demand of high quality wood products from sustainably managed forests. The Province of Niassa, through the Ministry of Agriculture, has recently encouraged the establishment of private forests plantations across the region. The implementation of the proposed A/R CDM project activity will therefore benefit the forestry sector through an increase in the resource supply, management and overall sustainability of the national resource base.

• To sequester carbon dioxide (CO_2) through the planting of managed forests in areas of degraded and degrading land, generating high quality emission reductions in greenhouse gases (GHG) that can be measured, monitored and verified. The project participants strive to demonstrate that carbon sequestration from forest plantations is a viable instrument to encourage private investment in the forestry sector especially on degraded lands, and in areas previously unattractive for investment.

• To promote environmental conservation, such as soil conservation, protection of water sources and enhancement of biodiversity through protection and management of existing indigenous flora and fauna and where possible enrichment planting with indigenous tree species.

• To facilitate socio-economic development of the local communities through:

- Promotion of tree planting and reforestation activities in the local communities
- Provision of employment and training opportunities for both skilled and unskilled labor
- Support the development of local community initiatives through designating 10 % ownership of the carbon revenues generated by the project to them to carry out development programs as decided upon by community representative committees

• To contribute for the development of local infrastructure including roads, bridges and public buildings

The species to be planted are mainly pine and eucalyptus species, including: *Pinus caribaea, Pinus elliottii, Pinus kesiya, Pinus oocarpa, Pinus patula, Pinus taeda, Pinus tecunumanii; Eucalyptus calmadulensis, Eucalyptus grandis, Eucalyptus saligna, Eucalyptus tereticornis, Eucalyptus urograndis and Eucalyptus grandis x camaldulensis* (clone). These species have been screened against the global database of invasive species and are not invasive in Mozambique[1]. However, in

[1] http://www.issg.org/database/species/search.asp?sts=sss&st=sss&fr=1&sn=&rn=mozambique&hci=-1&ei=173&lang=EN;

neighboring countries eucalyptus has been described as potentially invasive depending on how it is managed. The NRP will manage planted eucalyptus in recommended ways. The available forest management plan for the NRP lays out the procedures to avoid the spread of the Eucalyptus into other areas. The project is also being designed to meet the criteria of the Forest Stewardship Council™ (FSC™) and the Climate, Community and Biodiversity Standard (CCBS), which will confirm these practices as well as other social and environmental aspects of the project.

Table A.1.1 Species to be planted in the A/R CDM project

Plant/Species selected	Type	Common name	Uses
Pinus caribaea	Exotic softwood	Caribbean pine	fuel, fibre, timber, gum or resin, tannin or dyes, medicine
Pinus elliotii	Exotic softwood	Slash pine	
Pinus kesiya	Exotic softwood	Khasi pine	
Pinus maximinoi	Exotic softwood	Thinleaf Pine	fibre, timber, paper, firewood, resin extracts,
Pinus oocarpa	Exotic softwood	Mexican yellow pine, Hazelnut pine	construction, poles, fuel, gum or resin, medicine
Pinus patula	Exotic softwood	Patula pine	
Pinus taeda	Exotic softwood	Loblolly pine	
Pinus tecunumanii	Exotic softwood		
Eucalyptus camaldulensis	Exotic hardwood	Forest/River Red Gum	apiculture, fuel, fibre, timber, tannin or dyes, medicine
Eucalyptus grandis	Exotic hardwood	Flooded gum	apiculture, fuel, fibre, timber
Eucalyptus saligna	Exotic hardwood	Blue gum	apiculture, fuel, fibre, timber, essential oils
Eucalyptus tereticornis	Exotic hardwood		
Eucalyptus urograndis	Exotic hardwood		

NGR currently has land title for 5,710 ha[2] covering the area of the Malulu parcel. NGR is in the process of acquiring the land title for the other blocks of land in Ntiuille and Malica with 1,102 and 3,313 ha respectively. Of this total area approximately 5,242 ha is eligible for reforestation under the CDM. Areas of land containing standing miombo woodland and wetlands will be maintained as conservation areas. NGR adheres to all national legislation as laid out by the Ministry of Agriculture and its Department of Forestry and Wildlife, governing plantation forestry.

Table A.1.2 Planting schedules, ha

Malulu			
Year	Pine	Eucalyptus	Total
2007	35.7	10.4	46.1
2008	104.8	1.2	106

Malica			
Year	Pine	Eucalyptus	Total
2007	0	0	0
2008	0	0	0

http://www.issg.org/database/species/search.asp?st=sss&sn=&rn=Mozambique&ri=19365&hci=-1&ei=-1&fr=1&sts=&lang=EN

[2] DUAT 881, given to Malonda Foundation for the Malulu unit, covers a total area of 7,880 ha of which 5,710 have been demarcated for planting

2009	74.3	35.6	109.9
2010	333.7	82.7	416.4
2011	327.2	0	327.2
2012	114.3	111.5	225.8
2013	298.2	0	298.2
2014	459.6	0	459.6
Total	**1,747.8**	**241.4**	**1,989.2**

2009	0	0	0
2010	0	0	0
2011	305.4	0	305.4
2012	671.7	100.2	771.9
2013	415.6	146.8	562.4
2014	281.0	424.1	705.1
Total	**1,673.7**	**671.1**	**2,344.8**

Ntiuile			
Year	Pine	Eucalyptus	Total
2007	**0**	**0**	**0**
2008	0	0	0
2009	0	0	0
2010	0	0	0
2011	0	0	0
2012	250	0	250
2013	270	142	412
2014	246	0	246
Total	**766**	**142**	**908**

Total			
Year	Pine	Eucalyptus	Total
2007	35.7	10.4	46.1
2008	104.8	1.2	106
2009	74.3	35.6	109.9
2010	333.7	82.7	416.4
2011	632.6	0	632.6
2012	1036	211.7	1,247.7
2013	983.8	288.8	1,272.6
2014	986.6	424.1	1,410.7
Total	**4187.5**	**1,054.5**	**5,242**

The planting schedule will be repeated following the harvesting of each species – rotations for pine will be 25 years and eucalyptus 18 years.

The existing land use and baseline scenario is, further degradation of the land due to conversion of the grass and shrubland to cropland through slash and burn agriculture.

The estimated annual average and total GHG removals by sinks for the total crediting period are 23,585 and 471,692 tCO_2e.

The project contributes to sustainable development in Mozambique incorporating significant climate and social benefits. The project is establishing and managing forest plantations in areas of degraded and degrading land to meet the growing demand of wood products, while sequestering carbon dioxide (CO_2). Furthermore the project will promote socio-economic development of the local communities through:

- Promotion of tree planting and reforestation activities in the local communities
- Provision of employment and training opportunities for both skilled and unskilled labor
- Support the development of local community initiatives through designating 10 % ownership of the carbon revenues generated by the project to them to carry out development programs as decided upon by community representative committees

The plantations are sustainably managed and thus promote environment benefits, such as soil conservation, protection of water sources and enhancement of biodiversity through protection and management of existing indigenous flora and fauna and where possible enrichment planting with indigenous tree species.

A.2. Location of project activity

A.2.1. Host Party(ies)

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Mozambique

A.2.2. Region/State/Province etc.

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The project is located in the Lichinga and Sanga districts of the Niassa province of Mozambique: the Malulu parcel in Sanga, and the Malica and Ntiuile parcels in Lichinga. Within the Sanga district, the Malulu parcel is located in the Unango parish; Malica and Ntiuile are located in Chimbonila parish. Parishes are the smallest territorial administrative divisions.

A.2.3. City/Town/Community etc.

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The nearest city to the project is Lichinga City, which is the provincial capital of Niassa Province. Lichinga is located approximately 20km from the closest Lichinga project parcel, Malica.

NGR's headquarter is located in Lichinga: Av. Do Trabalho, 36, Lichinga town, Niassa Province.

The following are the villages and communities surrounding the project:

Malulu: Malulu village
Malica: Nconda village and Malica village
Ntiuile: Ntiuile village and Luissa village

Malulu

The closest village to Malulu parcel is Malulu village comprising the following neighborhoods: Cavago I and II, Ilinga, Antigos Combatentes, Burundi and Bairro cimento.

Malica

The Malica parcel is surrounded by two villages/communities: Malica village, which comprises 3 neighborhoods (Chicoa, Malica and Matengo) and Nconda village with one neighborhood - Nconda .

Ntiuile

The Ntuile parcel is surrounded by two villages: Ntiuile and Luissa villages, which comprise 1 neighborhood of the same name each.

These communities have given land to NGR and thus are regarded as the main communities impacted by NRP.

Following are presented the maps of land-class cover of project areas and location of surrounding villages.

A.2.4. Physical/Geographical location

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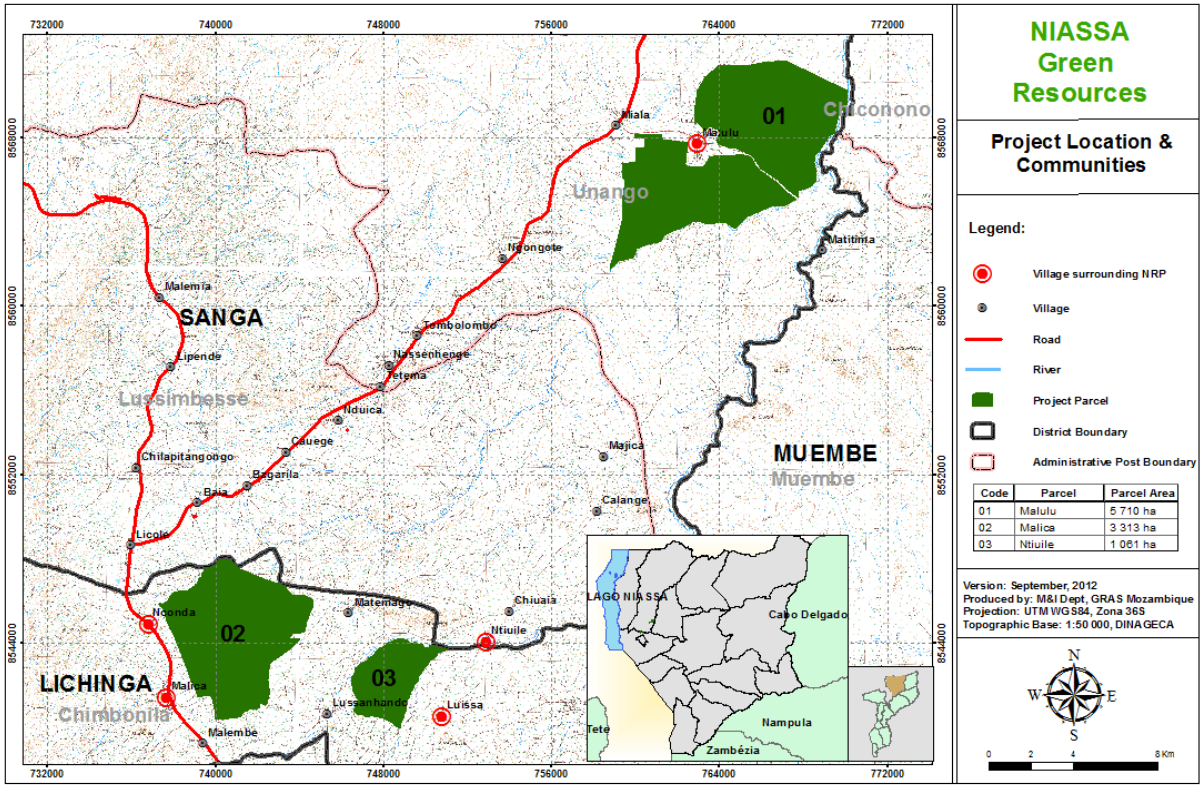

A.2.5. Geographical boundaries

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The following figures (A.2.5.1 – A.2.5.3) show the delineation of the CDM eligible areas, and thus project boundaries, of each discrete parcel of land which make up the total project area of the A/R CDM project.

Figure A.2.5.1 Project boundary (CDM eligible area) of Malulu parcel

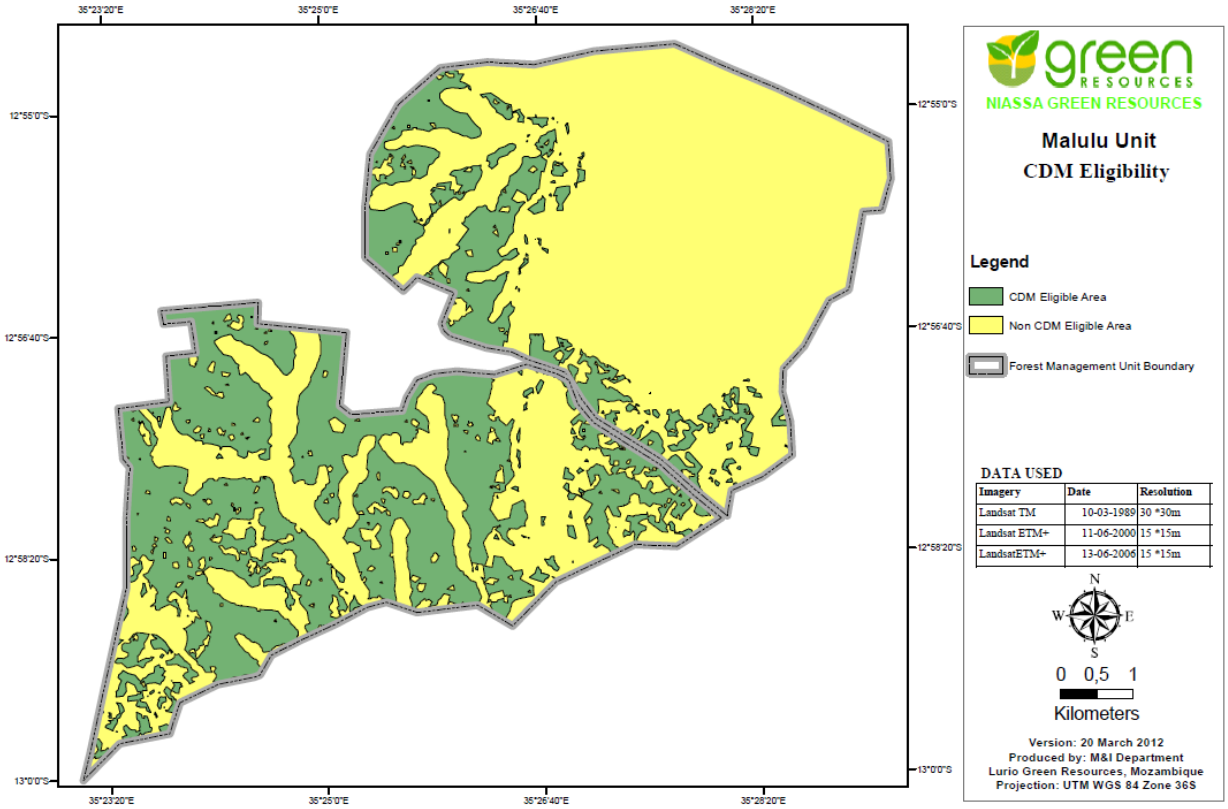


Figure A.2.5.2 Project boundary (CDM eligible area) of Malica parcel

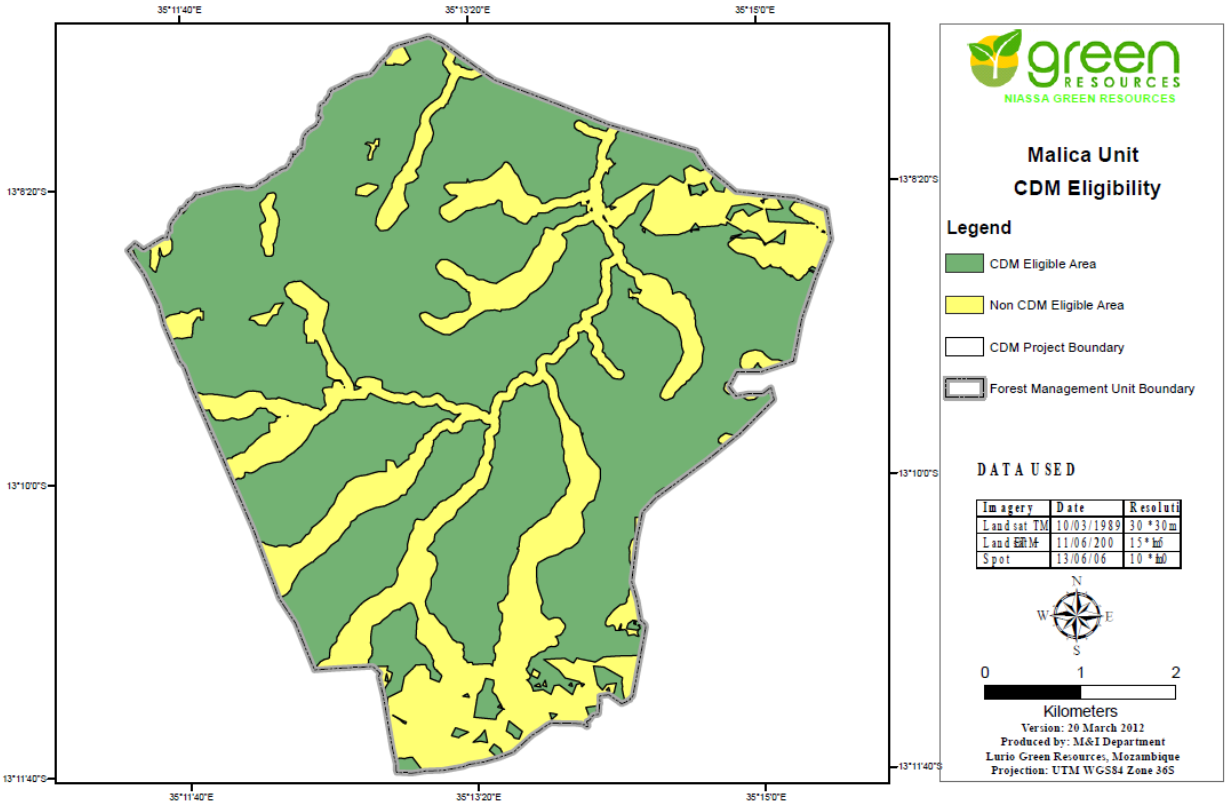


Figure A.2.5.3 Project boundary (CDM eligible area) of Ntiuile parcel

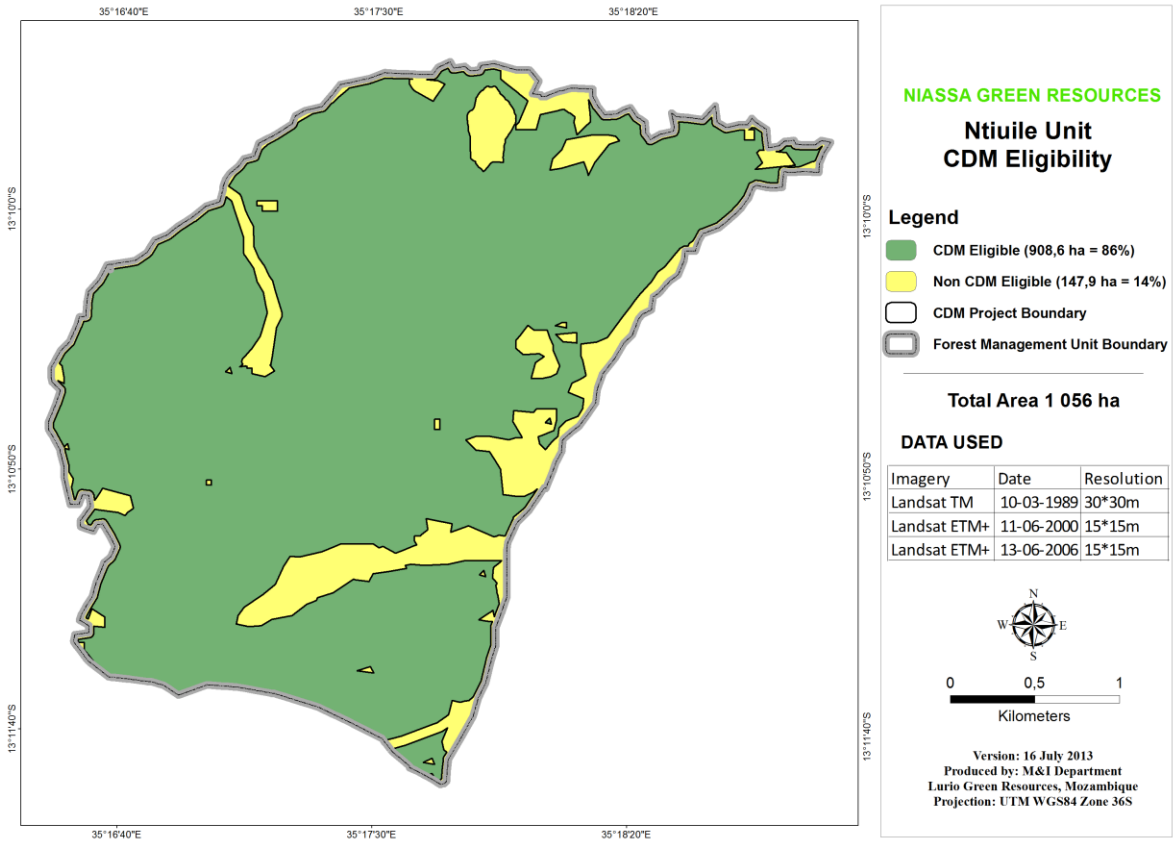
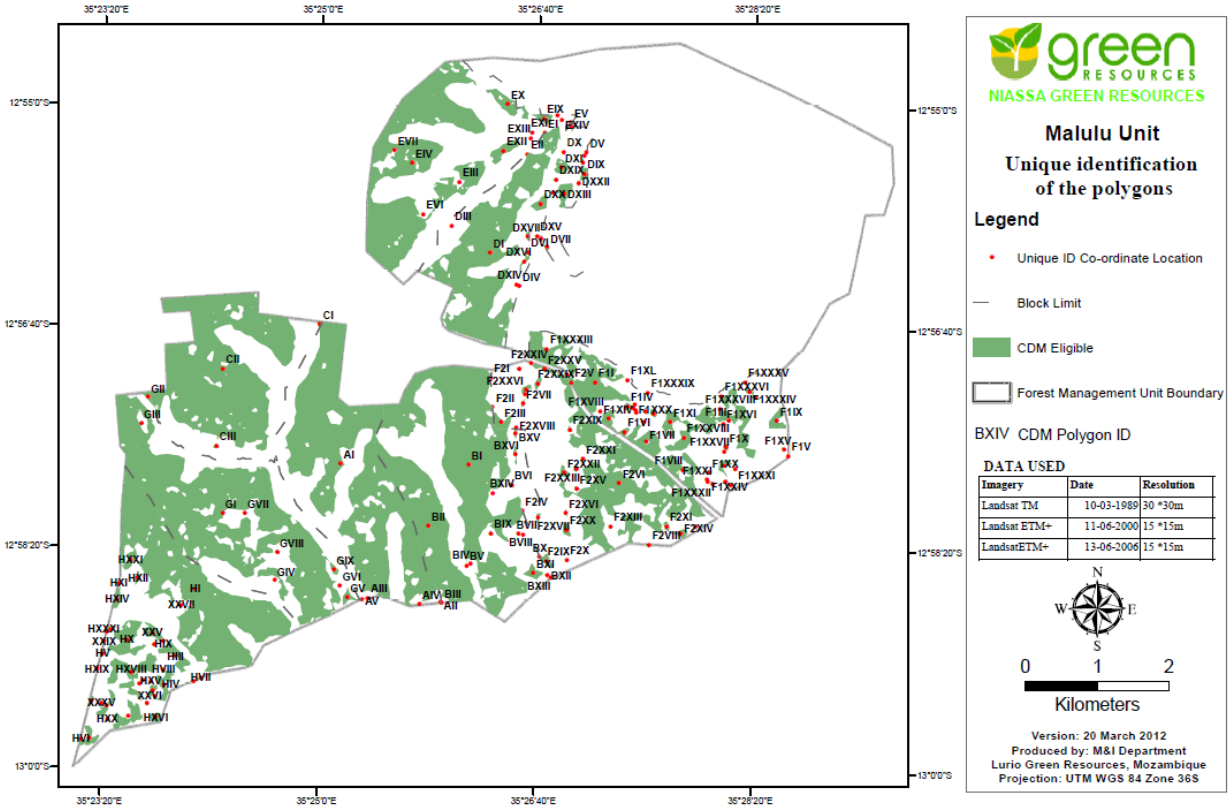


Table A.2.5.1 Unique identification of the polygons of the NRP

Malulu



Block ID	Area, ha	Eastings	Northings
AI	270.829	762461.995	8565861.541
AII	0.077	763852.703	8563942.929
AIII	0.001	762836.600	8563992.713
AIV	0.205	763556.768	8563908.220
AV	0.006	762758.504	8563978.238
BI	225.961	764241.015	8565847.102
BII	91.715	763682.873	8564994.716
BIII	0.024	763864.717	8563929.899
BIV	0.123	764270.269	8564473.341
BV	0.029	764213.637	8564448.005
BVI	0.311	764836.628	8565565.574
BVII	0.009	765000.735	8564875.483
BVIII	0.058	764936.342	8564894.215
BIX	0.214	764551.427	8564893.240
BX	0.019	765223.758	8564563.922
BXI	2.498	765139.872	8564344.750
BXII	0.007	765335.996	8564317.610
BXIII	0.000	765383.338	8564284.427
BXIV	0.026	764579.103	8565451.766
BXV	0.352	764892.219	8566280.031

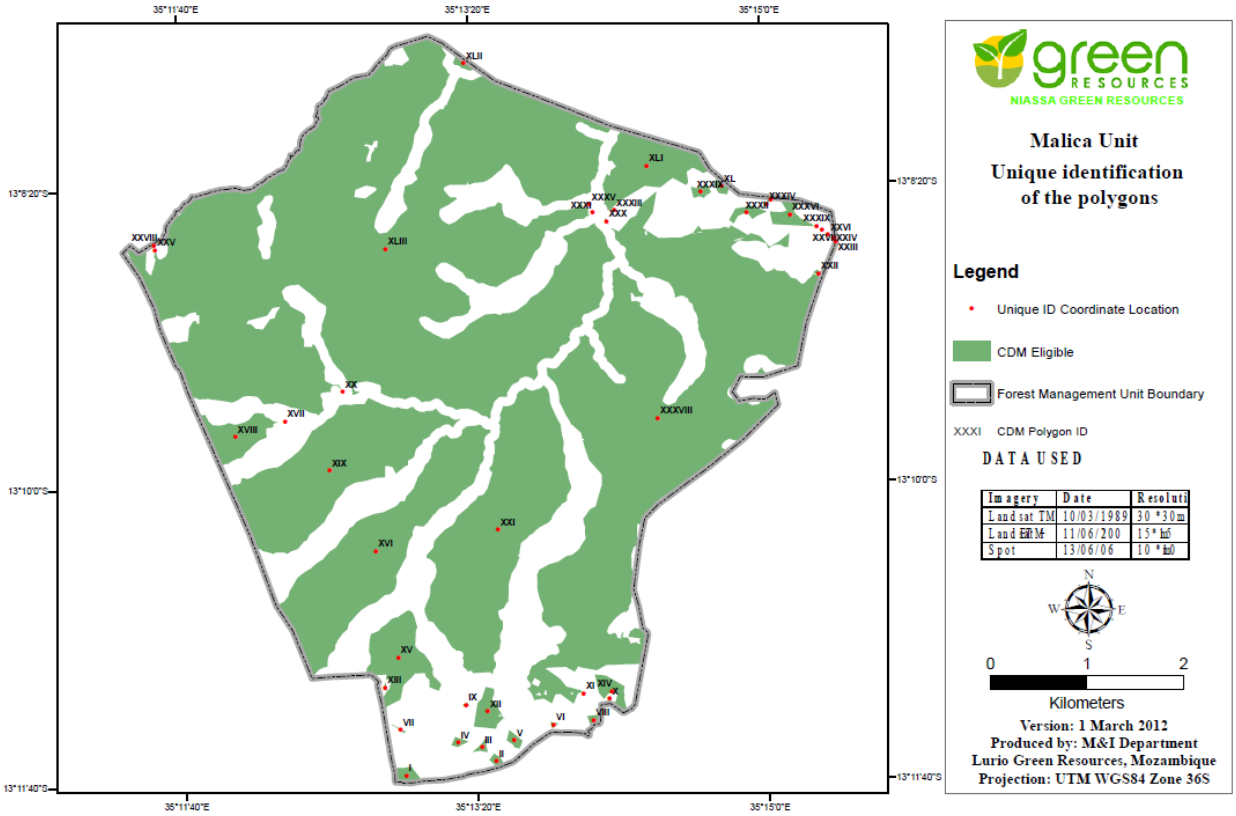
BXVI	0.571	764890.533	8565990.696
CI	0.310	762172.511	8567799.080
CII	234.722	760827.829	8567176.779
CIII	0.292	760735.092	8566104.314
DI	155.776	764537.860	8568788.238
DII	0.248	765673.784	8570536.647
DIII	0.007	764004.291	8569165.673
DIV	0.028	764945.556	8568322.575
DV	0.116	765880.046	8570179.368
DVI	0.069	765065.706	8568799.157
DVII	0.253	765330.448	8568863.701
DVIII	0.198	765251.076	8568985.586
DIX	1.537	765847.138	8569886.108
DX	0.027	765565.833	8570191.931
DXI	2.793	765534.377	8569976.451
DXII	0.054	765414.241	8569625.070
DXIII	4.311	765572.194	8569611.666
DXIV	0.014	764907.897	8568347.712
DXV	0.000	765193.432	8569020.258
DXVI	0.706	765017.603	8568667.319
DXVII	0.336	765062.726	8569013.198
DXVIII	0.186	765830.668	8570039.112
DXIX	0.122	765459.701	8569805.660
DXX	2.906	765243.420	8569468.095
DXXI	0.120	765849.681	8570132.214
DXXII	0.122	765771.607	8569760.446
EI	0.000	765299.638	8570446.912
EII	0.063	765059.433	8570156.864
EIII	18.514	764110.455	8569770.000
EIV	161.724	763458.746	8570037.487
EV	0.080	765662.396	8570595.839
EVI	0.062	763611.178	8569324.177
EVII	0.015	763212.326	8570212.487
EVIII	0.040	765475.984	8570687.729
EIX	2.210	765288.244	8570653.888
EX	7.330	764783.731	8570854.526
EXI	0.039	765127.497	8570456.315
EXII	5.264	764727.529	8570203.341
EXIII	0.014	765106.857	8570381.374
EXIV	0.001	765536.846	8570633.324
F1I	30.149	766001.559	8566985.679
F1II	0.021	765604.997	8567099.871
F1III	20.415	767855.569	8566454.892
F1IV	0.805	766449.475	8566647.715

F1V	0.001	768682.680	8565965.418
F1VI	1.006	766405.838	8566298.561
F1VII	9.326	766710.824	8566164.508
F1VIII	10.656	767215.992	8565769.982
F1IX	3.477	768526.123	8566453.872
F1X	0.488	767817.623	8566085.515
F1XI	4.861	767041.095	8566431.353
F1XII	0.060	766678.570	8566441.952
F1XIII	0.672	766806.248	8566559.669
F1XIV	0.015	766569.576	8566571.912
F1XV	0.108	768626.048	8566056.192
F1XVI	0.062	767784.196	8566412.071
F1XVII	0.011	767731.413	8566619.054
F1XVIII	0.062	766072.959	8566592.202
F1XIX	1.586	767789.690	8565831.267
F1XX	0.330	767581.654	8565734.162
F1XXI	0.080	767548.473	8565641.519
F1XXII	0.274	767810.077	8565603.010
F1XXIII	0.088	767886.165	8565557.917
F1XXIV	0.015	767566.144	8565604.110
F1XXV	2.986	766187.074	8566486.411
F1XXVI	0.083	766529.163	8566633.535
F1XXVII	0.006	767794.995	8566034.067
F1XXVIII	6.989	767231.134	8566217.050
F1XXIX	0.287	766694.486	8566581.542
F1XXX	0.005	766558.165	8566604.777
F1XXXI	0.131	767944.987	8565778.818
F1XXXII	0.276	767632.565	8565573.577
F1XXXIII	15.353	765325.820	8567450.653
F1XXXIV	0.606	768142.577	8566860.384
F1XXXV	0.129	768082.948	8566991.115
F1XXXVI	0.068	767755.004	8566794.670
F1XXXVII	0.489	768224.154	8566781.134
F1XXXVIII	0.061	766551.221	8566683.909
F1XXXIX	0.001	766731.942	8566846.250
F1XL	0.041	766447.984	8567021.469
F2I	0.116	764550.359	8567051.445
F2II	0.014	764575.642	8566643.904
F2III	3.482	764696.127	8566431.137
F2IV	0.000	764986.588	8565210.187
F2V	0.509	765672.242	8566991.040
F2VI	125.924	766333.652	8565589.550
F2VII	0.256	764997.342	8566693.150
F2VIII	0.093	766748.002	8564734.649

F2IX	1.728	765324.217	8564511.060
F2X	0.010	765605.332	8564527.176
F2XI	0.699	766992.666	8564990.909
F2XII	0.120	767392.670	8564981.873
F2XIII	0.001	766213.906	8564993.339
F2XIV	1.347	767190.791	8564889.553
F2XV	0.258	765743.060	8565511.288
F2XVI	0.186	765590.495	8565175.596
F2XVII	0.400	765205.814	8565112.655
F2XVIII	0.076	764906.281	8566361.096
F2XIX	0.249	765649.110	8566335.123
F2XX	1.456	765600.315	8564943.427
F2XXI	0.079	765829.303	8565926.787
F2XXII	1.425	765569.014	8565736.373
F2XXIII	0.326	765735.795	8565792.168
F2XXIV	0.019	765113.932	8567251.750
F2XXV	1.481	765297.072	8567168.226
F2XXVI	0.946	765040.674	8566896.785
F2XXVII	0.006	765026.981	8566821.851
F2XXVIII	0.212	764943.506	8567173.435
F2XXIX	0.969	765202.319	8566976.933
GI	280.199	760827.300	8565183.867
GII	1.020	759793.498	8566787.206
GIII	0.031	759700.430	8566424.936
GIV	4.850	761547.906	8564244.464
GV	1.657	762561.336	8564004.030
GVI	0.021	762454.768	8564174.793
GVII	0.030	761134.107	8565171.393
GVIII	0.203	761584.985	8564638.139
GIX	0.985	762372.535	8564395.334
HI	478.000	760440.948	8564117.439
HII	3.230	758968.011	8562063.397
HIII	5.830	760168.492	8563191.138
HIV	4.130	760014.523	8562795.838
HV	0.001	760518.896	8562888.533
HVI	0.006	759999.895	8563007.919
HVII	0.015	760002.176	8563395.647
HVIII	0.311	759154.787	8563227.723
HIX	0.011	758851.569	8562045.149
HX	12.300	759493.775	8563422.560
HXI	0.027	759379.812	8564199.611
HXII	0.778	759641.655	8564273.175
HXIII	0.032	760416.172	8562844.537
HXIV	1.960	759360.633	8563979.666

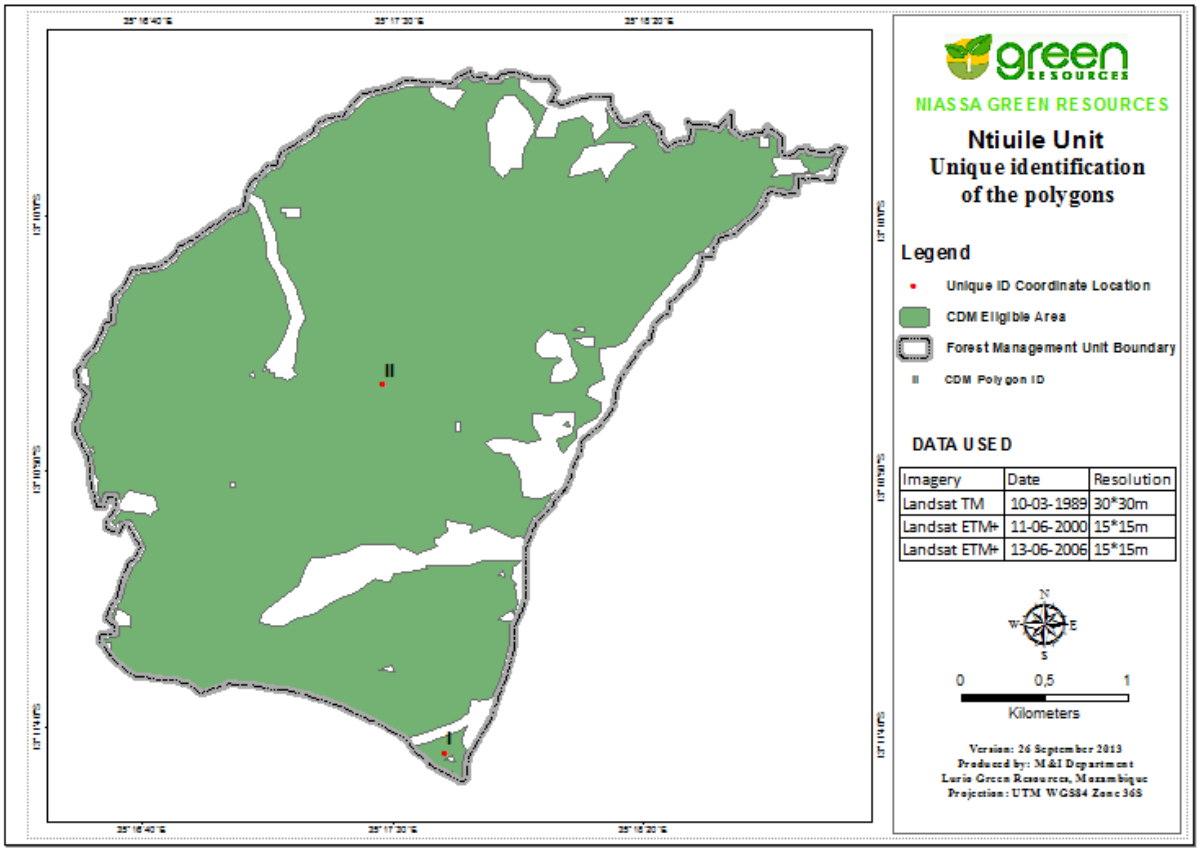
HXV	0.020	759212.342	8563523.301
HXVI	14.400	759555.391	8562964.911
HXVII	0.000	759082.712	8563012.361
HXVIII	0.015	759824.887	8562846.690
HXIX	1.490	759893.476	8562338.219
HXX	0.005	759222.770	8562321.401
HXXI	2.480	759541.025	8564530.342
HXXII	0.003	759663.631	8562801.894
HXXIII	0.513	758997.868	8562572.633
HXXIV	0.142	759872.688	8563355.308
HXXV	0.009	760246.784	8563902.836
HXXVI	0.158	759722.255	8562857.579
HXXVII	0.002	759178.350	8563397.401
HXXVIII	3.450	759849.593	8563520.522
HXXIX	0.006	759888.604	8562641.624
HXXX	1.070	759850.644	8562723.187
HXXXI	0.517	759269.790	8563565.776
HXXXII	6.420	759513.230	8562354.796
HXXXIII	2.540	759209.732	8562504.997
HXXXIV	0.105	759770.227	8562539.535
HXXXV	0.174	759135.652	8562543.775

Malica



Block ID	Area, ha	Eastings	Northings
I	3.585	740115.067	8540385.501
II	1.162	741053.192	8540514.585
III	0.838	740905.873	8540657.474
IV	0.929	740661.058	8540718.302
V	1.629	741239.591	8540726.725
VI	0.261	741649.107	8540875.467
VII	0.129	740065.484	8540861.124
VIII	0.951	742064.474	8540917.223
IX	0.122	740751.836	8541104.898
X	0.062	742235.724	8541133.785
XI	0.062	741966.761	8541192.597
XII	7.855	740970.268	8541030.257
XIII	0.155	739919.452	8541303.339
XIV	6.056	742258.730	8541210.433
XV	36.939	740060.861	8541611.563
XVI	159.180	739855.592	8542711.886
XVII	0.001	738947.888	8544075.718
XVIII	21.752	738430.755	8543926.885
XIX	157.909	739397.114	8543555.091
XX	0.001	739549.886	8544364.539
XXI	209.503	741123.106	8542904.103

XXII	0.323	744501.244	8545478.971
XXIII	0.002	744683.886	8545807.337
XXIV	0.024	744664.681	8545840.432
XXV	0.000	737646.320	8545879.269
XXVI	0.043	744605.971	8545873.379
XXVII	0.003	744543.496	8545920.505
XXVIII	0.000	737634.865	8545926.535
XXXIX	0.027	744487.184	8545962.937
XXX	0.053	742316.512	8546067.249
XXXI	0.029	742180.940	8546159.462
XXXII	2.780	743767.953	8546119.902
XXXIII	0.122	742399.889	8546175.065
XXXIV	0.062	743976.983	8546206.222
XXXV	0.036	742145.048	8546241.136
XXXVI	6.609	744215.899	8546092.174
XXXVII	0.294	744024.523	8546252.236
XXXVIII	585.069	742801.914	8544019.666
XXXIX	1.723	743300.201	8546347.473
XL	1.873	743517.880	8546397.523
XLI	46.627	742747.159	8546629.391
XLII	1.841	740877.440	8547730.371
XLIII	1102.034	740028.683	8545832.780
I	3.585	740115.067	8540385.501
II	1.162	741053.192	8540514.585



Block ID	Area, ha	Eastings	Northings
I	5.000	748675.983	8540092.352
II	903.600	748304.438	8542301.479

A.3. Environmental conditions

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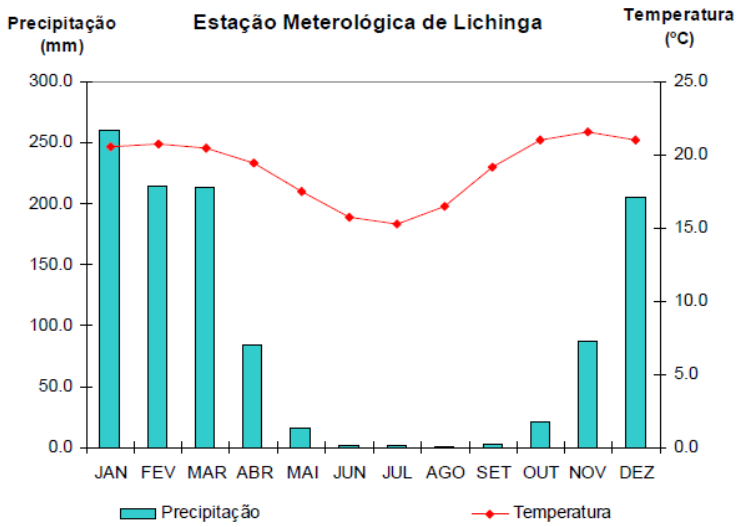
Climate

The project area has a temperate monsoon climate that is strongly influenced by altitude. Mean annual temperature is 19.1ºC varying between 24.3ºC maximum and 13.9ºC minimum. Temperature ranges by season with a mean temperature in July of 15°C whilst a mean of 22°C in October (figure A.5.1.1 below). The minimum monthly average observed was in July 1978 (8.3ºC) and the monthly maximum in November 1996 (29.7ºC).

Within the project areas, it is possible to observe two distinct seasons - the hot and humid season, from December to March, and the cool and dry season, from April to November. The mean annual rainfall is 1,100 mm in Lichinga. The majority (80%) of rain falls in the summer months between December and April with monthly averages of 209, 260, 214 and 212 mm respectively. The May to October months are the driest, with monthly averages of less than 22 mm, representing only 4.3% of annual rainfall. There are, however, great variations between years, reaching a maximum of 1,711 mm in 1989 and minimums of 698 and 700 mm in 1994 and 1995.

Figure A.3.1 Mean annual rainfall and temperature in Lichinga[3]



Source: National Meteorology Institute

Hydrology

NGR project areas are part of the hydrographic basin of Rovuma river. Within Rovuma river basin, specifically, the project area falls in the Lucheringo and Lugenda river subbasins. Important rivers and watercourses in this region are: Luchimua, Luelele, Lupolo, Luatize and Lucuise rivers. Lucheringo River, a river with gentle waterslope, has an average flow of 0.7 m3/s, varying between 0.05 m3/s and 17.9 m3/s, depending on the dry and rainy seasons respectively (data between 1970 and 1981) (IMPACTO, 2007 citing Austral Consultoria e Projectos, 1994).

Turbidity levels in this river are between 7.4 and 10.0 NTU, pH between 7.2 and 7.7, concentrations of nitrates (NO3) lower than 0.45 mg/litre, nitrites (NO2) between 0.03 and 0.05 mg/litre, chlorine (Cl) between 0.7 and 1.8 mg/litre, carbonates (CO3) at 0.0 mg/litre, sulphates (SO4) between 2.6 and 3.0 mg/litre and phosphates (PO4) at 0.34 mg/litre.

In terms of geo-hydrology, the project area is in a zone of very weak permeability (cartographic unit C2). Limited ground water occurs in these areas with average flows generally less than 3 m3/h (Impacto, 2007 citing Geo-hidrologia de Moçambique, 1987). Also in the project area there are zones identified as group C3, where the permeability of the rock is weak or zero. These areas are mountainous, without a significant alteration mantle, and almost totally lacking in ground water with average flows generally less than 1 m3/h. Their appearance is related with springs (Source: Geo-hidrologia de Moçambique, 1987).

Soils

Niassa Province is part of the Niassa Great plateau. The Province borders on the west with the Rift Valley (Lake Niassa) which penetrates the plateau in the north-south direction. The project area is in the Pre-Cambrian basalt complex (more than 600 million years old) which occupies the greater part of northern Mozambique. The most common rocks in the basal complex are metamorphic rocks, such as: gnaisses, granites, migmatites, anphibolites, micaschists and other ancient rocks.

The soils of the region are well structured consisting of a mixture of soil and alluvial clay deposits. They are normally average soils, red, and fertile (see figure 6 below). The soils are well drained but

[3] EIA, 2007

the infiltration is low due to high clay content. Some stone lines occur especially in the more broken areas and near outcrops of rock surface.

They are easily worked at field capacity but set hard when dry. Where stone-line soil area occurs should be planted with pine.

Ecosystems

Sitoe (2008), mentioned that according to Wild and Fernandes (1967), the Vegetation of the project area falls in the dry miombo woodlands with dominance of *Brachystegia sp.* and *Julbernardia globiflora* species as well as their associated species[4]. Additionally, Sitoe (2008) states that Campbell *et al* (1996) described miombo as the end spectrum of savannas dominated by woodland typically 10-20 m high, single storey, partly closed canopy of mostly pinnate-leafed trees, a discontinuous understorey of broadleaf shrubs, and an often sparse but continuous herbaceous layer of forbs, small sedges, and grasses.
Miombo vegetation is often associated with other vegetation types, particularly shrub savannas, dambos that occupy seasonally waterlogged shallow valley depressions typically grasslands without trees.
Along the time, the natural forests have changed greatly and the area occupied by them decreased. The flat areas changed the most compared to the high and sloping areas.

Within the wider boundaries of the project DUAT, there are still some areas with remnants of the past natural Miombo forests which will be put into conservation. These are mostly concentrated along river banks and water streams or close to mountainous areas. The area for reforestation is dominated by grass and shrubland; however, to get a full understanding of the species diversity as well as the ecosystem dynamics in the targeted areas, a formal ecological assessment should be carried out by an accredited and experienced professional.

An ecological assessment has been conducted for Malulu unit but similar studies should also be carried out for other units. According to the ecological assessment conducted in 2007, the Malulu project area is characterized by degraded grassland and shrubland. Three major ecosystems can be found within this unit namely (i) woodland, (ii) shrubland/shrub savanna, and (iii) grassland. The grassland and shrubland can be described separately in ecological terms. Grassland is represented by different features that, although not easy to differentiate on the satellite image are easy to differentiate in the field. The common characteristic is the grass dominance, with cover between 80 to 100 % with no woody component, or if present very scattered.

Within the grassland it is possible to differentiate in the field the following subtypes:

I. tall grass – mainly within recently abandoned machambas where grass can reach up to 3 m high, and is particularly dominated by *Monocymbium cereciforme*, *Cymbopogon dieterlenii*, and *Hyparrhenia filipendula.* Current machambas, apart from the crops, are a combination of grasses (Melinis repens, Pennisetum cetaceus, *Eragrostis aspera*, *E. ciliaris*) and forbs (*Bidens pilosa,Crotalaria* sp., Indigofera sp.). In these areas, scattered tree species can be part of the scenario, with *Mangifera indica* (mango tree), *Faidherbia albida*, and *Ficus sycomorus*

II. short grass – particularly found in waterlogged areas such as dambos and shallow water streams. Dominant grass height is only a few cms, up to 50cm, but cover is near 100%.

[4] Accompanying species include *Diplorhinchus condylocarpon*, *Pseudolachnostylis maprouneifolia*, among other typical Miombo woodland species. Miombo woodlands in this region occur interspersed with shrub savannas with Parinari, Uapaca, Faura or Protea, Vitex, Securidaca, and several species of Dombeya. The grass flora includes Hyparrhenia, Andropogon, and Chloridion.

Common species in this vegetation type are *Flaveria sp, Ceratia sp, Cyperus sp* and *Imperata cylindrica*. In wetter areas it is also common to find common reed (*Phragmitis australis*). Rarely woody plants are found in this subclass, but when found, they are dwarf representatives of the Riverine forest such as S*yzigium guinense*

The shrub savanna stratum is typically dominated by scattered shrubs and small sized trees, with a dominant height of 3-4m. The shrub savanna represents a mixture of i) successional secondary regrowth following abandonment of agricultural lands and a ii) transition between wet grassland and woodlands. The woody layer (shrubs and small size trees) is interspersed with a dense and tall grass layer of 1-2m high. Dominant woody species are *Protea sp, Cussonia paniculata, and Syzygium guinense* in the transition zone, but the successional shrub savanna is composed of typical Miombo species such as *Brachystegia spiciformis, B.aleni, B.boehmii,* accompanied by *Uapaca kirkiana* and *U.nitida*. The grass layer is mainly composed of *Schzachirium sp, Cymbopogon dieterlenii, Eneapogon sp* and *Heteropogon*.
Other ecosystems that are easy to identify in the field, but not identifiable on the satellite images include riverine forests (a subclass of woodland, together with the dominant Miombo woodland), tall grass and short grass, the later particularly found in wetlands, dambos and active and recently abandoned machambas (as subclasses of grassland).

Figure A.3.2 Major ecosystems found in Malulu unit

A. grassland

B. shrub savanna

C. woodland

The ecological assessment conducted in Malulu, also revealed that the two mountainous areas (Maaze and Zuvi) differ to the flatter lowlands in that they are still predominantly covered by woodlands, while the flat areas have been converted to agriculture in the past and are dominated by grasslands and currently abandoned machambas. In Malulu, water sources derive from the mountains and generate water streams that flow down to the rivers through riverine woodland and wet grasslands.

Rare or endangered species

The ecological assessment concluded that apart from the *Khaya anthoteca* that deserves special attention as it is considered of least concern in the Red data list for Mozambique, no other vegetation species were recorded as being in rare, endemic or even threatened by extinction. The EIA carried out for Malonda Foundation mentioned the existence of simango monkeys (*Cercopithecus mitis*) a rare species along Lucheringo river therefore, there is a potential for the occurrence of this specie in project area. However no depth observations were carried out for the fauna species, thus there is a need to carry out such type of assessment to decide the management measures to be implemented.

A.4. Technologies and/or measures

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Species selected

Selection of planting stock must be based on suitability to the site conditions, the management objectives and desired products. This includes selection of species, provenance and genotype. Research is essential to determine suitability of species to the site. Species selection should also favour diversification and where necessary native/indigenous species will be preferred due to their contribution in conservation of biodiversity and easily adaptability to the local environmental conditions.

The two main genus selected, *Pinus* and *Eucalyptus,* comprise exotic species adapted to the conditions of the area of introduction and are generally at an advantage compared with local species because: they have no predators and are chosen for being resistant to the various constraints of the area of implantation and therefore having better growth rate. The following species are currently being established:

- *Pinus patula*
- *Pinus kesiya*
- *Pinus caribaea*
- *Pinus oocarpa*
- *Pinus taeda*
- *Pinus tecunumanii*
- *Pinus elliottii*
- *Eucalyptus camaldulensis*
- *Eucalyptus grandis*
- *Eucalyptus grandis x camaldulensis*
- *Eucalyptus saligna*
- *Eucalyptus tereticornis*
- *Eucalyptus urograndis*

Seeds will be acquired from the areas with similar agro-ecological conditions to ensure that the most adapted species and provenances are planted.

Seed sources

The use of improved seed and high quality seedlings will determine the uniformity of the plantation and its productivity. Therefore the careful choice of the genetic material is essential. While the company's own seed improvement programme is not in place, seeds and improved materials are being acquired from reputable suppliers worldwide where the growing conditions are similar.

Nursery operations

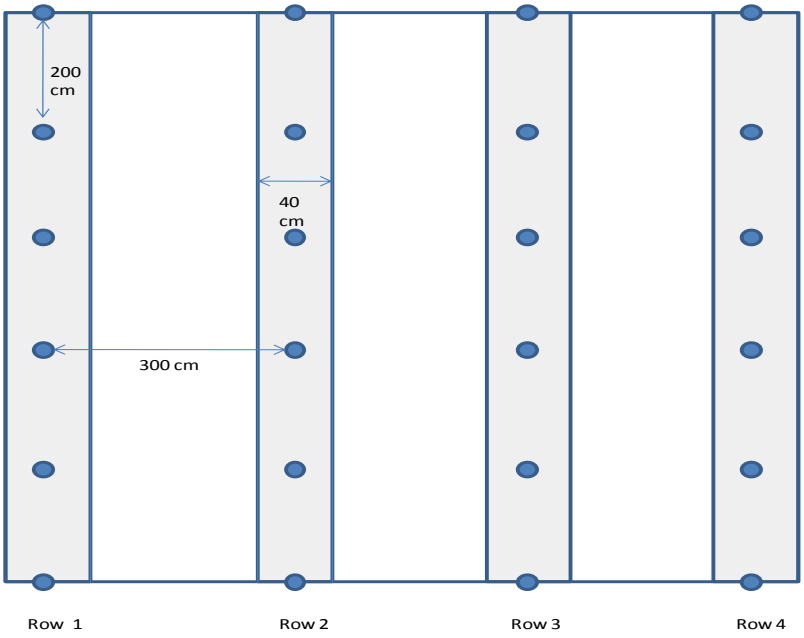
Good nursery practice is the foundation to good silviculture practice. Nursery cultural techniques tailored to producing good-quality seedlings, which will give high field survival, and fast initial establishment will be practiced. Initially the nurseries will mainly be growing plants from seed. Currently, the nursery is located in Malulu unit and is set to produce up to 1.2 million seedlings per planting season using polyethylene tubes. NGR is committed to establishing modern container-based nurseries with capacity for 3 million seedlings per year to supply all the seedlings needed for the planting operations.

Land preparation

Most of the plantation areas will be prepared manually. This will consist of removing the shrubs and cutting the grass which will be left on site to enrich the soil. Part of this material will be used by the local population for firewood and charcoal production, and as building materials. In some cases, controlled fires may be used to reduce the amount of combustible material, and favour subsequent operations. The preparation of land mechanically is also envisaged, through the use of heavy machinery that will concentrate woody material in a particular area, and work the soil in accordance with the lines of plantation so as to allow greater penetration of rainwater and of the roots of the plants being established.

Eucalyptus species are more sensitive to soil preparation than the pine species, pioneer on ecological succession. Therefore, strip ploughing will be applied on site preparation for compartments of eucalyptus (seeFigure A.4.1). Employing 3 x 2 m spacing, ploughing 40 cm strips will result in a 1340 m^2 of soil disturbance per hectare (13% of compartment area).

Figure A.4.1 Strip ploughing for eucalyptus compartments



Trials have demonstrated that ploughing results in improved eucalyptus growth and survival rate by reducing competition from other herbaceous vegetation more comprehensively than spot weeding. In addition ploughing loosens soil to a greater depth than pitting alone allowing for faster root establishment. Whenever ploughing will take place, it will follow the land contours.

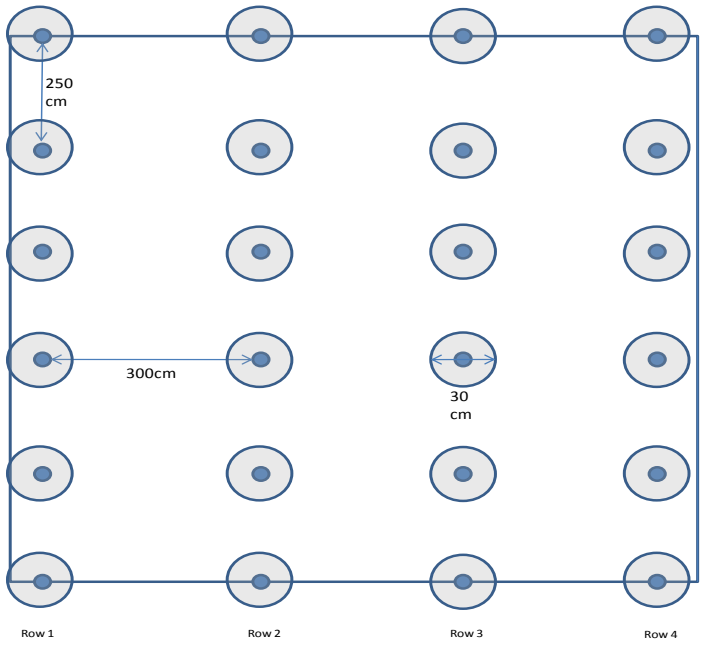
For pine which is more resilient in the initial years of establishment, compartments will be prepared by pitting alone (see

With a 7:3 planting ratio of pine to eucalyptus the overall soil disturbance in the project area (net planted area) will be 4.7%. This accounts for less than 10% of the total planted area of the project in line with CDM requirements.

Figure A.4.2). Employing a 3 x 2.5 m spacing and pitting with a diameter of 30 cm will result in 97 m^2 of soil disturbance per hectare (<1% of compartment area).

With a 7:3 planting ratio of pine to eucalyptus the overall soil disturbance in the project area (net planted area) will be 4.7%. This accounts for less than 10% of the total planted area of the project in line with CDM requirements.

Figure A.4.2 Pitting regime for pine compartments



Spacing and marking

Spacing affects tree growth in several ways. With close spacing growth of each tree (especially diameter) slows down due to early competition between the roots. Wide spacing ensures fast growth than close spacing. Trees planted at wide spacing develop large branches and often grow crookedly. At close spacing they grow straight in their endeavour to grow out of each other's shade. Generally a slow growing tree is stronger than a fast growing tree of the same species. Other factors affecting the choice of spacing are costs, method of weeding, weed suppression and demand for thinnings. A crop planted at close spacing quickly eliminates weeds, grows faster in height and gives trees of good shape. Wide spaced trees are healthier as well as fast growing in diameter. Therefore spacing choice depends on management objectives.

It depends also on the species and site quality. The better the site, the lower the stocking and vice versa. Higher stocking will mean that the site reaches a maximum MAI at the age of about six years, when clear felling or thinning must occur. Trials to better understand the MAI for Niassa project have been established.
Different spacing has been employed in the past in NGR project areas[5]. The experience from Malulu unit shows that for eucalyptus the 3 x 2 m spacing is best; for the pine 3 x 2.5 seems to be the most adequate and will be used in the future plantations.

The operation of marking the position where each tree is to be planted or sown is very important. A rope or wire is marked at intervals to correspond with the planting distance. The rope is laid out along the planting line with a man at each end and pegs are put at each mark before the rope is moved forward. The two men must ensure that the distance between lines is correct and that the rope is straight each time it is laid.

Planting

Planting must be done early during the rainy season (when moisture has penetrated to a depth of 15cm to 20cm) to ensure good survival and early growth of the nursery stock. This will also permit early

[5] In Malulu unit, where the project initiated, the initial spacing for both pine and eucalyptus was 3 x 3 however this was changed to 4 x 2 for the eucalyptus

beating up and weeding during the remainder of the rainy season. In Niassa region there is one rainy season, from October up until April.

Planting must be well organized and carried out by skilled men who should be supplied with plants by other workers who do the transporting from the depot. Depots of plants must be placed at suitable intervals around or within the planting area. All planting must be supervised by a forester and his senior staff. During planting the root collar should be 25 – 30mm below the soil level. The soil should be returned around the roots and the root collar pressed firmly. It is essential to press the soil close around the plant to avoid soil movement around the plant.

Fertilizing and use of hydrogel

The use of fertilizers in Eucalyptus plantation proved to be beneficial in Malulu unit. Therefore, an effort will be made to ensure that all eucalyptus plantations in NGR project areas are fertilized just after planting. Currently, 100g of NPK fertilizer are being applied per plant but in the future, the soil surveys result will inform the management about the level of nutrients and the best fertilizer to be applied in each area. Fertilizer will not be applied in pine seedlings once planted.

By holding the water for longer period in the roots, hydrogel contributes to the success of the initial stage of the plant in the field and prolongs the planting season. NGR project areas have a long drought period (6 months: Apr-Oct) therefore, the use of the hydrogel is very important and will be implemented for both pine and eucalyptus. Planting with hydrogel will take place in October, 1 month before the rainy season.

Beating up

Beating up or blank filling of planted seedlings should be done shortly after planting. Therefore an assessment of survival rates will be carried out within two weeks of planting. If establishment has been bad it is preferred to beat up during the same planting season to ensure that plants in the compartment will have similar growth as their neighbouring trees. However, the same process can take place during the second planting season. Beating up shall be done if survival rate is below 80 % in the compartment. If survival is below 50 % the area shall be replanted.

Weeding

Weeding reduces competition for water and nutrients between planted stock and undesirable plants of various species. Young trees require weeding until the shade cast by the canopy is sufficiently dense to suppress the weeds. Neglect of weeding is probably considered as the most important single factor contributing to the failure of forest plantations in the tropics, especially in areas with a pronounced dry season. If weeding is not carried out, trees are completely smothered by the weeds. *Pinus patula* and *Eucalyptus spp*. species are particularly sensitive to weed competition, thus there is a need for effective and thorough weeding for this species in particular.

Weeds are serious competitors for both nutrients and moisture and both are in deficient supply in Niassa in most areas. A poor weed control programme in the first year has been shown to greatly diminish yield in the long term. There is even a negative response to fertiliser application if no weed control is performed. Weed control starts at the time of land preparation and may include:

1) Burning of old rank vegetation which also burns/kills off some dormant seed
2) Land cultivation by ripping or ploughing
3) Pre-plant spraying with a non-selective herbicide and or a pre-emergent at planting time
4) Road making and compartment boundary delineation: no access and boundaries = no control

Weed control can be done in many ways and, depending on conditions, different methods are selected. Chemical control can cover large areas rapidly and can have a long-lasting effect if used correctly. However, more skill and supervision is needed. Some chemicals can only be used when rain is still four hours away, which often limits options in the rainy season. However, pre-emergents only work if rain occurs at spraying time or shortly after. Wind is also a factor, as chemical drift harms and even kills to the young trees. Therefore, a chemical team often stops spraying during the day and changes to manual weeding due to the weather.

Manual weed control is cheap but often the effect is short and return weeding has to happen soon after. However, weather conditions seldom affect its progress. Employment opportunities are currently very few in rural Mozambique and manual weeding will be an important positive impact associated with this forestry project. In the February, March and April months, additional manual weeding teams will be needed. Hoeing aims at killing weeds by exposing their roots to the sun. Slashing or strip or spot weeding should be carried out. Spot weeding is often used to reduce labour costs. Grass growth in plantations where initial clean hoeing is impossible is kept in check by slashing the grass as close to the ground as possible.

In NGR areas both manual and chemical control will be applied. Environmental friendly herbicides, approved by the FSC, such as round up or rondo will be applied in the first years of plantation establishment.

Pruning

Pruning is the deliberate removal using specialised equipment, preferably while still alive, of some of the branches from the lower trunk (bole) of a tree (about with 1/3 of the living crown of the relative depth of the canopy). The objective of pruning is to reduce knots in sawn timber and similar finished products. Branches form knots, which are the most common defects in timber, especially those formed by dead branches. The lateral grain distortion around knots leads to reduced timber strength. The decision to prune or not to prune must be almost entirely based on the consideration of economic factors. High pruning must be associated with price differentiation between pruned and unpruned timber.

The types of solid wood products such as poles and veneer normally requires pruning (brushing) to be done so as to limit the effect of knots. This is especially true for eucalyptus species that have branch die-off at an early age and these branches become loose knots. Loose knots create problems for the veneer maker and the woodworker (downstream value adding plant). Eucalyptus species are self pruning but brushing off the dead branches will be desirable in order to speed up occulation to maximize clear, knot free wood.

Pruning should be conducted in the dry season and will only be conducted in the Hardwood Working Cycle (HWC) and Softwood Working Cycle (SWC) for producing poles or sawnwood; pruning will not be conducted in the Pulpwood Working Cycle (PWC). Tables 10 and 11 present the pruning schedules for NGR plantations.

Table A.4.1 Pruning schedule for the different cycles

Pruning	SWC	HWC	PWC
First	3	4	n/a
Second	5	6	n/a
Third	8	10	n/a
Fourth	-	14	n/a

Table A.4.2 Pruning schedule for pine

Age	Mean dominant height (m)	Pruning height (m)	No. of trees pruned / ha
4	4.5	2.0	All
6-7	8.0	4.2	800
8-10	11.0	6.2	450

Thinning

Artificial thinning is the removal of a proportion of individual living trees from a stand before clear felling. It is generally understood to take place after the onset of competition. Thinning is carried out for several reasons, the major ones being to reduce the number of trees in a stand so that the remaining ones have more space for crown and root development to encourage stem diameter increment and so reach a utilisable size sooner; to remove trees of poor form; to prevent severe stress, which may induce pests, diseases and stand instability; and to provide an intermediate financial return from the sale of thinnings. More trees are initially established than the required final crop mainly to ensure sufficient trees from which the final crop can be selected, enhance early canopy closure to suppress weed growth and to utilise the site better.

The removal of trees by thinning goes on until only the final crop trees are left standing. To increase the quantity of wood very many trees are removed in a thinning so that the final crop trees quickly increase in diameter. For quality wood, the thinning is light such that stronger, dense, evenly grown trees are obtained, generally over a longer rotation.

NGR thinning operations will primarily be carried out during the dry season[6] according to the schedule in The thinning method to be used is selective thinning. It is essential that trees are planted in rows. Marking for thinning is done first prior to thinning. During this exercise, pruning of the trees will have been done. The following trees should be included in the selection:

- trees which are not straight
- trees which are damaged
- heavily branched trees which will have large knots
- trees which have a broken crown, and in which the leader is consequently forked

Table A.4.3. NGR uses adaptive management thus the thinning regimes will be adjusted as the Management learns from the planting growth and as need arise (e.g. pest breaks, etc.). On the HWC and SWC, thinning is to encourage stem diameter increment and so reach utilisable size sooner. On the PWC thinning will also be done through coppice reduction as a technique for regenerating eucalyptus by coppices.

The thinning method to be used is selective thinning. It is essential that trees are planted in rows. Marking for thinning is done first prior to thinning. During this exercise, pruning of the trees will have been done. The following trees should be included in the selection:

- trees which are not straight
- trees which are damaged
- heavily branched trees which will have large knots
- trees which have a broken crown, and in which the leader is consequently forked

[6] Carry out thinning in the dry season to minimize soil damage and because roads are easier to navigate than in summer/rainy season

Table A.4.3 Thinning schedule and percentages of removal for the different working regimes

Thinning Cycle	Years	% Cut
HWC		
First	5	30%
Second	8	30%
Third	12	45%
Fourth	18	100%
SWC		
First	8	32%
Second	12	35%
Third	17	45%
Fourth	25	100%
PWC		
First	8	100%

After this exercise all the marked trees are felled and arranged between the rows of the remaining standing trees. In the case of two thinnings, after the first thinning the trees are cut and left in the forest area for the perusal of the local communities. The second thinning is done for commercial purposes and the trees are extracted from the forest for such uses.

Road maintenance

Reliable and accessible roads all the year round are vital for achieving the management objectives. In general, constructing and building roads is a costly affair; it is therefore very important to do preventive maintenance. Preventive maintenance is a small cost compared to construction of the road network. To ensure accessibility all year round, regular annual maintenance will be done.

There are two types of road maintenance namely heavy and minor maintenance. Heavy maintenance is done yearly while minor maintenance is done usually after heavy rains or if there is harvesting in particular compartments. Usually road maintenance is done using hand tools such as hoes, spades and wheelbarrows. Several people are assigned to open up the culverts and maintain cambers of the roads, by removing grass on the road sides and filling potholes and patches. The cost of maintenance depends on the type of maintenance and road. A road maintenance plan will be prepared and presented on a yearly basis with costs estimation.

Fire protection

Forest fires are perhaps the biggest threat to forest plantations in Niassa province and other parts of the country. This is due to prolonged drought in the area, which occurs between July and December every year. The uncontrolled use of grass fires for land preparation and hunting by communities surrounding the forest is the main cause of forest fires. Therefore, forest fire prevention is the most important activity in the forestry annual calendar of events.

To control fires, main and secondary firebreaks will be set up, which must be kept clean. Water points for fire fighting will be established and marked, as well as the location of the fire breaks inside the plantation. The training of workers will be a priority, as well as awareness work among the local communities. Watch points equipped with communication radios will also be established at strategic places.

A detailed and intensive fire management programme will be developed and should involve the following:

1) Preparation of 20-25 m external firebreaks and 5 m internal fire lines around the plantations to stop external fires entering the plantations. This exercise involves removal of all vegetation along the fire breaks by screefing using hand tools. As the firebreaks cover several kilometres, this exercise is labour intensive and quite costly. During fire break preparations fire lines screefing should be avoided along the slopes for control of soil erosion. Herbicides should be used when the grass is still green or slashing carried out as an alternative mitigation measure. This might result in lower costs. Where necessary, prior assessment of these areas should be conducted and mitigation measures spelled out for any significant impacts.

2) Establishing a fire detection system in the plantations - this includes construction of fire towers in appropriate locations and mounting communication systems connecting fire towers to the office and to the fire patrol crews. The fire towers are manned on a 24-hour basis and the personnel look out for any signs of fire occurrence in the forest area. If any signs of fire are detected, the information is relayed to the office and to the patrol teams in the field so that fire fighters and equipment are mobilised and sent to the fire front in the shortest time possible. One tower is already installed in Malulu unit. Additionally, weather stations that record basic weather information such as the temperature, humidity, rainfall, and, wind speed will be established at the plantation areas. This information will be used daily to calculate a fire danger index.

3) Training and equipping fire fighters - a clear command structure will be established for the fire crew with specialised training and personal firefighting equipment. Grass fires or fires in young plantations can normally be fought with manual equipment such as fire beaters, rakes and knapsacks. A rapid response crew with water from bakkie pick-ups are crucial and to be supported by tractor and truck-based water tankers later.

4) Community education on use of fire and precautions needed to ensure that fire does not spread to forest plantations. Mobilising community support in case of an outbreak of fire. Sensitising local administration on need to control grass fires which are the main cause of forest fires.

It is emphasised that forest fire protection is costly as it involves labour intensive preparation of an extensive network of fire breaks and fire lines. Fire crews and other personnel have to remain on paid stand by for the entire period of the fire season.

Pests and diseases protection

Plantations are vulnerable to a number of threats against which the forester must be on guard. Susceptibility to pests and diseases has been shown to occur under the following circumstances:

- Failure to give proper attention to species/site matching, ie, “offsite planting”, resulting in trees growing under stress.
- Use of planting stock from a narrow genetic base.
- Failure to maintain optimum stocking levels and tree vigour through intermediate cuttings.
- Dependency on one or two species in plantation programmes.
- After a fire when trees are debilitated

At present, termite attack is the most vivid risk for eucalyptus. Termites attack root systems and stem bases of eucalyptus resulting in reduced performance and even mortality. Appropriate soil preparation techniques, chemical control at planting and subsequent applications are thus imperative. For this end, environmental friendly pesticides such as the Bandit (Imidaclorprid) that have been approved by the FSC will be used in the first phases of the plantation establishment. In one plantation cycle, the

pesticide will normally, be applied on the first year and, in case of reincidence of the termites attack on the second year. Research and development activities will also look at alternative methods aiming at reducing the use of chemical control in the long run.

Pests and diseases control require regular monitoring of diseases and pests in the plantations and seeking expert advice as soon as problems arise. In determining what to plant, species selection will aim at introducing species and provenances that are resistant to diseases and pests existing in the area. Species diversity will also reduce risks as some pathogens and pests are site specific.

Plantation harvesting

Harvesting includes tree felling, conversion to logs, extraction to roadside, stacking and loading onto the transport vehicle. Harvesting can be thinning or felling of mature stands. For this chapter refer to the *GRAS Harvesting and guidelines for Tanzania and Uganda operations* that will be adapted for Mozambique operations.
Before starting any of the operations described below, every worker must make sure that he/she has put on the required protective gear. It is the supervisor's responsibility to ensure that all staff is dressed adequately.

Harvesting techniques and equipment

Before work starts, planning has to be done first off site and then continues on site. The objective is to reduce unnecessary work, avoid physical strain and diminish the risk of accidents. Harvesting can be done manually with power saws or mechanically with harvesters. Harvesting will be started as manual operations but will be predominantly transformed to mechanized operations together with the increasing volumes of harvested timber. Manual work will always be needed in the thinning and pruning of trees. Some demanding areas may also be logged manually with chain saws.

Harvesters will be used for logging, debarking and cutting trees. Logging of each stand follows a plan that guides the harvester operator's work.

The log transport plan includes log transport routes and location of storage points. The location of these points is determined largely by the terrain.

Felling strips are planned along the transport routes. The felling strips should address the felling direction and order of the trees. Factors to be considered are terrain, transport routes and distances, working methods and wind direction. If trees are not felled in an orderly and systematic fashion, the result is extra work and reduced productivity. Planning of the work usually continues throughout the working day.

Directed felling is one of the most important principles in planning a harvesting operation. The objective is to save time and unnecessary work by directing the tree along the log transport route. In this way the felling becomes the 'first step of transport' as skilful felling brings the logs closer to their intended destination.

The desired direction of felling is determined by the supervisor or trained skilled worker. This decision should be based on terrain, transport routes, natural obstacles and working methods. Felling against other trees is to be avoided due to the physical damage it causes and because of the delays needed to release lodged trees.

The felling of a tree requires initial preparations, the making of the felling sink, the making of the main cut, pushing the tree down and completion of the cut. The felling sink is a notch made at the base of the tree in the direction of the fall.

Delimbing is the systematic removal of branches from a felled tree. Since workers have to walk along the length of the felled tree, they should work from the side with the fewest branches.

The worker must wear eye protection for delimbing with a chainsaw. Axes and/or machetes should be used to delimb small trees and branches.

After the felled tree has been delimbed and the logs measured to the desired lengths, the stem is ready for cross-cutting. The worker checks that there are no obstacles or other objects that may interfere. Special attention is paid to the work routine and protection equipment so that health and safety risks are minimised.

Clear felling

Clear felling is a process in tree harvesting where all trees in a given forest compartment are felled for the intended use. During this time it is expected that the forest has reached its maturity.

Logging is planned in advance and an increasing volume of wood will be harvested annually to be converted to wood products like chips, transmission poles and sawn timber.

Thinning and process residues will be utilized for chips and small poles. Harvesting is planned to be started sixteen to twenty years after planting is started.

In pole wood plantations, intermediate thinning and pruning is done until the trees are 18 years old. After harvesting, the areas are regenerated by planting seedlings/hybrids/clones or coppiced.

The abovementioned technology and know-how will be transferred to Mozambique through the development of the A/R CDM project activity and the training of the local employees that will implement the project.

A.5. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as a project participant (Yes/No)
Mozambique (host)	• Niassa Green Resources SA • Green Resources AS	No

A.6. Legal title to the land and rights to tCERs/lCERs issued for project activity

>>

Legal title to the land

All land in Mozambique belongs to the state. The area is leased from the government under the Direitos de Uso e Aproveitamento de Terra (DUAT) system. It is a land and benefit use approval from the Ministry of Agriculture. There is an important difference between the DUAT and a normal timber concession in the resource use under customary rights. Under the DUAT system these rights are negotiated and "signed off" by the local communities and a cadastre is surveyed out and allocated to the company leasing the land. A DUAT is a land use right on which the lease is based.

NGR has the right of land use and benefit for the Malulu parcel (7,880 ha). This was granted by the Government to the Malonda Foundation, which was streamlining the land acquisition process to encourage private investment in the forestry sector of Niassa by applying for all DUATs collectively and forming partnerships with the private sector.

The Malulu parcel, where the project started, has been granted DUAT 881, which covers a total surface of about 7,880 ha in this District. For the other parcels of land included within the A/R CDM project, NGR has been directly involved in the land acquisition process with the local communities and government. For these parcels of land NGR has obtained approval from the local communities, through the legal required community consultation meetings, and, the process has been submitted for government approval and issuance of the DUAT.

Rights to tCERs

Despite the inexistence of a specific regulation on carbon credits rights/ ownership in Mozambique at DNA level (Ministry for the Coordination of Environmental Affairs - MICOA), it is recognised by the DNA that carbon credits from forest plantations are owned by the owner of the land user right title. According to the land legislation, a Land user right title (DUAT) is issued for the implementation of activities under a certain approved project and covers the overall aspects of the approved project for the land development (including the use of the land for the project implementation, and sales of the products arising from the use of the land). The resources and products produced under the DUATs belong to the DUAT owner.

NGR has secured the land user rights for the Malulu parcel where the Carbon Project will be implemented. For the other two parcels of land (Malica/Nconda and Ntiuile/Luissa), NGR is awaiting Government approval and issuance of the DUAT. This means that, upon approval of the DUAT, the Government has approved NGR' project for the establishment and management of forest plantations in those parcels of land. Considering that the DUAT allows NGR to manage the lands and sell the "products" originated from its activities then, since the carbon credits are a result of the trees/ plantation establishment and management on NGR DUAT lands, these are also covered by the DUAT authorization and are owned by the DUAT owner, which is, in this case, NGR. The legal title of the CERs will be transferred from the land use rights holder (NGR) after the additional carbon was sequestered to the buyer upon delivery of certification documentation and signing of an Emission Reductions Purchase Agreement.

A.7. Assessment of the eligibility of the land

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To assess the eligibility of the land, the project proponent has applied the "procedure to demonstrate the eligibility of lands for afforestation and reforestation CDM project activities, version 01 (EB 35 Report, Annex 18).

Step 1a:

Demonstrate that the land at the moment the project start does not contain forest by providing transparent information that:

i) Vegetation on the land is below the forest thresholds (tree crown cover or equivalent stocking level, tree height at maturity *in situ*, minimum land area) adopted for the definition of forest by the host country under decisions 16/CMP.1 and 5/CMP.1 as communicated by the respective DNA; and

ii) All young natural stands and all plantations on the land are not expected to reach the minimum crown cover and minimum height chosen by the host country to define forest; and

iii) The land is not temporarily unstocked, as a result of human intervention such as harvesting or natural causes

Step 1b:

Demonstrate that the activity is a reforestation or afforestation project activity:

i) For reforestation project activities, demonstrate that the land was not forest by demonstrating that the conditions outlined under (a) above also applied to the land on 31 December 1989

ii) For afforestation project activities, demonstrate that for at least 50 years vegetation on the land has been below the thresholds adopted by the host country for definition of forest

The Mozambican DNA, the Ministério para a Coordenação da Acção Ambiental (MICOA), has officially submitted its forest definition to the UNFCCC. The following criteria were set for the CDM forest definition:

- A single minimum land area value of 1.0 ha
- A single minimum tree crown cover value of 30 per cent
- A single minimum tree height value of 5 meters

Step 1a, i) has been demonstrated through the analysis of satellite imagery (Spot and Landsat imagery from 2006) combined with GPS points taken whilst ground truthing through the different strata[7]. This analysis classified all the different land classes within the three parcels of land, identifying forest, wetland, grassland, shrubland and cropland strata (see B.4 for the baseline stratification maps). All forest areas have been removed from the A/R CDM project area. Step 1a, ii) has been confirmed through confirmation that the drivers of degradation in the region are still present – see section B.2 for further details on this through the application of the "Tool for the identification of degraded or degrading lands for consideration in implementing A/R CDM project activities, Version 1 (EB 41 Annex 15)". Step 1a, iii) is met as the land is not temporarily unstocked as a result of human intervention such as harvesting or natural causes.

For Step 1b the project proponent has demonstrated that the activity is a reforestation project activity by showing that the land was not forest on 31 December 1989. To demonstrate this, supervised classifications were carried out using Landsat TM images from 1989. Figures A.7.2a – c show these classifications.

[7] See Annex 6, Remote Sensing Methodology for mapping procedure

Figure A.7.1 Examples of the different strata in the parcels of land at project start (top: degraded grassland and shrubland; bottom left: forest plantation area; bottom right: cropland.

Figure A.7.2.a. Supervised classification of 1989 Landsat imagery of the Malulu parcel

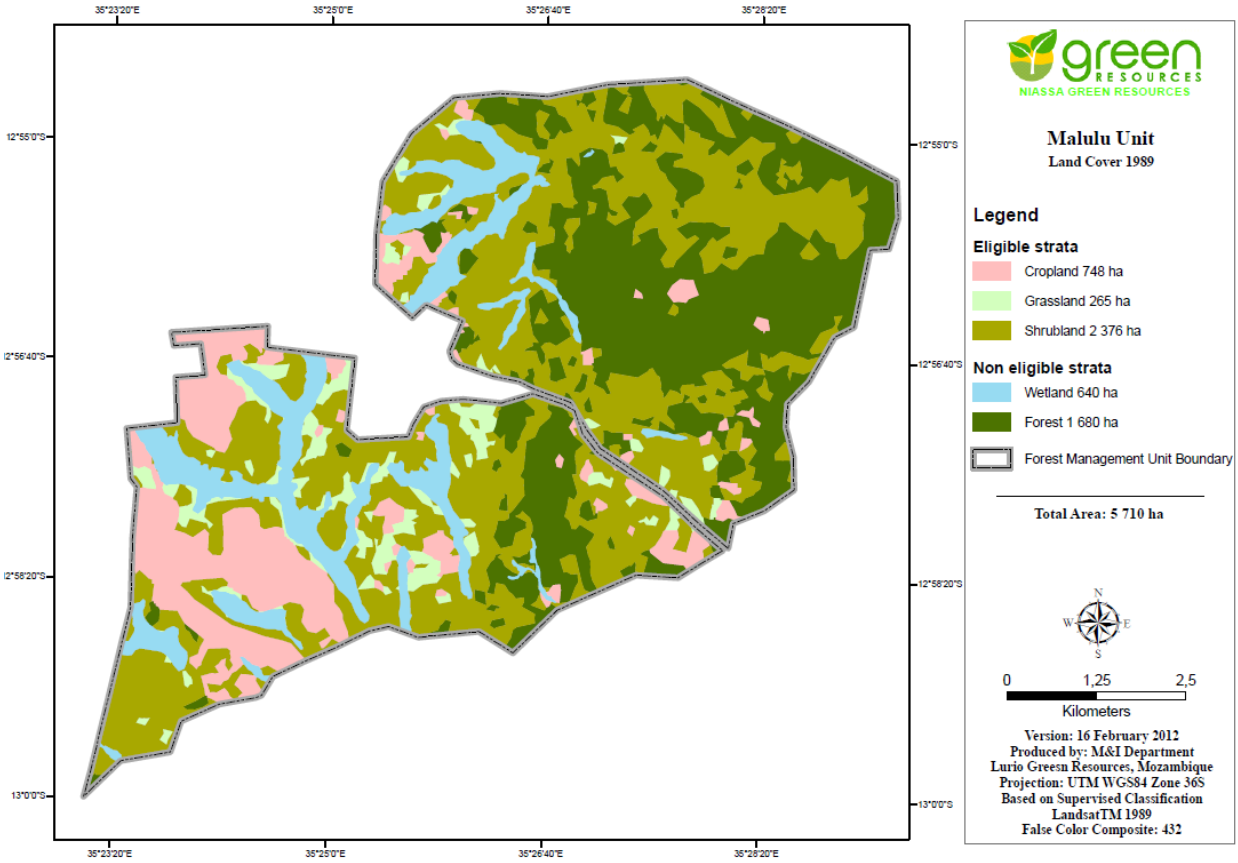


Figure A.7.2.b. Supervised classification of 1989 Landsat imagery of the Malica parcel

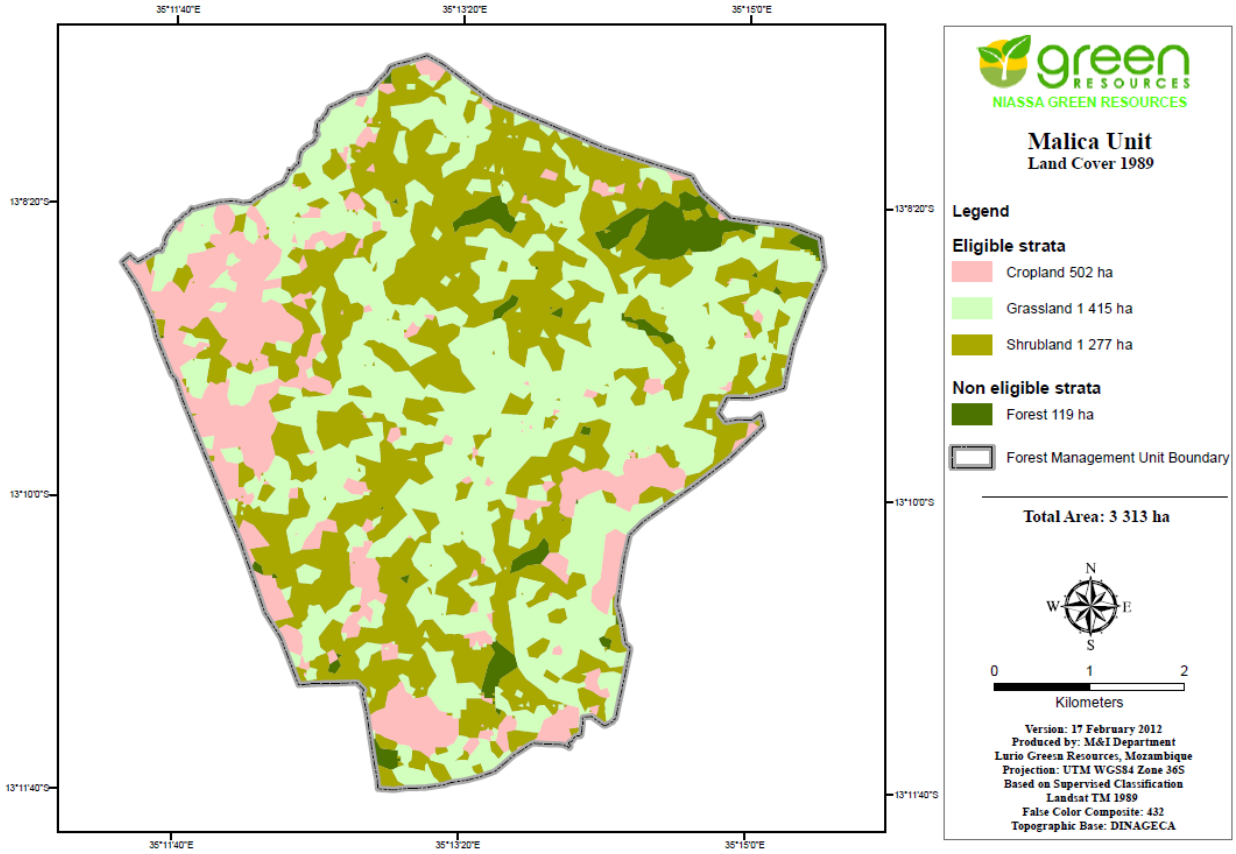
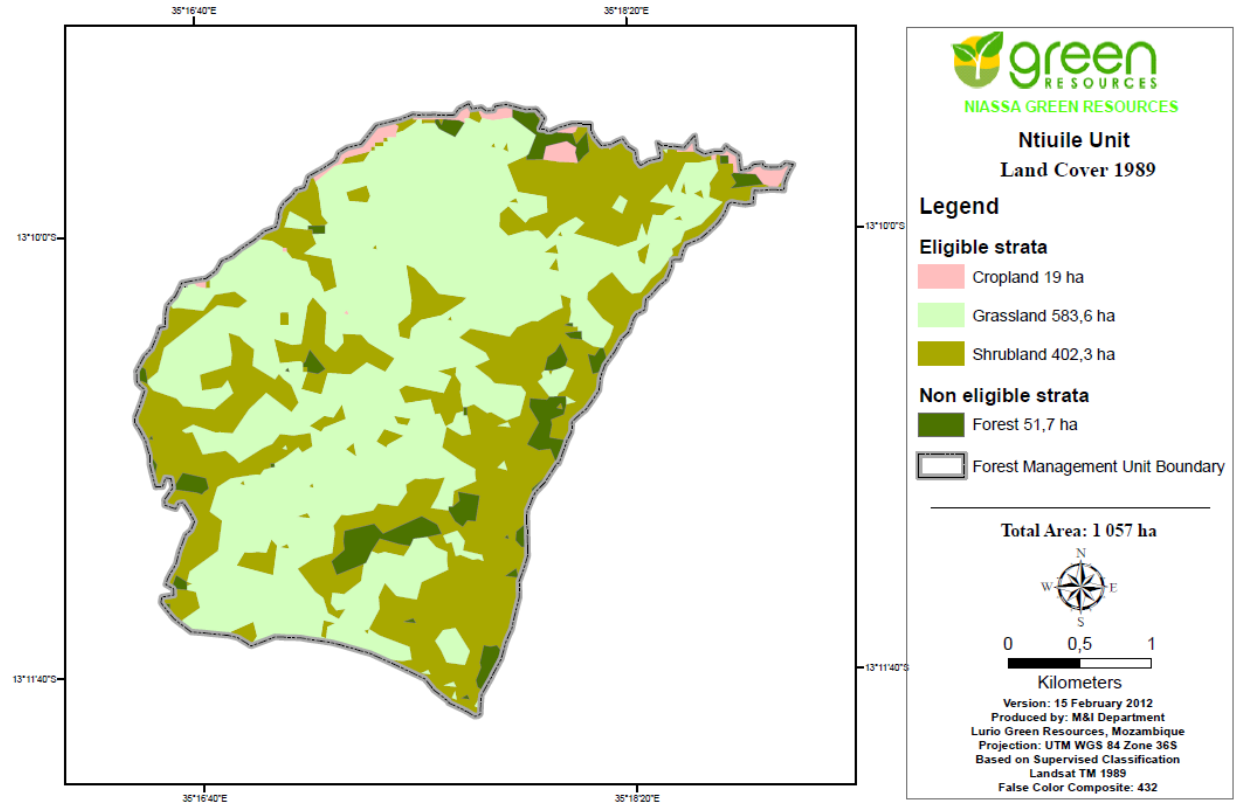


Figure A.7.2.c. Supervised classification of 1989 Landsat imagery of the Ntiuile parcel



A.8. Approach for addressing non-permanence

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Issuance of tCERs

A.9. Public funding of project activity

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Public funding from Parties included in Annex I is involved. See Annex 2 for information on sources of public funding and affirmation that such funding does not result in a diversion of official development assistance and is separate from and is not counted towards the financial obligations of those parties.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

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Consolidated afforestation and reforestation baseline and monitoring methodology AR-ACM0003, "Afforestation and reforestation of lands except wetlands" (Version 01.0.0).

The methodology also refers to the latest approved versions of the following documents:

- Clean Development Mechanism project standard
- Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities, Version 01.0
- Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities, Version 04.1
- Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities, Version 02.0.0
- Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity", Version 04.0.0
- Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity, Version 01.0
- Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities, Version 01.1.0

B.2. Applicability of methodology

>>

The methodology AR-ACM0003, Version 01.0.0, has the following applicability conditions:

(a) The land subject to the project activity does not fall into wetland[8] category;

[8] "Wetlands", "settlements", "cropland" and "grassland" are land categories as defined in the *Good Practice Guidance for Land Use, Land-use Change and Forestry* (IPCC, 2003)

No wetlands will be planted and the NGR has carried out extensive mapping work involving both analysis of high resolution satellite images and ground truthing to delineate and exclude any such areas from the project area.

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

(i) Land containing organic soils;

The project is not taking place on any organic soils.

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

The project activity is taking place in land that doesn't fall in the land management practices and inputs listed in appendices 1 and 2 to the methodology.

Considering appendix 1, cropland: the region where the project activity takes place is tropical moist, in areas where subsistence agriculture is practiced and as such low or no inputs are applied.

As for appendix 2, grassland, the project activity is developed in tropical moist areas where grasslands are degraded and no inputs are applied.

The "Tool for the identification of degraded or degrading lands for consideration in implementing A/R CDM project activities, Version 1 (EB 41 Annex 15)" has been applied to demonstrate that the lands are degraded or degrading.

Stage 1 of the tool requires the PP to screen the lands of the project to determine whether the area has been classified as "degraded" under any verifiable local, regional, national or international land classification system or credible study produced within the last ten years.

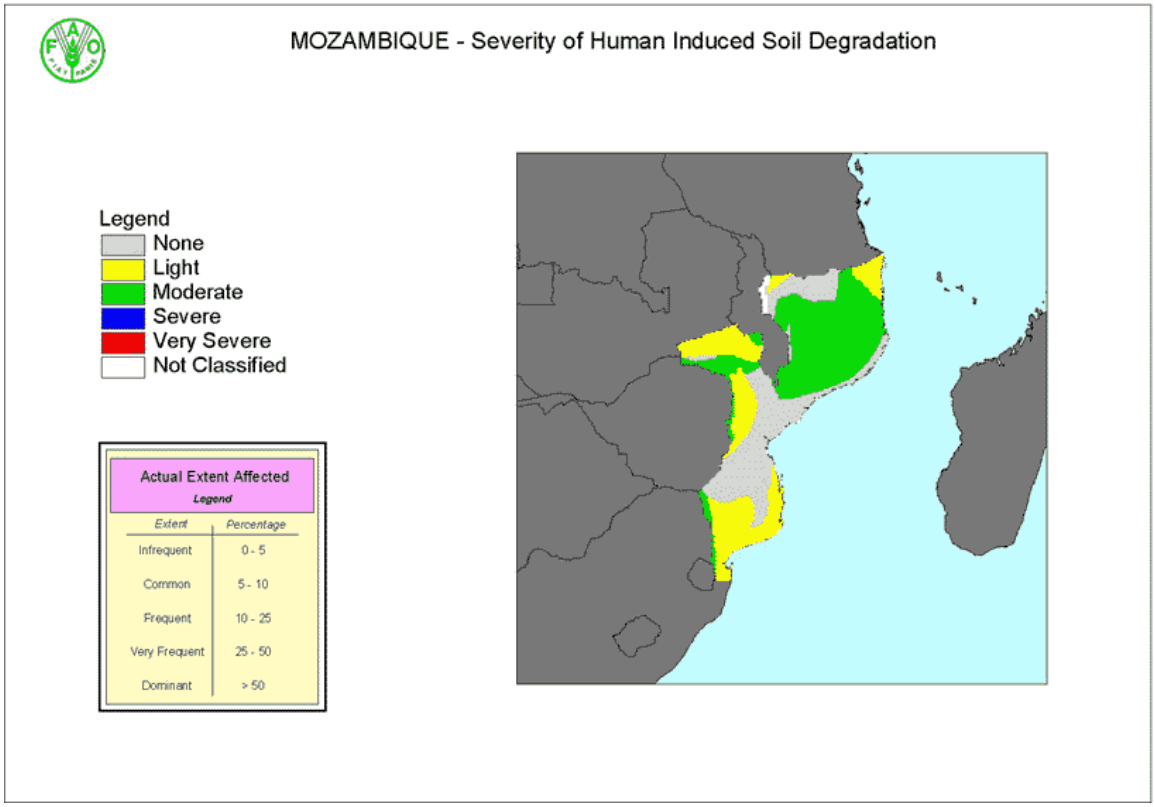
For NRP, the FAO (2008) National Soil Degradation Maps were used to show the land was classified as degraded (See Figure B.2.2); however, since the soil degradation assessments used to compile the map were obtained in the 1980s, it had to be shown that the drivers and pressures that led to the land becoming degraded are still present, and there are no or insufficient management interventions to reverse degradation. The drivers and pressures of land degradation in the region have been from charcoal and fuelwood production, as well as agriculture. These drivers are still present as can be seen from field evidence as well as the EIA, SEIAs and FSC assessment reports.

Figure B.2.1. Photos demonstrating examples of degradation

Further evidence that the anthropogenic degradation drivers and pressures that led to the land becoming "degraded" are still present (procedure (a) (i)) was provided by direct visual field evidence of selected indicators of land degradation. Land is classed as degraded and/ or degrading if a reduction in plant cover due to overgrazing or other land management practices is shown.

Figure B.2.2, shown below, shows the national soil degradation map for Mozambique[9]. Overlaying this image in Google Earth, it can be seen that the project area has moderate soil degradation[10].

Figure B.2.2 National Soil Degradation Map for Mozambique

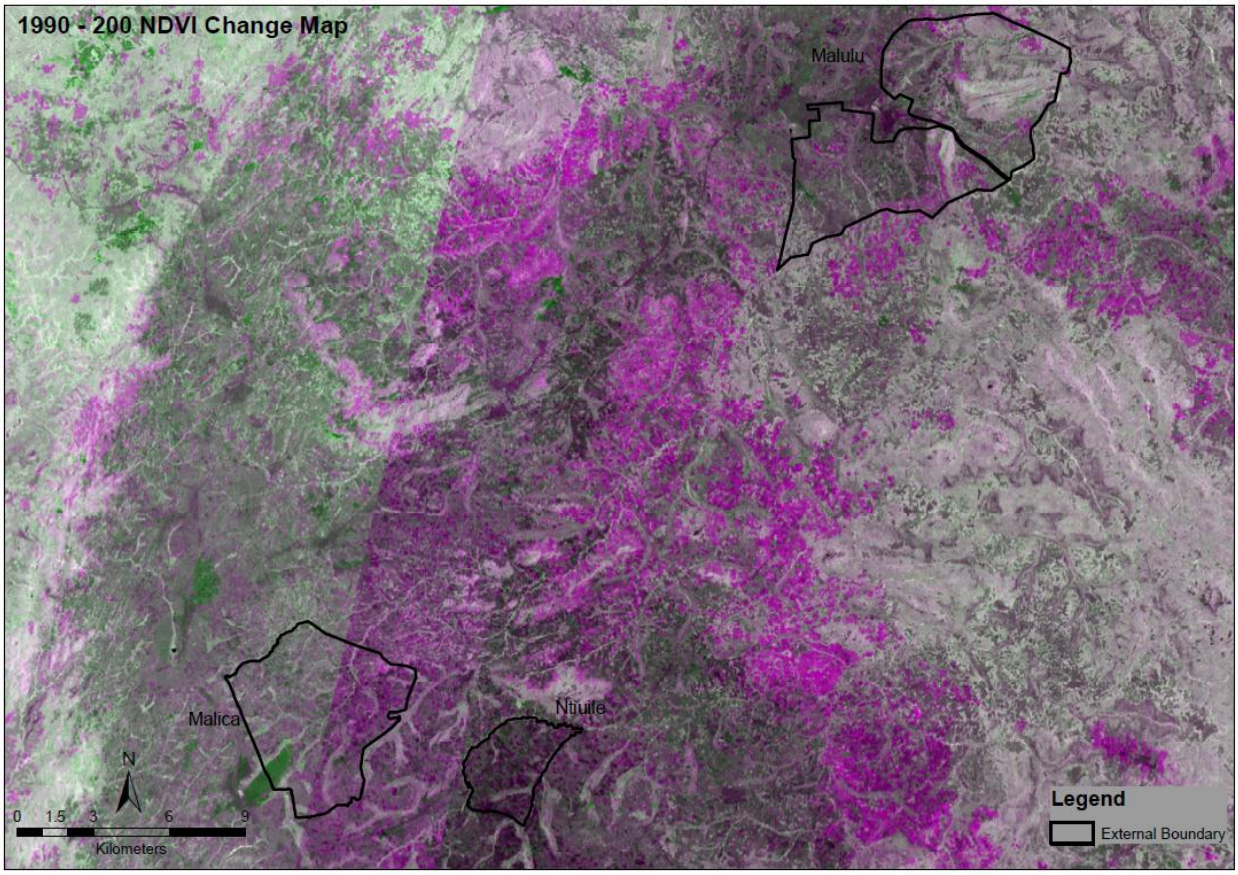


In addition to the FAO soil degradation map, a time series analysis from 1990 - 2000 using Landsat imagery further substantiates the successive pattern of degradation, as can be seen in Figure B.2.3.

[9] FAO (2008) National Soil Degradation Maps http://www.fao.org/landandwater/agll/glasod/glasodmaps.jsp
[10] KML file available

This multi-temporal change image (Figure B.2.3) highlights vegetation change in the area – magenta shows decreases in vegetation and green showing vegetation increase. It can clearly be seen that almost the whole of the NRP area has experienced a vegetation decrease between 1975 and 2005.

Figure B.2.3 Time series analysis showing vegetation change in Lichinga region between 1990 and 2000[11]



The project proponent is not choosing to account for changes in carbon stock in soil organic carbon (SOC) pool in the project scenario, and thus, consequently applicability conditions (d) and (e) from the methodology do not apply.

The combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities has the following applicability conditions:

- Forestation of the land within the proposed project boundary performed with or without being registered as the A/R CDM project activity shall not lead to violation of any applicable law even if the law is not enforced

The project is in line with all laws and international standards – as demonstrated through the certification of the Malulu block under the FSC[12].

- The tool is not applicable to small – scale afforestation and reforestation project activities

This is met since the NRP is not a small-scale project.

[11] The time series analysis is publically available from the ESRI website: http://changematters.esri.com/compare
[12] Malica and Ntuile are not FSC certified since they are more recent areas of land to be added to the project; however, the same principles are being applied to these areas

B.3. Carbon pools and emission sources

Carbon pools	Selected?	Justification / Explanation
Above-ground biomass	Yes	Major carbon pool subjected to project activity
Below-ground biomass	Yes	Below-ground biomass stock is expected to increase due to the implementation of the A/R CDM project activity
Dead wood	No	Under the applicability conditions of this methodology, carbon stock in this pool is likely to increase in project compared to the baseline. However, the methodology also provides the conservative choice of not accounting for changes in carbon stock in the pool
Litter	No	Under the applicability conditions of this methodology, carbon stock in this pool is likely to increase in project compared to the baseline. However, the methodology also provides the conservative choice of not accounting for changes in carbon stock in the pool
Soil organic carbon (SOC)	No	Under the applicability conditions of this methodology, carbon stock in this pool is likely to increase in project compared to the baseline. However, the methodology also provides the conservative choice of not accounting for changes in carbon stock in the pool

Sources	GHGs	Included?	Justification / Explanation
Burning of woody biomass	CO_2	Excluded	Carbon stock decreases due to burning are accounted as a change in carbon stock
	CH_4	Included	Burning of woody biomass for the purpose of site preparation or as part of forest management can lead to significant levels of emissions of methane
	N_2O	Included	Burning of woody biomass for the purpose of site preparation or as part of forest management can lead to significant levels of emissions of nitrous oxide

B.4. Identification of strata

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- Baseline net GHG removals by sinks

For the baseline stratification

Figure B.4.1 Baseline map showing land classes at Malulu

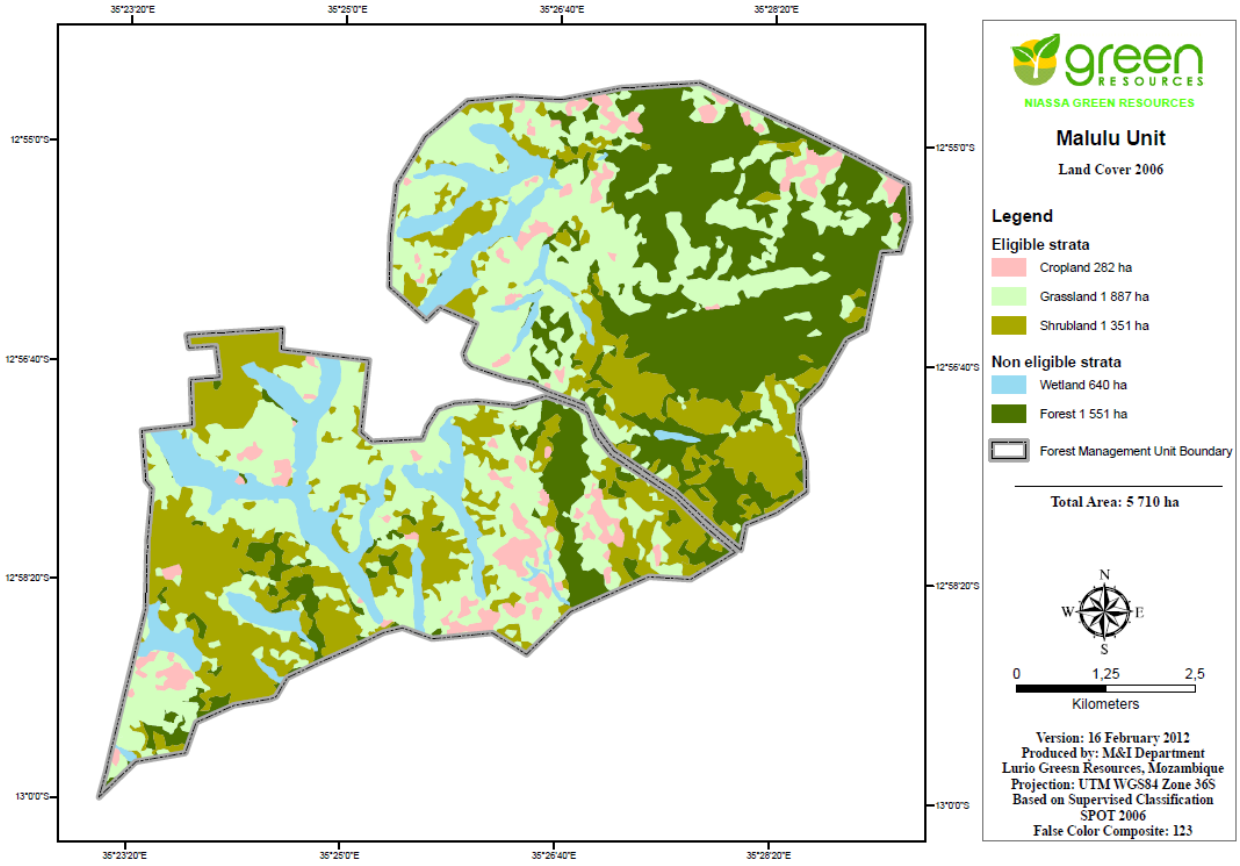


Figure B.4.2 Baseline map showing land classes at Malica

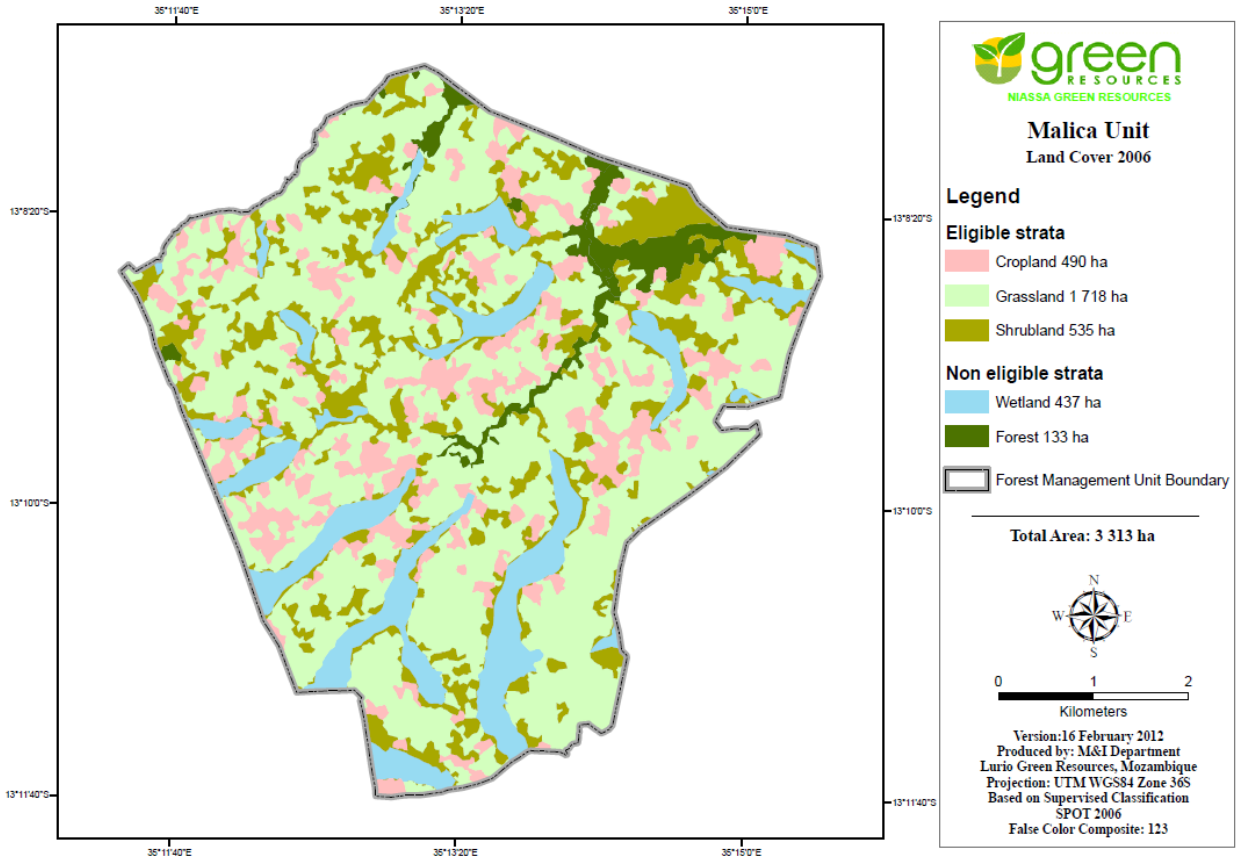
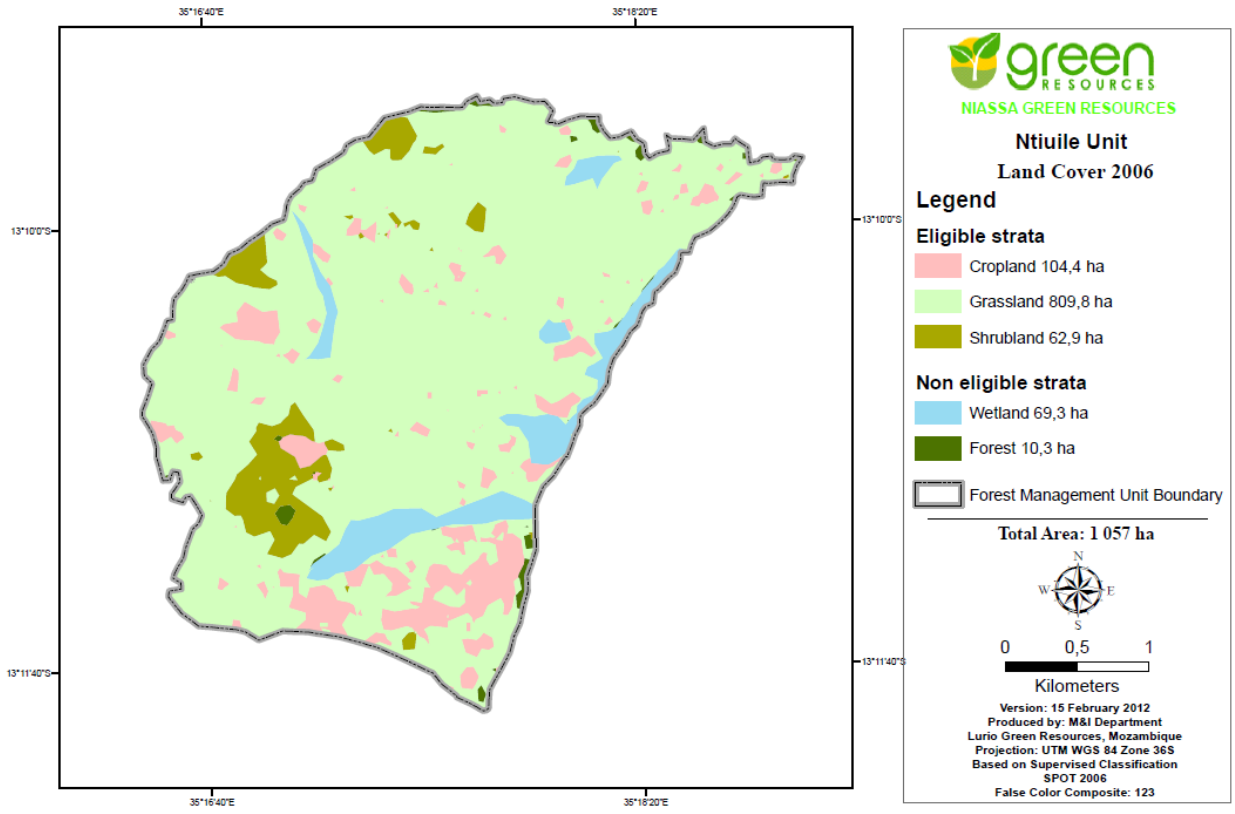


Figure B.4.3 Baseline map showing land classes at Ntiuile



- Actual net GHG removals by sinks

The stratification for *ex ante* estimations is based on the project planting from the management plan; however, since the management plan for the Malica and Ntiuile parcels is still under development, these stratifications are deemed tentative. The stratification for *ex post* estimations shall be based on the actual implementation of the project planting/ management plan.

Figure B.4.4 Actual net GHG removals by sinks map at Malulu

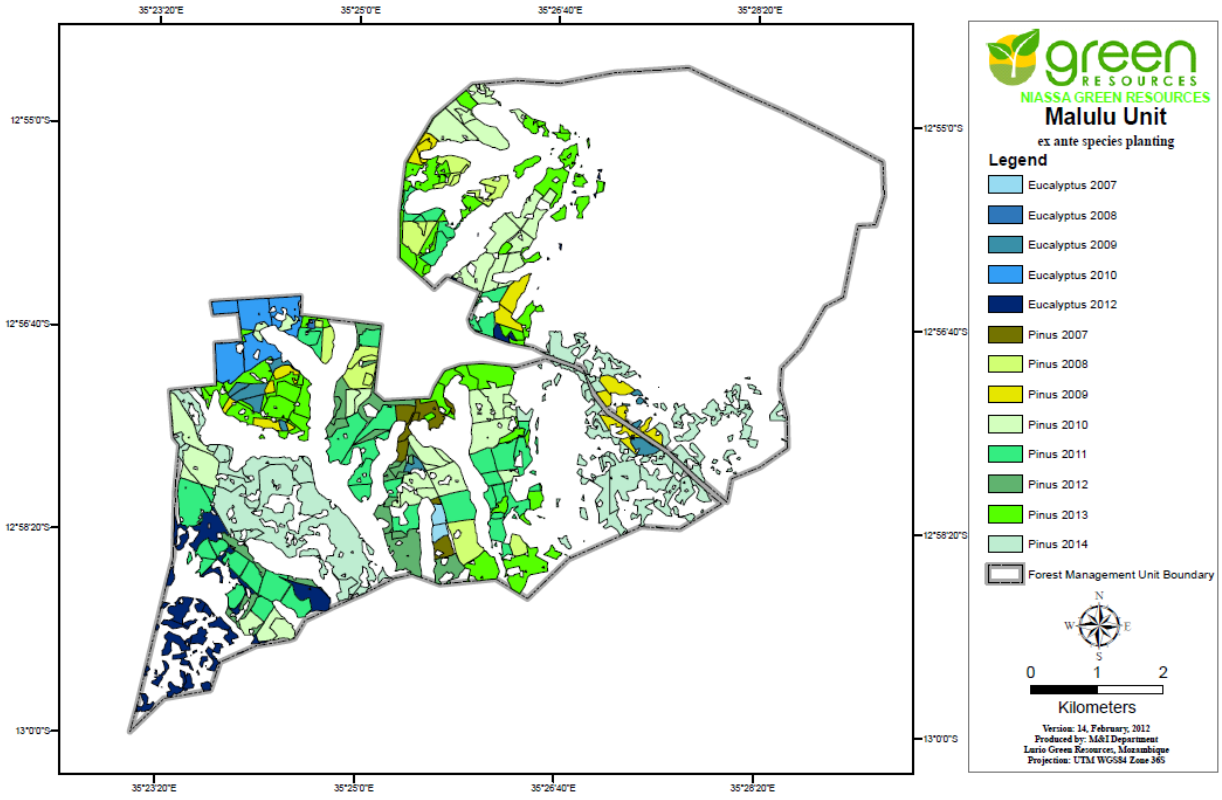


Figure B.4.5 Actual net GHG removals by sinks map at Malica

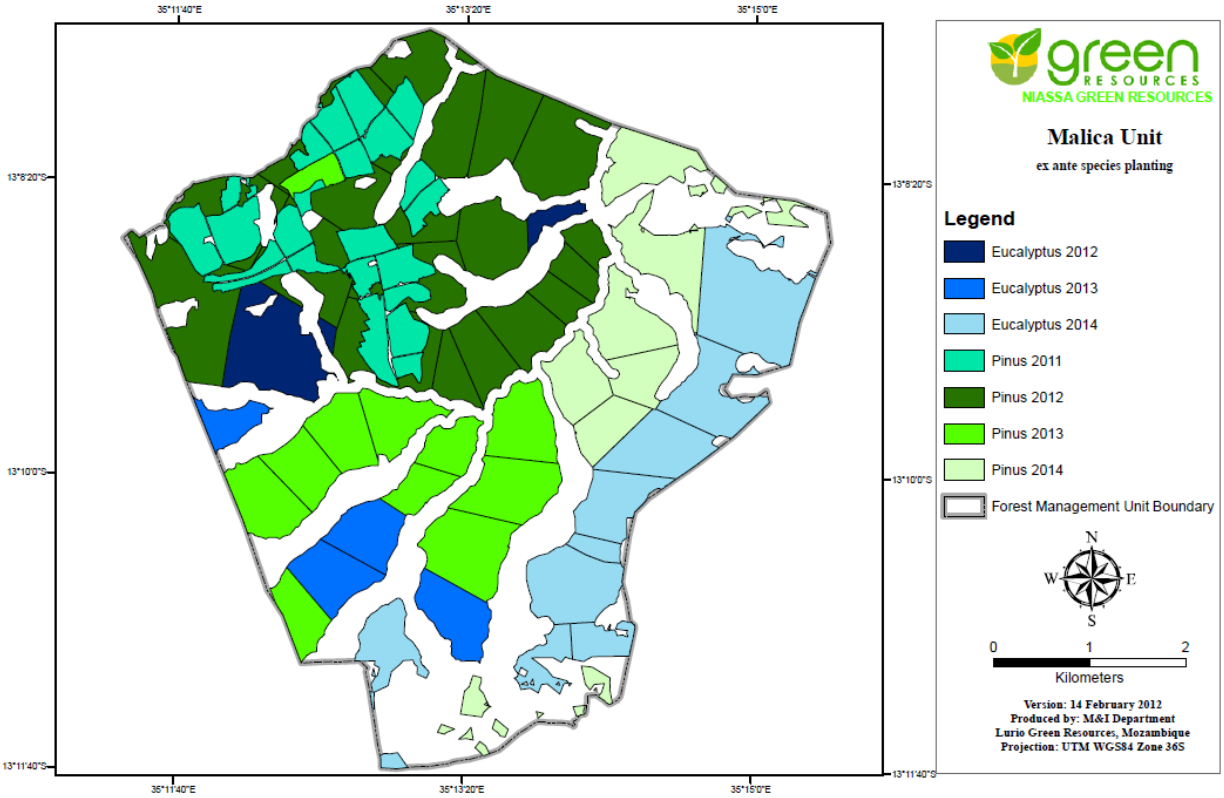
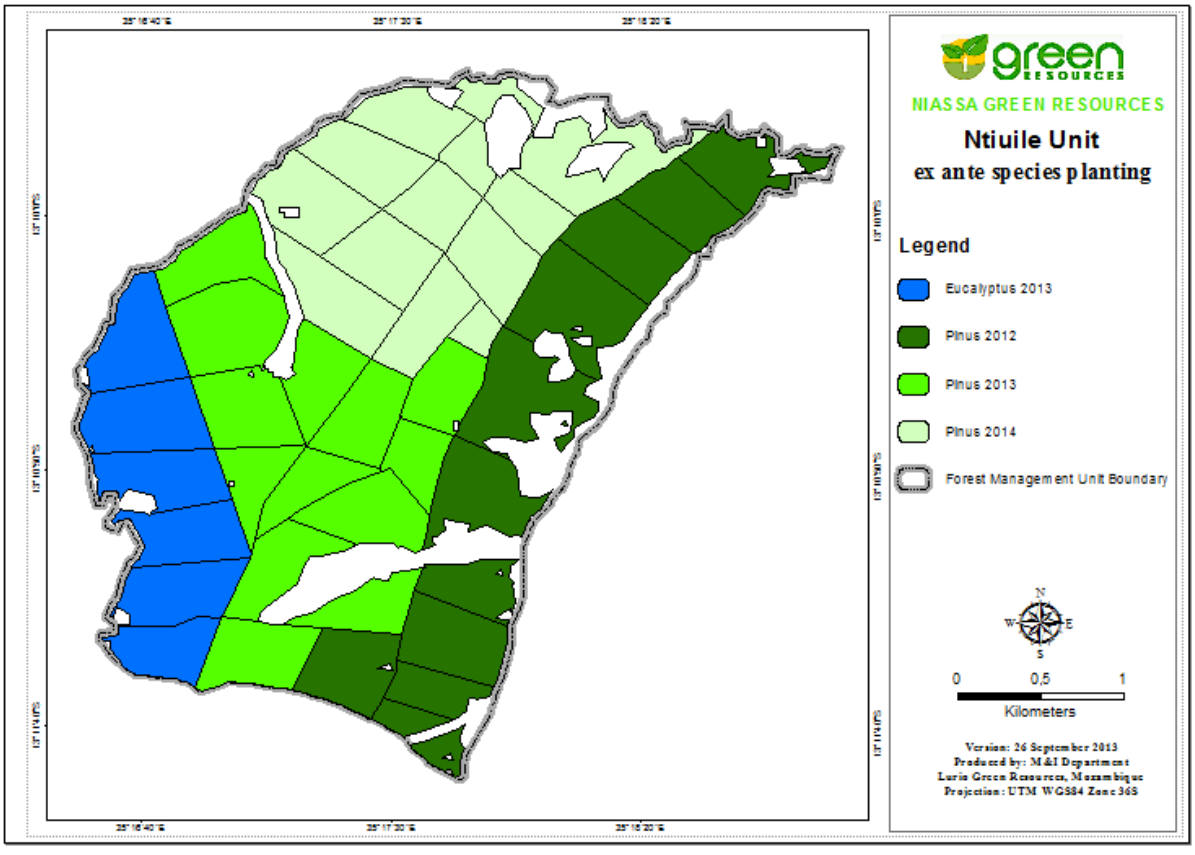


Figure B.4.6 Actual net GHG removals by sinks map at Ntiuile



B.5. Establishment and description of baseline scenario

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The "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities, Version 01 (EB 35, Annex 19)" was applied to the project to demonstrate the baseline and additionality.

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

The project start date is the 15th January 2007. Since the A/R CDM project's start date is after the 31st December 1999 but before the date of its registration, evidence is provided to show:

- The start date of the A/R CDM project activity was after 31st December 1999; and
- The incentive from the planned sale of tCERs was seriously considered in the decision to proceed with the project activity.

The project start date is when the first planting began at the Malulu parcel of the project. This is substantiated through NGR's inventory and monitoring system, Microforest.

Evidence that the incentive from the planned sale of tCERs was seriously considered in the decision to proceed with the project activity is shown through Green Resources' annual report from 2006, which includes a carbon offsets section as well as explicit references to the start of its Mozambican operations in Niassa. This documentation is publically available. In addition, confirmation of Green Resources strategy to use carbon finance for its forest plantations can be demonstrated through other A/R projects which have been registered under the CDM and VCS, which started before the Niassa project. For example, the Kachung Forest Project, which began in 2006, is registered under the CDM; whilst the Uchindile and Mapanda Forest Projects is registered under the VCS with a start date of 1997. Such an early project demonstrates that Green Resources has seriously considered carbon finance since the start of its operations. This is documented in a number of different documents, including board minutes and annual reports[13].

Additional documentation includes the initial "Agreement between Fundação Malonda and Tree Farms AS[14]", which was entered into on the 8th May 2007. This legal document, which outlines the commitments of Tree Farms in regard to the implementation of the reforestation project, explicitly refers to the use of carbon finance for the project. Further confirmation of Green Resources' carbon business can be seen through its annual reports from 2007 through to 2012.

Timeline	Event	Comments
September 11, 2006	Letter of intent from Green Resources to Malonda Foundation	Date of investment decision
December 12, 2006	Malonda Tree Farms approval by GRAS's board[15]	Board meeting
November 15, 2006	Plantation manager hired	
January 17, 2007	First planting	Microforest

[13] TreeFarms AS, Board Meeting Minutes: January 1999, December 1999, March 2000

[14] Green Resources AS was formerly called TreeFarms AS

[15] Green Resources board approved the investment in Niassa Green Resources (former Malonda Tree Farms), the subsidiary responsible for the operations in Niassa Province.

May 8, 2007 Agreement between Green Resources and Malonda Foundation

STEP 1. Identification of alternative land use scenarios to the proposed A/R CDM project activity

Sub-step 1a. Identify credible alternative land use scenarios to the proposed A/R CDM project activity

The most credible alternative scenario to the proposed A/R CDM project activity is the continuation of the pre-project land use and further degradation of the grass and shrubland strata to cropland. However, A/R without CDM is also a credible alternative land use scenario that must be considered. In addition, in line with the tool, forestation of at least a part of the land within the project boundary of the proposed A/R CDM project must be considered if applicable at a rate resulting from:

- Legal requirements; or
- Extrapolation of observed forestation activities in the geographical area with similar socio-economic and ecological conditions to the proposed A/R CDM project activity occuring in a period since 32 December 1989 as selected by the PPs

There was no legal requirement to reforest the land that makes up the A/R CDM project boundary as it is not legally demarcated as a forest reserve. The Malonda Foundation acquired the DUAT for the area, which meant that the opportunity for forestry activities on the land was enabled; however, it still was not mandatory.

The civil war in Momzambique meant that there were no or little forestation activities in the 1990s. The Malonda Foundation's engagement in the sector marked the initial steps in developing the sector post-war. The foundation's programme began developing in the early 2000s and became active around 2005 with several companies being awarded DUATs for first planting[18]. However, very little planting was done in the initial years since this was a phase of pilot planting for the companies. It is estimated that the companies, Chikweti and Florestas de Niassa, the first companies to begin planting, in 2005 and 2006, respectively, planted around 100 ha per year. Therefore the reforestation rate based on extrapolation of observed forestation activities is this rate over the total area deemed suitable for forestation activities. A study by the Mozambican Government[19] estimated the total suitable area in the Niassa region at 282,000 ha. Therefore, taking the rate of the 200 ha per year (the rate in the final year prior to project start for the NRP), this represents a rate of 0.07% of the land being reforested in the region per year. Since this reforestation rate is very low, forestation of at least a part of the land within the project boundary is not deemed viable, and thus is not applicable.

- Continuation of the pre-project land use – further degradation
- A/R without CDM

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

The identified realistic and credible land-use scenario of further degradation of the land due to conversion of the grass and shrubland to cropland can be considered to be valid because it is not against the applicable legislation. The country legislation does not forbid the conversion of forest lands to agriculture or other land-uses. The only legal requirement in this respect is the request of a

[18] 5 March 2006, Monica Branks, Notes, History, Forestry Plantation Investments

[19] The study assessed land available for forestry activities in Niassa Province: Zoneamento e Identificacao de Areas para Investimento no Sector Agrario e Analise Socio-Ambiental da Provincia de Niassa, volume 3, Plantacoes Florestais, Rural Consult LDA, Savcor Indufor, May 2007.

permit for vegetation clearing provided that this is not considered a pristine forest but, local communities do not apply to the government for agriculture lands and therefore do not take this legal requirement into account during the land selection for agriculture purposes. Additionally, the GoM is currently implementing a strategy, "Revolução Verde" (Green Revolution), which aims at increasing the agriculture production and productivity to fight hunger and poverty[20]. In its programme, the Government emphasises the role that family sector plays in the agriculture production, therefore the intensification of agriculture activities is a feasible option that is in line with the Government programs. Government policies also aim at achieving the sustainable use and preservation of the natural resources (lands, water, etc.)[21] However, in the way agriculture is currently being done (itinerant/shifting/extensive cultivation), it can be considered to be against the Government policies but, the GoM has limited capacity for the law enforcement and thus to avoid conversion of forest areas due to agriculture. Therefore the scenario of slash and burn agriculture is likely to continue as it is.

In 1997, the Government approved the forest and wildlife policy which defines as priority the promotion of A/R activities. In line with this policy, the GoM is promoting establishment of community A/R programs as well as an A/R program for industrial and commercial purposes. Additionally, the forestry and wildlife law and its regulation also provide for the establishment of special incentives for the forest plantations which are still inexistent after over 10 years of the approval of the legislation. It is in this regard that the Malonda Foundation, in Partnership with the GoM, started the Program in Niassa for attracting investors for A/R projects, and NGR is a result of this program. A/R without CDM is therefore consistent with enforced mandatory and applicable laws and regulations.

STEP 2. Barrier analysis

Sub-step 2a. Identification of barriers that would prevent the implementation of at least one alternative land use scenario

- Continuation of the pre-project land use
- A/R without CDM

In the current project scenario, natural regeneration is not expected to occur, because of the drivers of degradation still being present in the region (slash-and-burn agriculture), as well as the lands having poor soils and there being few seed sources. This results in tall grass out competing the young seedlings and prevents seeds from landing on the soil. This is demonstrated by the failure of tree-growth in the last decades in the area.

The establishment of A/R programs is a feasible option in the area but this is only possible for large A/R companies that have lower return requirements from their investments.

A/R from small scale companies is not feasible as the existing banks in the country do not provide loans or credits for forest plantations due to perceived risks associated to the activity. Furthermore, local communities lack the technical expertise and knowledge for implementing A/R Projects. Therefore, this activity is not likely to occur.

A/R without CDM for private companies is prevented by an investment barrier - insufficient financial returns. However, following the combined tool to identify the baseline scenario and demonstrate additionality, this barrier must be demonstrated by carrying out investment analysis.

[20] MINAG (2009). CONCEITO, PRINCÍPIOS E ESTRATÉGIA DE REVOLUÇÃO VERDE EM MOÇAMBIQUE. Maputo. 21Pp

[21] MINAG (2009). CONCEITO, PRINCÍPIOS E ESTRATÉGIA DE REVOLUÇÃO VERDE EM MOÇAMBIQUE. Maputo. 21Pp

Sub-step 2b. Elimination of land use scenarios that are prevented by the identified barriers

The following is a list of land use scenarios that are not prevented by any barrier:

1. Continuation of the pre-project land use[22]

Sub-step 2c. Determination of baseline scenario (if allowed by the barrier analysis)

Forestation without being registered as an A/R CDM project activity is prevented by an investment barrier, as such the list contains only one land use scenario, which is continuation of the pre-project land use (not prevented by any barrier).

STEP 3. Investment analysis

Sub-step 3a. Determine appropriate analysis method

Benchmark analysis (Option III) is applied as the project generates revenues not just from the sale of tCERs – which rules out applying simple cost analysis. Investment comparison analysis is not applicable to the project since the alternative land use scenario requires no investment at all. Benchmark analysis is therefore the appropriate analysis.

Sub-step 3b. – Option III Apply benchmark analysis
The equity Internal Rate of Return (IRR) has been applied as the financial indicator for the A/R CDM project since there is only one potential project developer. An equity IRR is used since GRAS' financing at the point of the investment decision was equity based. Therefore the debt equity ratio is considered zero. A letter is provided from one of GRAS' equity investors, which demonstrates the required benchmark and the reason for selecting the equity IRR. The IRR is determined after tax in line with investors' interests.

In line with the Additionality Tool, the benchmark is to represent standard returns in the market, considering the specific risk of the project type, but not linked to the subjective profitability expectation or risk profile of a particular project developer.

The benchmark has been derived from a company internal benchmark since there is only one potential project developer. This is based on GRAS' equity investors' requirements to proceed with investment in the NRP due to its potential to provide an expected total return of 25% in the long term[23]. This benchmark has been consistently applied in the past to other projects developed by GRAS; for example, the A/R CDM Kachung Forest Project, which is registered under the CDM and the ARR VCS Bukaleba Forest Project which is registered under the VCS. The benchmark is further substantiated by the standard return on equity by IbbotsonAssociates' 2005 Cost of Capital Perspectives Report, which is in line with the second approach for deriving the benchmark.

Data for required returns on capital was not available for forestry within Mozambique; however it was possible to look more generally at equity investments within the country. IbbotsonAssociates (www.ibbotson.com), a leading provider of independent investment research in major international markets, annually determine the required return of capital for investments in 173 countries from the perspectives of foreign investors. The statistics represent the IRR-return that an investor would expect to receive if investing in a particular country. The report looks at perspectives from six different countries (UK, France, Germany, Canada, Japan and Australia) and applies both a linear and

[22] Since A/R without CDM is prevented from an insufficient returns barrier, investment analysis is carried out to demonstrate this.
[23] Further evidence of the benchmark is provided by private equity investors – documentation available to DOE

logarithmic scale of the Country Risk Rating Model to determine the according IRRs. In total, 12 IRR-values are provided covering all six countries and the two different model scales.

For 2005 investments in Mozambique, the analysis shows a range of required IRRs of 26.25 – 32.64 %, with an average of 30.14% for all country perspectives with both models (IbbotsonAssociates, 2005[24]).

Benchmark = 25%

Sub-step 3c. – Option III Apply benchmark analysis

The financial model to determine the IRR at the NRP was developed using justified plantation assumptions and costs – the majority of which were substantiated through the Niassa Business Plan Financial Model. The financial model considers a total plantable area of 36,000 ha as stated in the Business Plan.
The costs were on a per hectare basis and linked to the planting schedule which scaled the costs up to the total project area. Beating up (replanting) for 20% of the plantable areas was assumed to account for any mortality that may occur. Capital expenditure (Capex) is included in line with the Niassa Business Plan. Additionally a study[25] commissioned by the Mozambican Government was used for comparison which further substantiates the assumptions provided in the Niassa Business Plan.

Table B.5.1.1 Cost input parameters

Parameter	Cost	Source
Seedlings	0.02 USD per seedling	Management plan financial model
Land preparation	4 – 5 mandays per activity	Management plan financial model
Crop management	6 – 18 mandays per ha	Management plan financial model
Chemical costs	Herbicide: USD 7 per L NPK: USD 2 per kg Pesticide: USD 75 per L	Management plan financial model
Fire protection	5 – 11 mandays per activity	Management plan financial model
Road costs	USD 3500 per km	Management plan financial model
Tax rate	32%	KPMG Corporate Tax Rate Survey
Exchange rate	25.8 MZN to 1 USD	www.xe.com

Revenues from each timber species and the sale of tCERs were accounted for in the model. Harvested timber volumes were inputted based on the merchantable timber yield models by Alder (2004) for pine and eucalyptus to determine the amount of timber that will be available at the planned commercial thinning and harvesting years. Although these yield models were developed in Uganda, they have been deemed suitable due to the lack of available yield tables and volume equations for these species in Mozambique. Site indexes have been selected for each species based on the expected volumes sustained in the Niassa business plan. Carbon revenues were modelled based on average prices of the "State and Trends of the Carbon market 2006".

Stumpage prices used in the Niassa business plan have been applied. Since the timber revenues are based on stumpage prices, no harvesting costs are factored into the model.

[24] IbbotsonAssociates, 2005: International Cost of Capital Perspectives Report 2005. The report will be submitted to the DOE but cannot be published due to copyright constraints

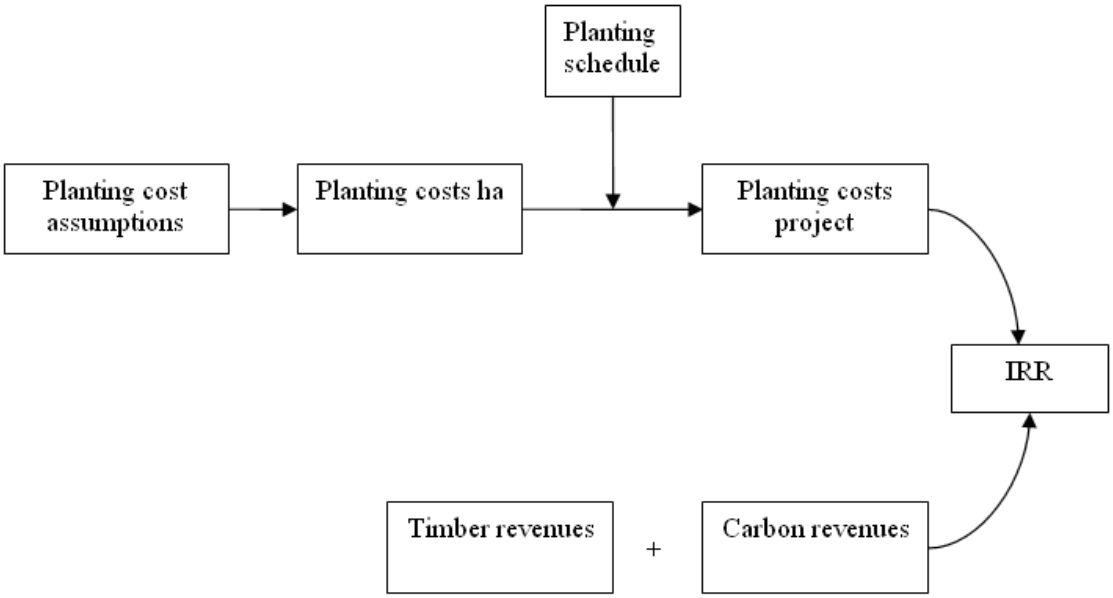
[25] The study includes an investment analysis for a forest plantation in Niassa Province: Zoneamento e Identificacao de Areas para Investimento no Sector Agrario e Analise Socio-Ambiental da Provincia de Niassa, volume 3, Plantacoes Florestais, Rural Consult LDA, Savcor Indufor, May 2007

Table B.5.1.2. Assumed stumpage prices in IRR calculation

Species and timber type	Price USD
Pine	
First thinnings	30
Second thinnings	41
Third thinnings	75
Harvest	188
Eucalyptus	
First thinnings	30
Second thinnings	41
Third thinnings	75
Harvest	217.5

A corporate tax rate of 32% is assumed in the model, which is based on what the corporate tax rate was at the start of the project[26]. Figure B.5.1, shown below, outlines the structure of the financial model as presented in Excel. The timeframe of the model is from 2007 to 2040. This period is from first planting to final harvesting of the first rotation of pine – the longest rotation species (26 years) being planted at NRP. For investments that have deferred value outside of this time period, the revenues have been discounted and included as a cash inflow in the final year of the investment period – this includes the fair value of the plantation stands and the capex book value.

Figure B.5.1. Schematic of financial model components



The IRR based on the above assumptions, without the sale of tCERs, has been calculated as 18.8% (table B.5.1.3 below). The A/R CDM project activity has a less favourable indicator than the benchmark of 25% and is therefore not considered financially attractive without the benefits from the sale of tCERs. The project would therefore not have been viable without the potential of carbon financing.

[26] See KPMG's Corporate Tax Survey 2006

Table B.5.1.3 Project scenarios and respective IRR

Project scenario	IRR
Solely timber revenues	18.8%
Timber revenues + tCERs (price $7.04)	24.9%
Timber revenues + tCERs (price $11.56)	30.9%

Sub-step 3d - Sensitivity analysis

Sensitivity analysis was carried out to test whether the investment analysis was robust to reasonable variations in key parameters. The critical parameters were identified as capex, timber prices and site index. A variation of 10% was assumed for each of these parameters and for the site indexes a site index of 14 for pine and 28 for eucalyptus was used. Furthermore and given that the Government study presents lower cost assumptions for land preparation, the investment analysis was also tested for no land preparation and planting costs to demonstrate that these costs are not a critical parameter of the investment analysis; the IRR without carbon still doesn't meet the benchmark (table B.5.1.4).

Table B.5.1.4. Sensitivity analysis results

Parameter change	IRR without carbon	IRR with carbon (tCER = $7.04)	IRR with carbon (tCER = $11.56)
Standard assumptions	18.8 %	24.9 %	30.9 %
10% decrease in capex	19.2 %	25.5 %	31.7 %
10% increase in capex	18.5 %	24.5 %	30.3 %
10% decrease in stumpage price	18.1 %	24.5 %	30.6 %
10% increase in stumpage price	19.5 %	25.4%	31.3 %
Site indexes increased	20.5 %	26.1 %	31.9 %
No land preparation & planting costs	19.6 %	25.8 %	32.1 %

All assumptions, costs and revenues, are contained in the financial model and will be presented to the DOE during the validation of the A/R CDM project.

Furthermore, for each parameter it was determined the change needed for the project to hit the benchmark: even with zero capex the project would be just below the benchmark at 24.3 %, while an increase of site indexes to 20 for Pine and 34 for Euc would be needed to reach the benchmark (24.8%). Doubling the timber prices would still be below the benchmark (24%). Each of the scenarios seems highly unlikely as they represent dramatic changes in the parameters and as such are not expected to occur.

From applying the decision tree in the CDM tool for benchmark analysis, since the financial indicators of neither the A/R CDM project activity (without being registered as an A/R CDM project activity) nor the alternative scenario (continuation of the pre-project land use) meets the benchmark, the baseline scenario is the continuation of the pre-project land use.

STEP 4. Common practice analysis

The geographical scope of this analysis is considered to be the Niassa Province. This Province is considered the most remote and poor within the whole of Mozambique with an evident lack of infrastructure and general investment. Therefore regions beyond this can be considered as having different socio-economic conditions, and thus aren't considered in the common practice analysis.

Over the last five years the Niassa region has seen significant developments to its forestry sector following prioritization of government polices to promote A/R activities. The Malonda Foundation's programme to facilitate private investment in the sector is aligned with such polices and has helped to start up a private sector forestry industry in the Niassa region. Including Green Resources, there are currently six private forestry companies operating in the Niassa region: Chickweti, Florestas de Niassa, New Forests, Niassa Green Resources SA, Florestas de Massangulo and UPM. Most of the existing companies only started with initial assistance from the Malonda Foundation who streamlined the land acquisition process by applying for all DUATs collectively before transferring these to the companies respectively. Also the EIAs were paid by Malonda Foundation.

Following the tool and given several forestry companies have started their operations in Niassa, the technological scope used in this comparative analysis focuses on the regulatory environment and on the financing structure of each company.

There are essential distinctions between Green Resources project and the other similar activities taking place in the region by the other private forestry companies. An essential distinction is the capacity of each company to finance its operations. Generally the companies indicated above have access to finance at lower rates of return than Green Resources. UPM, the largest company that is operating in the Niassa region is a publically listed company on the NASDAQ QMX Helsinki stock exchange and as such has the opportunity to raise finance from the capital markets at a lower rate than that of Green Resources. This means its return requirement profile does not have to be as high, which explains why Green Resources requires the additional revenue stream to make the project financially viable. In the case of Chickweti and Companhia Florestal de Messangulo their main investor is the Global Solidarity Forest Fund, which has a lower rate of return than Green Resources benchmark of 25%[27]. Another essential distinction is Green Resources' compliance and certification to FSC. The Niassa Reforestation Project is the only FSC certified forest in the region and this has additional costs linked to it.

Table B.5.2. Characterization of the companies engaging in forestry operations in Niassa (areas in ha)

	Active in Niassa	Initiated planting	Planned plantation area	Planted	Total project	FSC
NGR	x	x	23,000	1,945	42,330	x
UPM	x	x	220,000	1,260	220,000	
Chikweti	x	x	68,500	14,250	140,000	
C Florestal Messangulo	x	x	50,000	4,378	100,000	
New Forests	x	x	60,000	3,217	87,000	
Florestas de Niassa	x	x	120,000	3,426	210,000	

B.6. Demonstration of additionality

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Demonstrated in section B.5. above using the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities, Version 01 (EB 35, Annex 19)".

B.7. GHG removals by sinks

B.7.1. Explanation of methodology

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Baseline net GHG removals by sinks

[27] http://www.3ignet.org/resourcecenter/resourcePDFs/2007FebGSFFMemInv.pdf

Following "guidance on conditions under which the change in carbon stocks in existing live woody vegetation are insignificant" from the CDM EB (EB 46 Report, Annex 16), the project's baseline changes in carbon stocks are assumed to be zero. The procedure in the guidance is that the change in carbon stocks of existing woody vegetation sinks may be accounted as zero for an area of land within the project boundary if one of the conditions in the guidance is met.

Condition (v) in the guidance is: "harvesting/grazing of foliage, or harvesting/coppicing of live wood, commonly occurs at levels sufficient to result in static or declining biomass in the existing woody vegetation"
Condition (v) is met at the NRP as this has been the principle driver resulting in the successive land degradation that is shown in the time series and maps shown in Figure B.2.3. Furthermore, the Socio-economic assessment carried out in the area clearly describes the on-going activities ("no-action alternative") as "cutting down of trees and wood plants in favour of crop cultivation, and use of wetlands during the dry season for cultivation of vegetables, rice and sweet potato"[28]). This information is backed up by the information collected in the leakage assessment[29].

According to the applicability conditions of the methodology, since the carbon stock in SOC is unlikely to increase in the baseline, the change in carbon stock in SOC is conservatively assumed to be zero for all strata in the baseline scenario.

Based on the above, the baseline carbon stock changes are conservatively assumed to be zero.

However the pre-project carbon stock of trees and shrubs (t = 0) was estimated (see below).

Actual net GHG removals by sinks

Actual net GHG removals by sinks shall be calculated following equation 2 from the methodology:

$$\Delta C_{ACTUAL,t} = \Delta C_P - GHG_{E,t} \qquad \text{Eq. 2}$$

Where:

ΔC_{ACTUAL}	Actual net GHG removals by sinks in year t; t CO_2-e
$\Delta C_{P,t}$	Change in the carbon stocks in project occurring in the selected carbon pools, in year t; t CO_2-e
GHG_E	Increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year t; t CO_2-e

Changes in carbon stock in the selected carbon pools:

The *ex ante* change in carbon stock in the project scenario were calculated using equation 3 from the methodology.

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta C_{SHRUB\_PROJ,t} + \Delta C_{DW\_PROJ,t} + \Delta C_{LI\_PROJ,t} + \Delta SOC_{AL,t} \qquad \text{Eq. 3}$$

[30] Details of the procedure and of the calculations are provided to the DOE.
[30] Details of the procedure and of the calculations are provided to the DOE.

$\Delta C_{P,t}$	Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e
$\Delta C_{TREE\_PROJ,t}$	Change in carbon stock in tree biomass in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e
$\Delta C_{SHRUB\_PROJ,t}$	Change in carbon stock in shrub biomass in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e
$\Delta C_{DW\_PROJ,t}$	Change in carbon stock in dead wood in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e
$\Delta C_{DW\_PROJ,t}$	Change in carbon stock in litter in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e
$\Delta C_{DW\_PROJ,t}$	Change in carbon stock in SOC in project, in year *t*, in areas of land meeting the applicability conditions of the tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities", as estimated in the same tool; t CO_2-e

According to the methodology the changes in carbon stock in the project are equal to the changes in carbon stock in trees. Equation 3 is then simplified to the following:

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t}$$

However according to the methodology pre-project carbon stock in trees and shrubs has to be estimated.

The tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities", Version 04.1 provides a default technique for estimating the carbon stock in trees in the baseline provided the crown cover is below a certain threshold, in this case 6%. The crown cover at NRP was estimated using high resolution satellite imagery of before project start (2006 for Malulu unit and 2010 for Malica and Ntuile units) on 10 ha plots randomly sampled. The result was then clipped with the CDM eligible area[30].

Carbon stock in trees in the baseline is estimated as follows (equations 20 and 21):

$$C_{TREE,BSL,i} = \frac{44}{12} \times CF_{TREE\_BSL} \times B_{FOREST} \times (1 + R_{TREE\_BSL}) \times CC_{TREE\_BSL,i} \times A_{BSL,i}$$

$$C_{TREE\_BSL} = \sum_{i=1}^{M} CC_{TREE\_BSL,i}$$

C_{TREE_BSL}	Carbon stock in living trees in the baseline, in the project boundary, at the start of the A/R CDM project activity; t CO2-e

[30] Details of the procedure and of the calculations are provided to the DOE.

$C_{TREE, BSL, i}$	Carbon stock in living trees in the baseline, in baseline stratum i, at the start of the A/R CDM project activity; t CO2-e. Baseline strata are delineated on the basis of tree crown cover
CF_{TREE_BSL}	Carbon fraction of tree biomass in the baseline; t C (t.d.m.)$^{-1}$. A default value of 0.47 t C (t.d.m.)-1 is used
B_{FOREST}	Default above-ground biomass content in forest in the region/country where the A/R CDM project is located; t d.m. ha-1
R_{TREE_BSL}	Root-shoot ratio for the trees in the baseline; dimensionless. A default value of 0.25 is used unless transparent and verifiable information can be provided to justify a different value
$CC_{TREE\_BSL, i}$	Crown cover of trees in the baseline, in baseline stratum i, at the start of the A/R CDM project activity, expressed as a fraction (e.g. 10% crown cover implies = 0.10); dimensionless i BSL TREE CC ,
$A_{BSL, i}$	Area of stratum *i* in the baseline, delineated on the basis of tree crown cover at the start of the A/R CDM project activity; ha
i	*1, 2, 3, …* tree biomass estimation strata within the project boundary

For shrubs the tool provides a similar approach; the area of shrub estimation was based on the land use classification of pre-project (2006,) satellite images (figures A.7.2.a to A.7.2.c above). Shrub carbon stock was then estimated using equations 26 and 27 of the tool:

$$C_{SHURB,BSL,i} = \frac{44}{12} \times CF_S \times (1 + R_S) \times \sum_i A_{SHRUB,i} \times b_{SHRUB,i} \qquad \text{Eq. 26}$$

$$b_{SHRUB,i} = BDR_{SF} \times b_{FOREST} \times CC_{SHRUB,i} \qquad \text{Eq. 27}$$

Where:

$C_{SHURB, t}$	Carbon stock in shrubs within the project boundary at a given point of time in year *t*; t CO_2-e.
CF_s	Carbon fraction of shrub biomass; t C (t.d.m.)$_{-1}$. A default value of 0.47 is used unless transparent and verifiable information can be provided to justify a different value.
R_s	Root-shoot ratio for shrubs; dimensionless. The default value of 0.40 is used unless transparent and verifiable information can be provided to justify a different value.
$A_{SHRUB, I}$	Area of shrub biomass estimation stratum *i*; ha
$B_{SHRUB,I}$	Shrub biomass per hectare in shrub biomass estimation stratum *i*; t d.m. ha$_{-1}$
BDR_{SF}	Ratio of shrub biomass per hectare in land having a shrub crown cover of 1.0 (i.e. 100 per cent) and the default above-ground biomass content per hectare in forest in the region/country where the A/R CDM project activity is located; dimensionless. A default value of 0.10 should be used unless transparent and verifiable information can be provided to justify a different value.
B_{FOREST}	Default above-ground biomass content in forest in the region/country where the A/R CDM project activity is located; t d.m. ha-1. Values from Table 3A.1.4 of IPCC GPG-LULUCF 2003 are used unless transparent and verifiable information can be provided to justify different values.
$CC_{SHRUB,I}$	Crown cover of shrubs in shrub biomass estimation stratum *i* at the time of estimation, expressed as a fraction (e.g. 10 per cent crown cover implies = 0.10); dimensionless.

For the rest of the crediting period, the ex-ante carbon stock was estimated by modelling of tree growth and stand development, while ex-post carbon stock will be estimated through measurement of fixed area sample plots as follows:

$$B_{TREE\,l,j,p,i} = V_{TREE,j}(\alpha_{1,l},\alpha_{2,l},...)xD_j xBEF_{2,j} x(1+R_j) \qquad \text{Eq. 5 (appendix 1)}$$

Where:

$B_{TREE,l,j,p,i}$	Biomass of tree *l* of species *j* in sample plot *p* of stratum *i*; t d.m.
$V_{TREE,j}(x_{1,l},x_{2,l},...)$	Stem volume of tree *l* of species *j* in sample plot *p* of stratum *i* estimated by using the tree dimension(s) as entry data into a volume table or volume equation; m^3
D_j	Basic wood density of tree species *j*; t d.m. m^{-3}
$BEF_{2,j}$	Biomass expansion factor for conversion of stem biomass to above-ground tree biomass, for tree species *j*; dimensionless
R_j	Root-shoot ratio for tree species *j*; dimensionless

To calculate the *ex ante* change in carbon stocks in tree biomass in the project, the PP has had to use growth data from Uganda due to the lack of available growth data from Mozambique. Site indexes have been selected which give the same volume as the estimated Mean Annual Increments in the business plan, which is based on expert opinions. Additionally data recorded in Niassa for Eucalptus stands with 5 years have confirmed the site index used in the *ex-ante* projections. Therefore the *ex-ante* projections are deemed reliable.

The growth data from "*Yield of Eucalyptus and Caribbean pine in Uganda, D. Alder et al. 2003"* is used to project the merchantable timber volume and thus the biomass growth of the project. During *ex-post* calculations, the growth data (standing volume per hectare) will be collected and converted into biomass through Wood Density (WD) and Biomass Expansion Factors (BEF) and root-shoot ratio (R) using equations and steps described in the methodology.

In the absence of the project and regional specific parameters during PDD preparation for the biomass expansion factors (BEF), wood density (D), carbon fraction (CF) and root-to-shoot ratio, the project participants have used default values from the GPG LULUCF 2003 (Table 3A.1.10). The "Guidelines on conservative choice and application of default data in estimation of the net anthropogenic GHG removals by sinks, Version 2" have been followed in selecting the default values. The following is a summary of the sources and relevant procedure, in line with the guidance, for the conservative choice of default data.

Parameter	**Source and conservative choice**
Wood density:	
Eucalyptus and Pine:	Species-specific (*Eucalyptus grandis* and *Pinus caribeae*) data from a recent Uganda study for the same ecological zone has been used since the methodology does not provide a default value nor are there local peer-reviewed studies.

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Biomass Expansion Factor (BEF)

Eucalyptus:	No species-specific data was available thus data was taken from a Brazilian study for the same genus and similar climatic zone.
Pine:	No species-specific data was available thus following guidance from a CDM clarification AR_AM_CLA_20, the default value of 1.15 was used.

Root-shoot ratio

Eucalyptus and Pine: According to the A/R Methodological Tool, "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" R is calculated based on above-ground biomass:

*R = exp [-1.085 + 0.9256 * ln(A)] / A*, where A is above-ground biomass content (t d.m. ha^{-1}). A was calculated as the average above-ground biomass over the first rotation.

The resulting conservative default data is given in Table B.7.1.1:

Table B.7.1.1. Wood density, BEF and Root-Shoot ratio for species used

Tree species	Wood Density (tonnes d.m.m-3)	BEF	Root-Shoot ratio
Eucalyptus	0.526	1.45[31]	See carbon model
Pine	0.383	1.15[32]	See carbon model

The project participants consider that any changes due to thinning have been taken into consideration in the growth figures that were used; however, the trend shall be monitored. The impact of disturbances, e.g. losses from fire and pests, are considered to be small and are a result of natural events.

Tree biomass in sample plot *p* of stratum *i* is calculated as follows:

$$B_{TREE\ p,i} = \sum_{J} B_{TREE,j,p,i} \qquad \text{Eq. 2 (appendix 1)}$$

Where:

$B_{TREE\ p,i}$ Tree biomass in sample plot *p* in stratum *i*; t d.m.

$B_{TREE\ j,p,i}$ Biomass of trees of species *j* in sample plot *p* in stratum *i*; t d.m

Tree biomass per hectare in plot *p* of stratum *i* is calculated as follows:

$$b_{TREE\ p,i} = \frac{B_{TREE,p,i}}{A_{PLOT,i}} \qquad \text{Eq. 1 (appendix 1)}$$

Where:

$b_{TREE,p,i,t}$ Tree biomass per hectare in sample plot *p* in stratum *i*; t d.m. ha^{-1}

$B_{TREE,p,i,t}$ Tree biomass in sample plot *p* in stratum *i*; t d.m.

$A_{PLOT,i}$ Area of sample plot in stratum *i*; ha

Mean tree biomass per hectare in stratum i and the variance of tree biomass per hectare in the stratum are estimated as follows (stratified random sampling):

[31] Taken from the study "Crescimento, Produção de Biomassa e Eficiência Nutricional de Eucalyptus spp., sob três espaçamentos em uma sequência de idades", Ladeira, 1999.

[32] Taken from the CDM tool "Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities"

$$b_{TREE,i} = \frac{\sum_{p=1}^{n_i} b_{TREE,p,i}}{n_i} \qquad \text{Eq. 16}$$

$$s_i^2 = \frac{n_i \times \sum_{p=1}^{n_i} b_{TREE,p,i}^2 - \left(\sum_{p=1}^{n_i} b_{TREE,p,i}\right)^2}{n_i \times (n_i - 1)} \qquad \text{Eq. 17}$$

Where:

$b_{TREE,i}$	Mean tree biomass per hectare in stratum *i*; t d.m. ha^{-1}
$b_{TREE,p,i}$	Tree biomass per hectare in sample plot *p* in stratum *i*; t d.m. ha^{-1}
n_i	Number of sample plots in stratum *i*
s_i^2	Variance of tree biomass per hectare in stratum i at a given point of time in year t; (t d.m. ha^{-1})^2

Mean and total tree biomass per hectare within the project boundary are estimated as follows:

$$b_{TREE} = \sum_{i=1}^{M} w_i \times b_{TREE,i} \qquad \text{Eq. 14}$$

$$B_{TREE} = b_{TREE} \times A \qquad \text{Eq.13}$$

Where:

$b_{TREE,}$	Mean tree biomass per hectare within the project boundary; t d.m. ha^{-1}
w_i	Ratio of the area of stratum i to the sum of areas of biomass estimation strata; dimensionless
$b_{TREE,i}$	Mean tree biomass per hectare in stratum *i*; t d.m. ha^{-1}
B_{TREE}	Total tree biomass within the project boundary; t d.m.
A	Sum of areas of the biomass estimation strata within the project boundary; ha

Carbon stock in tree biomass within the project boundary and associated uncertainty:

$$C_{TREE} = \frac{44}{12} \times B_{TREE} \times CF_{TREE} \qquad \text{Eq. 12}$$

$$u_C = \frac{t_{val} \times \sqrt{\sum_{i=1}^{M} w_i^2 \, x \, \frac{s_i^2}{n_i}}}{b_{TREE}} \qquad \text{Eq. 15}$$

Where:

C_{TREE}	Carbon stock in tree biomass within the project boundary; t CO_2-e

B_{TREE}	Total tree biomass within the project boundary; t d.m.
CF_{TREE}	Carbon fraction of tree biomass; t C t d.m.$^{-1}$. A default value of 0.47 is used unless transparent and verifiable information can be provided to justify a different value.
u_C	Uncertainty in C_{TREE}
t_{val}	Two-sided Student's t-value for a confidence level of 90% and degrees of freedom equal n-M, where n is the total number of sample plots and M is the total number of strata for tree biomass estimation.
b_{TREE}	Mean tree biomass per hectare within the project boundary; t d.m. ha^{-1}
s^2_i	Variance tree biomass per hectare within project boundary at a given point of time in year t (i.e. the standard error of the mean); t d.m. ha^{-1}
n_i	Number of sample plots in stratum *i*

Change in carbon stock in trees is calculated assuming a linear growth. Therefore, the change in carbon stock in tree biomass over a period of time is calculated as follows:

$$\Delta C_{TREE,(t_1,t_2)} = \frac{C_{TREE,t2} - C_{TREE,t1}}{T} \qquad \text{Eq. 14}$$

Where:

$\Delta C_{TREE,(t1,t2)}$	Change in carbon stock in tree biomass within the project boundary during the period between a point of time in year t1 and a point of time in year t2; t CO2-e yr^{-1}
$C_{TREE,t2}$	Carbon stock in tree biomass within the project boundary at a given point of time in year t_2; t CO_2-e
$C_{TREE,t1}$	Carbon stock in tree biomass within the project boundary at a given point of time in year t_1; t CO_2-e
T	Time elapsed between two successive estimations ($T = t_2 - t_1$); yr
t	1,2,3,... years counted from project start of the A/R CDM project activity

For the first verification, the variable $C_{TREE,t1}$ in equation 14 is assigned the value of carbon stock in the baseline that is: $C_{TREE,t1} = C_{BSL}$ for the first verification, where $t_1 = 0$ and t_2 = year of the first verification.

Equation 14 is as follows:

$$\Delta C_{TREE,(t_1,t_2)} = \frac{C_{TREE,t2} - C_{BSL}}{T} \qquad \text{Eq.1}$$

Non-CO_2 GHG emissions:

Removal of biomass in the process of land preparation does not have to be accounted for. The emissions from the use of fire in land preparation (A.4) can be assumed to be zero due to slash-and-burn being a common practice in the baseline – in line with Step 7(a) from the tool: "Estimation of

non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity, Version 04.0.0".

Non-CO_2 GHG emissions from forest fires will be monitored throughout the project and accounted for following the above mentioned tool. In line with the applicability conditions, emissions resulting from any occurrence of fire within the project boundary shall be accounted for each incidence of fire which affects an area greater than the minimum threshold area reported by the host Party for the purposes of defining forest, provided that the accumulated area affected by such fires in a given year is $\geq$ 5% of the project area.

The non-CO_2 emissions from forest fires will be calculated following equation 7 of the tool:

$$GHG_{FF\_TREE,t} = 0.001 * \sum_{i=1}^{M} A_{BURN,i,t} * b_{TREE,i,t_L} * COMF_i * \left(EF_{CH4,i} * GWP_{CH4} + EF_{N2O,i} * GWP_{N2O}\right)$$

where:

$GHG_{FF\_TREE,t}$	Emission of non-CO_2 gases resulting from the loss of aboveground biomass of trees due to fire, in year t; t CO_2-e
$A_{BURN,i,t}$	Area burnt in stratum i in year t; ha
b_{TREE,i,t_L}	Mean aboveground tree biomass per hectare in stratum i in year t_L which is the year in which last verification was carried out before occurrence of the fire; t d.m. ha^{-1} Where aboveground biomass of living trees is not burnt by fire, b_{TREE,i,t_L} may be set equal to zero
$COMF_i$	Combustion factor for stratum i; dimensionless
$EF_{CH4,i}$	Emission factor for CH_4 in stratum i; g CH_4 (kg dry matter burnt)$^{-1}$
GWP_{CH4}	Global warming potential for CH_4; dimensionless Default value of 21 is used
$EF_{N2O,i}$	Emission factor for N_2O in stratum i; g N_2O (kg dry matter burnt)$^{-1}$
GWP_{N2O}	Global warming potential for N_2O; dimensionless Default value of 310 is used
I	1, 2, 3 … M strata
T	1, 2, 3, … years elapsed since the start of the project activity

Estimation of leakage

To determine the *ex ante* estimation of leakage, the CDM tool, "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity, Version 01 (EB 51 Annex 15)" was applied.

The tool is applicable when:

1. The increases of GHG emissions from the displacement of activities cannot be considered insignificant – following the most recent: (i) "Guidelines on conditions under which increase in GHG emissions attributable to displacement of pre-project crop cultivation activities in A/R CDM project activity is insignificant, Version 01(EB 51 Annex 13)", (ii) "Guidelines on conditions under which increase in GHG emissions related to displacement of pre-project grazing activities in A/R CDM project activity is insignificant, Version 01 (EB 51, Annex 14)".

2. The displacement of agricultural activities attributable to the A/R CDM project activity is not expected to cause any drainage of wetlands or peatlands

Step 1 of the tool was carried out through Participatory Rural Appraisals (PRAs) with the local communities around the project area and through the application of remote sensing to create land-use maps of the pre-project area to estimate the area subject to pre-project agricultural activities. Specifically, PRAs were used to estimate the number of cattle grazing in the pre-project area and the maps to determine the area of land under crop cultivation that would likely be displaced.

The PRA summaries can be found in Annex 5. The results of the PRAs show that leakage due to displacement of grazing activities is insignificant. However, the displacement of agricultural activities is likely to lead to significant emissions. The following steps of the tool were therefore applied to the cropland areas that are expected to be displaced[33].

The following steps of the tool were then applied:

The fraction of the total area of A/R CDM project activity subject to displacement of agricultural activities in year *t* was calculated by applying the following equation:

$$D_{t^*} = \frac{\sum_{t=1}^{t^*} Ad_t}{A}$$

Where:

D_t	Fraction of the total area of A/R CDM project activity subject to displacement of agricultural activities in year *t*; dimensionless
A	Total area of A/R CDM project activity
Ad_t	Area subject to pre-project agricultural activities that are displaced during year *t* since the start of the A/R project activity; ha
t	*1, 2, 3, ...t** years elapsed since the start of the A/R CDM project activity

Step 2: Take ΔC_t – annual change in carbon stock in all selected carbon pools for year *t*; t C yr^{-1}, as calculated following requirements of the baseline and monitoring A/R CDM methodology within which this tool is used.

For the planned (*ex ante*) or actual (*ex post*) verifications calculate:

[33] See NGR's procedure on voluntary resettlement (Procedure 3.3)

$$\Delta C_{t=t_{ver}} = \sum_{t=1}^{t_{ver}} \Delta C_t * 1year$$

Where:

$\Delta C_{t=tver}$	Sum of annual changes in carbon stock in all selected carbon pools since the start of the A/R CDM project activity to the year of verification t_{ver}; tC
ΔC_t	Annual change in carbon stock in all selected carbon pools for year *t*.
t_{ver}	Year of verification event; yr

Step 3: For each year *t* take D_t and select t_{ver} which occurs immediately after the year *t* in order to calculate:

$$\Delta CD_{t^*} = D_{t^*} * \Delta C_{t=t_{ver}}$$

Where:

ΔCd_{t*}	Sum of annual changes in carbon stock in all selected carbon pools since the start of the A/R CDM project activity to the year of verification t_{ver} attributable to the area subject to pre-project agricultural activities that are displaced during year t^* since the start of the A/R project activity
$\Delta C_{t=tver}$	Sum of annual changes in the carbon stock in all selected carbon pools since the start of the A/R CDM project activity to the year of verification t_{ver}; t C
D_{t*}	Fraction of the total area of A/R CDM project activity subject to displacement of agricultural activities in year *t*;* dimensionless
t_{ver}	Year of verification event; yr
t	*1, 2, 3, ...* t^* years elapsed since the start of the A/R CDM project activity

Step 4: Estimate the factor, *f,* as the fraction of land covered by forest (according to the national definition of forest) in region containing the A/R CDM project activity. The region shall be the smallest territorial administrative division/s encompassing all areas of land included in the A/R CDM project activity for which data on forest cover are publically available.

Step 5: Calculate average leakage due to displacement of agricultural activities in year *t**:

$$LK_{Agric,t^*} = \frac{44}{12} * \frac{f}{T_{cred}} * \Delta Cd_{t^*}$$

B.7.2. Data and parameters fixed ex ante

(Copy this table for each data and parameter.)

Data / Parameter	$CC_{TREE\_BSL,i}$
Unit	Dimensionless
Description	Crown cover of trees in the baseline stratum *i*
Source of data	Satellite images
Value(s) applied	0. 594
Choice of data or Measurement methods and procedures	Method provided in the AR-Tool 14 to estimate pre-project carbon stock by estimation of proportionate crown cover. High resolution satellite images from before project start were used to assess crown cover in 10 ha plots in the CDM eligible area.
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

Data / Parameter	$A_{SHRUB,i}$, A_i
Unit	ha
Description	Area of shrub biomass stratum, area of baseline stratum *i* (respectively)
Source of data	Satellite images
Value(s) applied	$A_{SHRUB,I}$ = 1,948.9 A*i* = 5,242
Choice of data or Measurement methods and procedures	The area of shrub biomass stratum results from the sum of shrubland area for each management unit as classified in images from before project start. The area of baseline stratum was considered as the total CDM project area (this is conservative).
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

Data / Parameter	$CC_{SHRUB,i}$
Unit	Dimensionless
Description	Crown cover of shrubs in shrub biomass stratum *i*
Source of data	Default value from the A/R Methodological Tool, "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activity".
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	Default value
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

Data / Parameter	D_j
Unit	t d.m. m^{-3}
Description	Density (overbark) of tree stem species
Source of data	Strength Properties of Selected Uganda Timbers, Zziwa et al, International Wood Products Journal, 2010, Vol 1, No 1, was used for both species.
Value(s) applied	<table><tr><td></td><td>Basic wood density</td><td>Density (D_j)</td></tr><tr><td>Eucalyptus</td><td>0.526</td><td>0.507</td></tr><tr><td>Pine</td><td>0.383</td><td>0.386</td></tr></table>
Choice of data or Measurement methods and procedures	International data is used since national data is not available
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

Data / Parameter	$BEF_{eucalyptus}$
Unit	Dimensionless
Description	Biomass expansion factor for conversion of stem biomass to above-ground biomass for eucalyptus
Source of data	Taken from a study on Eucalyptus species, Ladeira (1999).
Value(s) applied	1.45
Choice of data or Measurement methods and procedures	International data is used since national data is not available
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

Data / Parameter	BEF_{pine}
Unit	Dimensionless
Description	Biomass expansion factor for conversion of stembiomass to above-ground biomass for pine
Source of data	Taken from the CDM tool "Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities"
Value(s) applied	1.15
Choice of data or Measurement methods and procedures	Default data used due to the lack of national data
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	As recommend by the CDM A/R working group clarification AR_AM_CLA_0020.

Data / Parameter	R_j
Unit	Dimensionless
Description	Root-to-shoot ratio for tree species (eucalyptus and pine)
Source of data	Equation from the A/R Methodological Tool, "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activity" was applied to determine the root-shoot ratio.
Value(s) applied	$R = exp\ [-1.085 + 0.9256 * ln(A)] / A$ where A is above-ground biomass content (t d.m. ha^{-1})
Choice of data or Measurement methods and procedures	Default data used due to the lack of national data
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

Data / Parameter	$V_{TREE,\ Eucalyptus}$
Unit	m^3
Description	Stem volume of eucalyptus trees for trees of given age/diameter/height/
Source of data	Alder yield model
Value(s) applied	The volume equation for eucalyptus is: $V = 0.489 \times (B \times H)^{\wedge} 0.942$ Where: V = Volume B = Basal area H = Height
Choice of data or Measurement methods and procedures	Yield model is based on data from Uganda on same species.
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

Data / Parameter	$V_{TREE, pine}$
Unit	m^3
Description	Stem volume of pine trees for trees of given age/diameter/height
Source of data	Alder yield model
Value(s) applied	The volume equation for pine is: *V = ((4.534 x 10-5 xDBH)^ 1.8875) xH^1.0304 xN* Where: *V* = volume *DBH* = Diameter at Breast Height *H* = Height *N* = Number of trees per ha
Choice of data or Measurement methods and procedures	Yield model is based on data from Uganda on *Pinus caribaea*.
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

Data / Parameter	$COMF_i$
Unit	Dimensionless
Description	Combustion factor for stratum i
Source of data	Default data from the tool: "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity".
Value(s) applied	The following default values will be applied:

Forest type	Mean age (years)	Default value
Tropical forest	3- 5	0.46
	6 -10	0.67
	11 -17	0.50
	18 and above	0.32

Choice of data or Measurement methods and procedures	Used in equation 7 of the tool: "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity".
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

Data / Parameter	EF_{CH4}
Unit	g kg^{-1} dry matter burnt
Description	Emission factor for CH_4 in stratum i
Source of data	Default data from the tool: "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity".
Value(s) applied	6.8 (tropical forest)
Choice of data or Measurement methods and procedures	Used in equation 7 of the tool: "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity".
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

Data / Parameter	EF_{N2O}
Unit	g kg^{-1} dry matter burnt
Description	Emission factor for N_2O in stratum i
Source of data	Default data from the tool: "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity".
Value(s) applied	0.2 (tropical forest)
Choice of data or Measurement methods and procedures	Used in equation 7 of the tool: "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity".
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

Data / Parameter	t_{val}
Unit	Dimensionless
Description	Two-sided Student's *t*-value, at infinite degrees of freedom in the first iteration and at degrees of freedom equal to (n-1) in subsequent iterations, for the required confidence level
Source of data	Student's t-distribution table
Value(s) applied	1.645
Choice of data or Measurement methods and procedures	This is at the 90% confidence level in line with the CDM methodology
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

Data / Parameter	*E*
Unit	td.m (or td.m.ha^{-1})
Description	Acceptable margin of error (i.e. one-half the confidence interval) in estimation of biomass stock within the project boundary; in units used for *si*
Source of data	Default data from the tool: "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity".
Value(s) applied	10%
Choice of data or Measurement methods and procedures	Set in CDM methodology
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

B.7.3. Ex ante calculation of net anthropogenic GHG removals by sinks

>>

Actual net GHG removals by sinks

Pre project carbon stock in year 0 is:

C_{shrub} = 44/12 x 0.47 x (1+0.25) x 55 x 0.59 x 5242 = 36,921 tCO_2e
C_{shrub} = 44/12 x 0.47 x (1+0.4) x 1948.9 x 0.1 x 55 x 0.5 = 12,931 tCO_2e

As shown above, ex ante calculations applied a yield model and the BEF method to obtain the tree biomass for each species; as such in year 1, the carbon stock per ha for eucalyptus and pine would be:

$C_{Eucalyptus}$ = 0.3 tCO_2e /ha
C_{Pine} = 0.1 tCO_2e /ha

The change in carbon stock in the project in year 1 would be:

ΔC_{ACTUAL} = 8 - 49,852 = - 49,8546 tCO_2-e

Leakage

According to the methodology (see section B.7.1) leakage from pre-project agricultural activities has to be assessed.

Step1: Estimate the area subject to pre-project agricultural activities that is expected to be afforested/ reforested (therefore the activities have to be displaced).

The baseline classification maps from 2006 (See C.3.1-C.3.3) show the total area of land under cultivation and thus what would likely be displaced through implementation of the project. These areas are deemed to be conservative since it includes land which was used for agricultural purposes but which were left fallow. The total area of cropland prior to project start over all three parcels of land that make up the A/R CDM project was 614 ha.

The fraction of the total area of A/R CDM project activity subject to displacement of agricultural activities is as follows:

t	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	....*t*
Ad_t	1.29	8.9	2.59	15.85	14.09	225.78	202.65	143.54	0	0	0	0
A	5,242											
D_t	0.000	0.002	0.002	0.005	0.008	0.051	0.090	0.117	0.117	0.117	0.117	0.117

Step 2: Annual change in carbon stock in all selected carbon pools for year *t*; t C yr^{-1}
$\Delta C_{t=tver}$ = 80,140 tC for the planned 2017 verification.

Step 3: Sum of annual changes in carbon stocks for first verification
ΔCd_{t*} was calculated as shown below (for the first verification)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017

ΔCd_t	20	156	195	438	653	4,105	7,203	9,397	9,397	9,397	9,397

Step 4: Estimate factor, *f*, as the fraction of land covered by forest (according to the national definition of forest) in region containing the A/R CDM project activity.

Figure 1a and b in Annex 4, show land class classification of the two parishes which are contained within the A/R CDM project boundary. These are the parishes of Unango (for the Malulu parcel) and Chimbonila (for Malica and Ntiuile). The land class of each parish has been determined through a supervised classification of Landsat imagery from 2006. Since more than one territorial administrative division is involved then *f* has been calculated as a weighted average of the individual divisions' fraction of land covered by forest using area as a weight.

f was calculated as 0.087 based on the results shown in Annex 4, Figure 1.a and b.

Step 5: Calculate average leakage due to displacement of agricultural activities in year *t**
Applying the equation from step 5, leakage was calculated as follows for the first verification:

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
$LK_{Agric,t}$	0	2	3	7	10	65	114	149	149	149	149

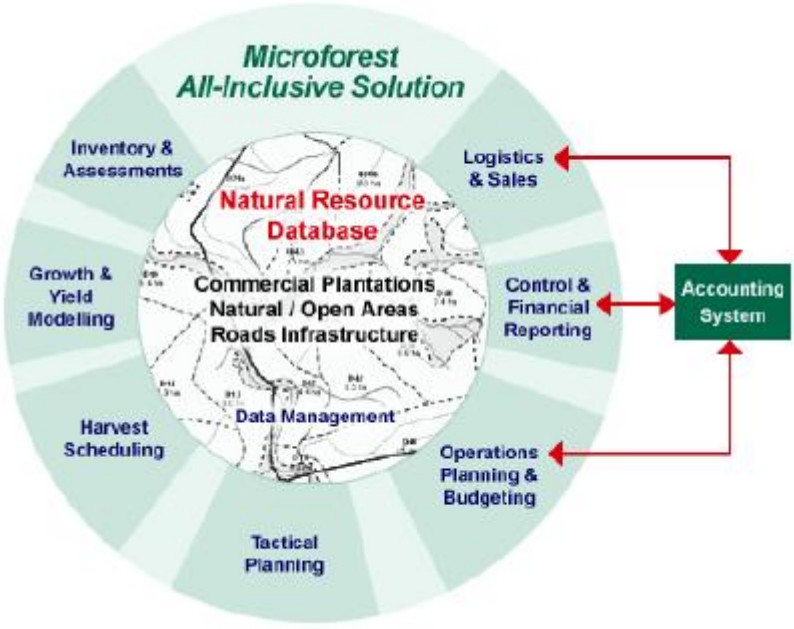
B.7.4. Summary of ex ante estimates of GHG removals by sinks

Year	Baseline net GHG removals by sinks (tCO_2e)	Actual net GHG removals by sinks (tCO_2e)	Leakage (tCO_2e)	Net anthropogenic GHG removals by sinks (tCO_2e)	Cumulative net anthropogenic GHG removals by sinks (tCO_2e)
Year 1	0	-49,852	0	-49,852	-49,852
Year 2	0	8	2	6	-49,846
Year 3	0	162	3	159	-49,687
Year 4	0	447	7	440	-49,247
Year 5	0	1,246	10	1,236	-48,011
Year 6	0	3,282	65	3,217	-44,794
Year 7	0	5,782	114	5,668	-39,126
Year 8	0	11,870	149	11,721	-27,405
Year 9	0	21,529	149	21,380	-6,026
Year 10	0	34,879	149	34,729	28,704
Year 11	0	50,786	149	50,637	79,341
Year 12	0	56,049	673	55,375	134,716
Year 13	0	57,872	673	57,199	191,915
Year 14	0	57,489	673	56,816	248,730
Year 15	0	56,093	673	55,419	304,150
Year 16	0	54,306	673	53,632	357,782
Year 17	0	34,362	0	34,362	392,144
Year 18	0	52,336	0	52,336	444,480
Year 19	0	19,184	0	19,184	463,664
Year 20	0	8,028	0	8,028	471,692
Total	0	475,858	4,166	471,692	-
Total number of crediting years	20				
Annual average over the crediting period	0	23,793	208	23,585	-

B.8. Monitoring plan

Green Resources has a monitoring and inventory system called Microforest, which is the company's principle archiving platform. Microforest is an integrated plantation and natural resource management system[34]. It encompasses the entire life cycle of forestry operations and includes modules that manage inventory, modelling, planning, scheduling, operations, logistics and financials. An organisational diagram for project monitoring is shown at the end of this section in Figure B.8.2. This details the responsibilities, information flows and levels of control.

[34] See Microforest factsheet



Project establishment

To ensure forest establishment is carried out in line with the management plan the following will be monitored and recorded in Microforest:

- Site preparation: Ensure site preparation is implemented based on practice documented in section A
- Information on the number of species planted, area of stratum, and planting layout as per the management plan shall be prepared

Forest management

To ensure that the forest management practices described in section A are implemented, the following parameters will be monitored and recorded in Microforest:

- Planting: date, location, area, tree species, thinning intensity, volumes or biomass removed
- Thinning: date, location, area, tree species, thinning intensity, volumes or biomass removed
- Harvesting: date, location, area, tree species, volumes, or biomass removed
- Coppicing: date, location, area, tree species, volumes or biomass removed
- Checking and confirming that harvested lands are re-planted as planned
- Monitoring of disturbances: date, location, area (GPS coordinates and remote sensing, as applicable), tree species, type of disturbance, biomass lost, implemented corrective measures,change in the boundary of strata and stands

Displacement of agricultural activities

As part of the relocation programme – displacement of Machambas outside the plantation blocks, records will be kept concerning the location of the previous and actual Machambas, as well as, information on the
Community woodlots (number of seeds, species, number of tools, identification of farmers, date, etc).

B.8.1. Data and parameters to be monitored

(Copy this table for each data and parameter.)

Data / Parameter	*A*
Unit	Ha
Description	Area of tree biomass stratum i
Source of data	Measured
Value(s) applied	Stratum / Area: Pine 2007 35.7; Pine 2008 104.8; Pine 2009 74.3; Pine 2010 333.7; Pine 2011 632.6; Pine 2012 1036; Pine 2013 983.8; Pine 2014 996.6; Eucalyptus 2007 10.4; Eucalyptus 2008 1.2; Eucalyptus 2009 35.6; Eucalyptus 2010 82.7; Eucalyptus 2012 211.7; Eucalyptus 2013 288.8; Eucalyptus 2014 424.1
Measurement methods and procedures	Initial measurement is carried out in accordance with the SOP: Boundary measurement and Survival Checking. The area is calculated in ArcGis
Monitoring frequency	Measured at each verification event
QA/QC procedures	Further analysis for QA/ QC is carried out through remote sensing of high resolution imagery when satellite images are available.
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

Data / Parameter	$A_{PLOT,i}$
Unit	Ha
Description	Area of sample plots in tree biomass stratum i
Source of data	Measured and calculated
Value(s) applied	Radius = 11.28 m, which is equivalent to 0.04 ha
Measurement methods and procedures	The radius of each plot is measured from the centre of the plot following the GRAS Inventory Guidelines. All the plots are registered in ArcGis to produce a map of the location of all the plots. The data from the plots is used in excel (as well as being backed up) to calculate the total plot area. The area of a plot is calculated by squaring the radius and multiplying it by π. The sum of all the plots within the stratum, *i*, is taken to give the total area of sample plots.
Monitoring frequency	Measured at each verification event
QA/QC procedures	10% of all plots are remeasured
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

Data / Parameter	DBH_i
Unit	cm
Description	Tree diameter at breast height
Source of data	Measured
Value(s) applied	10.6 cm (average taken from yield model)
Measurement methods and procedures	Measured following GRAS Inventory Guidelines.
Monitoring frequency	Measured at each verification event
QA/QC procedures	10% of all plots are remeasured
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	

Data / Parameter	H_i
Unit	m
Description	Tree height (dominant height)
Source of data	Measured
Value(s) applied	14.2 cm (average taken from yield model)
Measurement methods and procedures	Measured following GRAS Inventory Guidelines. The dominant height is the average of the height measured in the four trees with the largest dbh. Trees with height defects (fox tails for example) are not included in height measurements.
Monitoring frequency	Measured at each verification event
QA/QC procedures	10% of all plots are remeasured; Vertex calibrated each morning.
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	

Data / Parameter	*T*
Unit	Time period elapsed between two successive estimations of carbon stock in trees and shrubs/ Year
Description	
Source of data	Recorded time
Value(s) applied	N/A
Measurement methods and procedures	N/A
Monitoring frequency	Measured at each verification event
QA/QC procedures	N/A
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	If the two successive estimations of carbon stock in trees are carried out at different points of time in year *t2* and *t1*, (e.g. in the month of April in year *t1* and in the month of September in year *t2*), then a fractional value is assigned to *T*.

Data / Parameter	*N*
Unit	Dimensionless
Description	Total number of possible sample plots within the project boundary (the sample space or population)
Source of data	Recorded time
Value(s) applied	N/A
Measurement methods and procedures	*N* is equal to project area divided by the size of the sample plot
Monitoring frequency	Measured at each verification event
QA/QC procedures	N/A
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	

Data / Parameter	w_i
Unit	Dimensionless
Description	Relative weight of the area of stratum i
Source of data	Calculated
Value(s) applied	Stratum / w_i: Pine 2007 0.01; Pine 2008 0.02; Pine 2009 0.01; Pine 2010 0.06; Pine 2011 0.12; Pine 2012 0.20; Pine 2013 0.19; Pine 2014 0.19; Eucalyptus 2007 0.00; Eucalyptus 2008 0.00; Eucalyptus 2009 0.01; Eucalyptus 2010 0.02; Eucalyptus 2012 0.04; Eucalyptus 2013 0.05; Eucalyptus 2014 0.08
Measurement methods and procedures	The relative weight of the area of a stratum *i* is equal to the area of the stratum *i* divided by the project area
Monitoring frequency	Measured at each verification event
QA/QC procedures	N/A
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	

Data / Parameter	s_i^2
Unit	$(\text{t d.m. ha}^{-1})^2$
Description	Variance of tree biomass per ha in stratum *i*.
Source of data	Data obtained from the plantation or from similar plantations
Value(s) applied	N/A
Measurement methods and procedures	Approximate value of the variance of tree biomass in each stratum is either known from existing data related to the project area or existing data related to a similar area, or is estimated from a preliminary sample.
Monitoring frequency	Measured at each verification event
QA/QC procedures	N/A
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

Data / Parameter	$A_{BURN\ i,t}$
Unit	Ha
Description	Area burnt in stratum *i* in year *t*
Source of data	Measured
Value(s) applied	N/A
Measurement methods and procedures	The area burnt from all forest fires in each particular year is summed. Measured following GRAS' Inventory Guidelines – see "Fire Damage Assessment".
Monitoring frequency	Measured at each verification event
QA/QC procedures	N/A
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	-

B.8.2. Sampling plan and stratification

>>

Permanent sample plots (PSPs) are used for sampling over time to measure and monitor changes in carbon stocks of the relevant carbon pools in each compartment. The plots are treated in the same way as other lands within the compartment and stratum e.g. in terms of site preparation, weeding, pruning, thinning, harvesting, etc. Once ex-post stratification has been carried out, the number of PSPs required will be calculated. The ex-post stratification will be carried out in GIS and allow for the area of each stratum to be calculated. Equations 57 and 61 from AR-AMC0001 Version 05.2.0 have been used to calculate number of PSPs required per stratum to achieve a targeted precision level for biomass estimation within each stratum of ± 10% of the mean at a confidence level of 90 % (using parameters derived from existing plantation data from the region). The project participants anticipate using circular shaped PSPs of plot size between 200-400 m^2. For the PSP sample size calculations, an estimate of the biomass (*Q)* at the first verification event, scheduled for 2014, was determined using the yield model timber volumes, *BEFs* and root-to-shoot ratio for each of the species. The standard deviation was assumed to be 50% of the mean – this was assumed to be a conservative value based on PSPs implemented at other GRAS projects.

The plots will be systematically located with a random start in each stratum or sub-stratum following the GRAS Standard Operating Procedure (SOP) for a generation of PSP coordinates. See Table B.8.2.1 for calculated number of PSPs and Figure 2.1.

Table E.2.1. *Ex ante* calculation of number of PSPs (based on 400 m^2 PSPs) for 2011 verification

Species	Cohorts		
Eucalyptus	2007-2008	2009-2010	2011
	28	30	N/a
Pine	2004-2006	2007-2009	2010-2011
	30	30	N/a
Totals	58	60	N/a

The plots will be marked on the ground by an inconspicuous centre pole marking the centre of the plot. Trees will also be marked but in a way so that they are not clearly visible: only a small spot of paint at breast height and a number marked at the bottom of the trunk.

Ex-post stratification of the planted area will occur at the time of the first verification event, and subsequently prior to proceeding verification events. Ex-post stratification will take into account year of planting, tree species, forest management activities/stand development, site index and catastrophic events such as disease outbreak and fire.

B.8.3. Other elements of monitoring plan

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Because of the long-term nature of the A/R CDM project activity, data shall be archived and maintained safely. Data archiving shall take both electronic and paper forms, and copies of all data shall be provided to each project participant. All electronic data and reports shall also be copied on durable media such as CDs and copies of the CDs are stored in multiple locations. The archives shall include:

- Copies of all original field measurement data, laboratory data, data analysis spreadsheet;
- Estimates of the carbon stock changes and non-CO2 GHG and corresponding calculation spreadsheets;
- GIS products;
- Copies of the measuring and monitoring reports.

There are no animals grazing in the project area therefore, leakage due to animal displacing is negligible. Additionally, though negligible, some leakage is anticipated from NGR project implementation mainly due to displacement of agriculture activities. Other activities that may somehow be affected are the fuelwood collection. To mitigate these impacts NGR will implement a community development program that comprises varied activities including, among others, the promotion of alternative income generating activities.

There are some agriculture activities being implemented in NGR project areas, and some of these will need to be relocated. To mitigate the impacts over the loss of lands used for agriculture and housing (reduction of existing cultivated areas and expansion areas), NGR will implement a relocation programme for the farmers that exist in the project areas. The relocation program includes, among others: the compensation of the affected farmers who have lands inside the project areas (following PRO 3 that establishes the facilitation in opening of new farm areas and inputs provision). This support will be given to the farmers who opt to leave the project and open new areas that are not classified as forests as the company is not willing to incentivise the devastation of native forests. Additionally, to avoid perverse incentives i.e., incentives for the establishment of new farms in its project areas, the compensation will only be given to farmers who already had their farms before the DUAT acquisition by the company and who are willing to voluntary leave the plantable lands in NGR DUATs. As part of the compensation program NGR will facilitate the land preparation in the new areas and, as such will be able to track down the new farms location and ensure farmers are not chopping down native forests.

Agricultural programme

The agriculture development program - NGRADO will be implemented to incentivise the establishment of settled agriculture as well as other income generation activities replacing some of the current unsustainable exploitation activities. The program is expected to contribute for the food security, and cover 1500 peasants in the next 5 years with a production area that is equivalent to 2040ha. The production and productivity levels of the agriculture sector are expected to increase with the implementation of the agriculture development program that will facilitate the access to inputs, markets and provide extension services and technical support on improved production technologies. Therefore, with the implementation of NRP, it is expected that the land use will change to a mosaic of forest plantations that are intercalated with areas of natural vegetation (woodlands) and agriculture fields.

Community woodlots

NGR project area is characterized by grasslands with scattered trees. Therefore, although common, the amount of fuelwood collection (firewood) gathered by local communities in the project areas is not high, thus negligible. Still, it is expected that some displacement of fuelwood collecting activities will take place in NGR project areas. To mitigate this impact, NGR is allowing the local communities to collect the wood wastes produced during the land clearing process. Additionally, as part of its social responsibility, NGR will promote the establishment of community woodlots to increase the supply of forestry resources /materials to meet the local demand for forestry products (e.g. firewood, poles for fencing, charcoal, etc.) originated from plantations reducing thus the pressure over natural forests. This is expected to contribute for the company conservation efforts of achieving a long term conservation of the existing natural forest resources in the project areas. Furthermore, NGR will continue to allow the local communities to gather firewood from pruning and first thinning of the project plantations.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

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The project start date is 15th January 2007 which coincides with the starting date of the establishment of the forest plantations.

C.1.2. Expected operational lifetime of project activity

>>

60 years; however, the forest project is envisaged to have a sustainable lifetime, thus extending beyond the crediting period.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>

Renewable; this is the first crediting period.

C.2.2. Start date of crediting period

>>

Same as project start date which is 15th January 2007.

C.2.3. Length of crediting period

>>

20 years and 0 months.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

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One of the main risks of the project is fires due to the long drought period and the uncontrolled use of fire by local communities to prepare land for agriculture and hunting. To mitigate this impact, NGR will: establish and maintain fire breaks around the plantation blocks, regularly remove combustible material, especially high and dry grass beside the access roads, keep the areas below the coverage of the tree canopy free of easily inflammable vegetation, Undertake awareness campaigns about uncontrolled bush fires to the local peasants, take measures to manage and control fires, and to fight against uncontrolled bush fires; and have a fire fighting plan

Hydrological impacts are also a major concern. Forest plantations can have negative impacts on the flow and water quality, namely:

- Increase in nutrients and chemical contamination of water bodies due to the use of fertilisers, herbicides and pesticides;
- Sedimentation in the rivers due to runoff of sediments carried by rain water during the logging phase and the construction of roads;
- Reduction of flows in the water basins: forests have access to water at higher soil depths and greater evapo-transpiration;

Mitigation measures for these impacts include measures such as: i) establish a riverine buffer zone where native vegetation is conserved to protect the rivers from run-offs of sediments, ii) Ensure that any mechanical cultivation of soils is done by strips and that sediment barriers are created with vegetation where accelerated soil erosion proves to be inevitable; iii) Pay special attention to the location, construction and maintenance of plantation roads/paths since these are the primary source of sediment, iv) be careful with the roads construction (length, density, location, construction details), v) Carry out logging operations in such a way to minimise accelerated soil erosion, taking into account that the bare soil after logging is very susceptible to run-off and thus to transport of sediment, vi) Restore the forest coverage rapidly after logging, vii) Avoid the forestry exploitation in the rainy season, and exceptionally humid periods, when the soils are saturated with water, which encourages more surface run-off and mudslides and viii) Choose the logging machinery to minimise effects on the soils.

Other negative impacts on the environment are:

- Alteration and /or permanent loss of land and natural habitats, due to the establishment of forest plantations;
- Pollution caused by dangerous/semi-dangerous waste and chemicals (fertilizers, pesticides), that may result in soil and water contamination;
- Uncontrolled spread of exotic species outside the plantation blocks;
- Soil erosion
- Increased dust and noise
- Increased poaching resulting from an inflow and concentration of people from surrounding locations;

To mitigate these impacts NGR will, among others, ensure that: i) all activities involving chemicals and fuels transfer, storage and potential for contamination are confined to duly placed areas (areas that are not ecologically sensitive), ii) all areas are built on impermeable cemented basins to contain possible spills and signage is posted to identify these areas, iii) fuels' storage, maintenance or resupply of vehicles or equipment will occur at a distance not less than 50 metres from any housing area, water course or wetlands, or where there is a potential for spills of fuel to contaminate the water course or the ground water, v) vehicles and machinery are maintained regularly.

Significant positive impacts were outlined in the EIA amongst them: the sequestration of large amounts of CO2 contributing to reducing greenhouse gases and mitigating climate change, and reducing the pressure on natural resources.
Besides producing the targeted commercial products, NRP plantations will also supply non-wood forest products and provide a variety of social services; NRP forest plantations will also be managed to enhance their biodiversity protection functions providing ecosystem services such as maintenance of the soil nutrient levels, watershed protection, reduction of erosion through soils' stabilization, improvement in soil's structure as well as carbon storage. NRP project is being implemented in marginal lands that were previously used for shifting agriculture and which unsustainable practices lead to land degradation. Therefore, NRP plantations will contribute to improve soil fertility and protect against erosion. NRP plantations are also expected to significantly increase the organic carbon content. This has been seen in Brazil where increased organic carbon contents have been recorded in soils when pastures were converted to Eucalyptus plantations (Lima et al., 2009[35]). Planted forests are also being used in the tropics as a form of protective reclamation on degraded or sensitive sites, for example after mining operations or in degraded upland areas which were previously forested (Evans & Turnbull 20047).

NGR is also be implementing an agriculture development programme aimed at changing agricultural practices and incentivising the settled agriculture. Therefore NRP is expected to contribute to reduction of the land cover changes and contribute for the native forests conservation. Furthermore, the existing patches of natural forests (riverine forests and woodlands) and wetlands of significance at the landscape level within the NRP project areas will not be harvested commercially and will be sustainably managed to continue providing services to local communities. The biodiversity levels in NRP areas are low therefore, by protecting these natural areas NRP will contribute to enhance the remaining biodiversity within its project areas. Within NGR project areas there are not many forested areas except from the Malulu Block J which is currently being set aside and managed for conservation purposes due to the relatively high carbon stocks within the project areas. A management plan has been drafted for the area and conservation measures are being discussed with the affected communities. Furthermore, alternatives, to reduce the pressure over these natural forests, are being considered and these include promotion of alternative income generation activities and woodlots establishment for supplying the wood materials demanded by the local communities.

Apart from the commercial forests, under the Company social responsibility NGR will engage the local communities for the establishment and management of community woodlots to supply fuelwoods, building/construction materials (e.g. poles for fencing of houses) and other wooden products demanded by the communities living nearby the project areas. By providing these wood products, NRP plantations will contribute to reduce the pressure over the native forests and as a consequence reduce the deforestation that is caused by the increasing demand for wood products. The increasing demand for fuelwood and building materials by urban and rural populations particularly in poor countries is the main cause of deforestation of natural forests in the tropics and sub-tropics. This

35 Lima A.M.N, Silva I.R, Neves J.C.L, Novais R.F, Barros N.F, Mendonca E.S, Smyth T.J, Moreira M.S and Leite F.P (2006). Soil organic carbon dynamics following afforestation of degraded pastures with eucalyptus in southeastern Brazil. Forest Ecology and Management 235: 219 – 231

demand is increasing all over the world and the forest plantations may represent a considerable contribute to meet this demand hence, relieving the pressure that would be put on natural forests (Campinhos 1999[36]; Nambiar 1999[37]; Sedjo 1999[38]; Jacovelli 2009[39]). Forest plantations can supply raw materials in short term compared to the natural forests as they normally use improved varieties with a shorter growing period.

D.2. Environmental impact assessment

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It is a legal requirement of the Government of Mozambique that an Environmental Impact Assessment (EIA) be conducted for proposed activities that are likely to have significant impacts on the environment. An EIA was commissioned by the Malonda Foundation covering the Malulu parcel of the A/R CDM project. The EIA assessed possible ecological and socio-economic impacts of the project through field surveys, community consultations and interviews with key stakeholders. An additional EIA is being carried out for the two more recent parcels of land (Malica and Ntuile) of the project; however, the project proponents expect it to have similar recommendations as the Malulu one, since the areas are similar in terms of biophysical and socio-economic conditions.

The EIA[40] was carried out by an independent firm, *Impacto - Projectos e Estudos Ambientais*, following the recommendations of the Ministry for Coordination of Environment Action (MICOA), national legislation (namely, the Environment Framework Law, the Forestry and Wildlife Law, the Regulations on Environment Impact Procedure, the General Directive for Environment Impact Studies) and internationally accepted norms and procedures for EIA.

The EIA concluded that through the implementation of well defined mitigation measures and compliance with the principles and criteria of FSC, it will be possible to avoid/minimize the potential negative impacts of the project as shown in section D.1 above. Furthermore, the project will follow the Environmental Management Plan (EMP) as proposed in the EIA.

The environmental management plan (EMP) as proposed in the EIA, will be used to monitor changes in the vegetation, pests and diseases, soil quality, water flow and quality, biodiversity and social economic aspects, etc in the course of implementation of the project with the purpose to record project performance and of mitigating any negative impacts that may arise.

The outcome or results of the various parameters monitored in the environmental monitoring plan are analysed annually and reports prepared for use by the project proponents and other relevant stakeholders.

Additionally, site specific EIAs will be carried out before main activities (e.g. planting and roads establishment) take place in the planned planting area to identify risks and proper mitigation measures for the potential negative impacts that can't be avoided.

Fires

To control fires (see section A.4.), main and secondary firebreaks will be set up, which must be kept clean. A fire detection system will be implemented, including fire towers in strategic locations and a communication system connecting fire towers to the office and to the fire patrol crews. Water points for fire fighting will be established and marked, as well as the location of the fire breaks inside the

36 Campinhos, E (1999) Sustainable plantations of high-yield Eucalyptus tree for production of fiber: the Aracruz case. New Forests 17: 129-143.

37 Nambiar E.K.S (1999). Pursuit of sustainable plantation forestry. Southern African Forestry Journal 184: 45-62

38 Sedjo R.A (1999). The potential of high-yield plantation forestry for meeting timber needs. New Forests 17: 339 – 359

39 Jacovelli P (2009) Uganda's sawlog production grant scheme: a success story from Africa. International Forestry Review 11: 117-122

40 Niassa Province Reforestation Project, Volume II, Environmental Impact Study Report, September 2007

plantation. The training of workers will be a priority, as well as awareness work among the local communities.
During surveillance operations, the fire brigade will also look for illegal activities, like poaching and report to the plantations manager, which will take appropriate action.

Hydrology

NRP will follow FSC guidelines on the choice of chemicals and will ensure a correct application of them, including safety procedures in handling, storage and disposal. Furthermore, the quality of the water will be monitored according to the Environmental Management Plan and any necessary corrective measures will be applied.
Forest operations and infrastructure construction will be carefully planned to avoid/ mitigate soil erosion.
As for water flow it is expected to have a low impact during the rainy season and forests may, in fact, have a positive impact in increasing water flow during the dry season. This is physically plausible due to increased attenuation during the rainy season, as part of the flow, which otherwise would have occurred as surface runoff in the rainy season, is held back and slowly released as base flow during the dry season.

Other mitigation measures are as follows:

- The project will only establish plantation on degraded land; natural forests and ecologically sensitive areas, like wetlands, will be conserved, including maintaining a buffer zone of 30m around all water sources where no plantation will occur.
- The risks will be minimized by only using chemicals approved by FSC; procedures will be set in place and training will be given to handle dangerous waste and chemicals;
- As mentioned above NRP will apply mitigation measures regarding forest operations and infrastructure construction, like plan logging areas to reduce the extension of land exposed to wind and rain, rapidly restore forest cover after logging and plan the road system along the contours and with good drainage channels;
- The project will implement measures to minimize dust and noise like provide protective equipment to workers and use equipment with low levels of noise;
- Awareness work will be carried out to workers to prevent poaching, as well as, collaboration with local authorities.

NGR is also implementing a management plan for the conservation areas to ensure that through proper forest management, sustainable harvesting, ecosystems, biodiversity and economic benefits for the local community are maintained in the long term.

The references to supporting documents are listed as follows:

- "Niassa Province Reforestation Project – Environmental Impact Study Report", September 2007, Volume II.

- "Licenca ambiental No 30/2008, 06/06/2008"

SECTION E. Socio-economic impacts

E.1. Analysis of socio-economic impacts

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A socio-economic impact assessment (SEIA) was carried out as part of the government required environmental impact assessment for the Malulu region, as well as, a SEIA for Malica and Ntiuile regions.

Agriculture is the main activity and is almost totally exploited by the household sector using the rain feed agriculture and mixing of crops.

Overall the majority of respondents are aware of the NRP and its objectives and believe it will have a positive impact on the communities of the project area. However, some cases were found in Nconda where a people's previous experience with another forestry company operating in the area had led to a negative perception of the impact of forestry projects. NGR must therefore provide further sensitization regarding the project in these areas.

The main positive impacts outlined in the SEIA were:

- Increase in waged employment and hence an increase in purchasing power and greater stimulus to the local economy;
- Support to agriculture and livestock
- Development of infrastructures such as roads, electricity, communication, water and other needs for the project to operate;
- Increase in social infrastructures such as schools and health units;
- Contribute to an increase in education and literacy and health conditions of the communities
- Resource for local construction materials and support on construction of improved housing
- Creation of community funds, including 10% of the revenue from the sale of carbon credits, as it's Green Resources policy

Since 2008, NGR in collaboration with the Malonda Foundation has established programs of social responsibility and community development. One key component of these programs is education: according to the 1997 Census, 78% of the population in Sanga district was illiterate. In 2007, MTF started a program of empowerment of workers of forest plantations through the *Literacy and Adult Education (AEA)*. The objective of the program is to promote an integral development of the workers through the implementation of an Adult Education and Literacy system, which aims to train the workers to gain writing, reading and calculation knowledge, as well as to promote the participation of workers in social activities, stimulate a good performance at the work place, strength the negotiations capacity of the worker/employee and facilitate the access to the legal instruments that regulate the work relation. During the lessons the students were also empowered in basic knowledge of STD, HIV/AIDS, sexual and reproductive health, nutrition, fight against forest fires, decentralized planning and community participation. About 80 workers, from whom 42 men and 38 women, non-educated, or with a low education level have participated in the AEA course.

Additionally community and government authorities have outlined other benefits that result from the activity of the company:

- Reduction of uncontrolled fires, as a result of the active role of the company in fire prevention and detection, whose staff not only support the communities during the incidents, but also raise awareness
- Reduction of the level of theft in the villages as a result of employment and increased income
- Increase in household purchasing capacity (mainly households with company workers)
- Improvement of living conditions (mainly households with company workers)
- Increase in forestry resources and employment for future generations.

The SEIA also highlighted the following negative socio-economic impacts, which reflect the concerns expressed by the communities:

- Plantation taking place in the proximity of housing and farming areas

- Reduction of housing and farming areas
- Difficulty/ increased distance to access agricultural fields and natural resources (medicinal plants, firewood, etc);
- Difficulty of accessing sacred places (cemeteries);
- Increase in social conflicts, due to the migration of people to the project area in search of jobs.

Both EIAs expressed concern regarding a possible increase in STD diseases, particularly HIV-AIDS. As already mentioned NGR will continue undertaking several measures, like awareness campaigns and counseling.

NGR is making a continuous effort to involve the community and assure the access to land and income opportunities. Some of the mitigation measures suggested in the EIA are already being implemented and a mechanism for Land Conflict Management was created.

NGR doesn't foresee the relocation of houses and families from the project areas in Niassa province. However, there were and still are some families carrying out low productivity agricultural activities in NGR project areas. These farms pose a risk to the forest plantations as they are normally the starting point of uncontrolled burnings, thus, NGR is establishing partnership agreements with the communities (NGR Procedure 3.3) including compensation measures for farmers within plantation areas and is negotiating with the government the concession of new agricultural lands for farmers. The farmers will receive support with tillage, good quality seeds and inputs, as well as, technical advice to ensure an increased productivity.

Regarding the communities' sacred places (cemeteries) the company together with members of the communities has identified and demarcated all the places, as well as, a site for medicinal plants. NGR has developed Procedure 10 – Identification, management and monitoring of sites of cultural and religious interest in Malulu, to ensure good conservation of these sites. The communities are fully responsible for these sites. Similar procedures will be carried out for Malica and Ntiuile regions.

E.2. Socio-economic impact assessment

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The SEIAs were carried out separately, one for the Malulu unit and the other one for Malica and Ntiuile units. Main conclusions point for a need of NGR to further inform and involve the communities about the NRP as this is essential to ensure a sustainable development in these regions.

The SEIA for the Malulu project area reflects the analysis of data collected in existing documents of MF/MTF and regional and local authorities, as well as interviews to the government institutions at district level, local authorities and influent and interested groups of Malulu and Miala. Also during the inquiries in the field some techniques of participative diagnosis were used, in particular direct observations in some relevant aspects like: plantation areas, pasture, and types of habitation, water supply sources, and others. The SEIA for the other project areas uses data collected via a household survey, focus group interviews and key informant interviews, as well as, data collected via internet searches and the use of various reports and published articles.

The study area covers the villages of Miala and Malulu (Malulu unit), Malica and Nconda (Malica unit) and Ntiuile and Luissa (Ntiuile unit)

As mentioned above, NGR will implement the Environment Management Plan proposed in the EIA, which also considers monitoring of socio-economic parameters.

The references to supporting documents are listed as follows:

Niassa Province Reforestation Project – Environmental Impact Study Report, September 2007, Volume II."

Socio-Economic Study of the Action Area of Malonda Tree Farms, SA, Malonda Foundation, District of Sanga, Administrative Post of Ugango, Lichinga, April 2009.

Hamer N & Cundill G., March 2012. *Niassa Green Resources Ntiuile and Malica Plantations: Social Impact Assessment*, Grahamstown, South Africa.

SECTION F. Local stakeholders consultation

F.1. Solicitation of comments from local stakeholders

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Since the initial stages of the project development, NGR has made all efforts to ensure that local stakeholders are fully involved in every step of the process. As part of the company policies, stakeholders' consultation is an ongoing process that occurs every 3 months. As such, to date various consultation processes have been carried out at different levels to update the stakeholders about the project development as well as to gather their feedback about the impacts of the company activities and discuss any other issues that may arise from time to time.

Initial community consultations were carried out, in 2005, by Malonda Foundation, as part of the land acquisition process[41]. After these, another set of community consultation meetings took place in the villages of Sanga and Lichinga district between July 2006 and August 2007 for the EIA process[42] to collect the feedback of the local communities about the projects proposed and instruct the EIA process. After these meetings, another series of meetings were held between July and August 2007 to discuss the draft EIS. Within these meetings, that were open to the public participation, the project was presented to the stakeholders including an explanation of the activities to be carried out as well as their potential impacts on the biophysical, social, and economic environments.

The objective of these Public Consultation meetings was to listen to the feelings of the Interested and Affected Parties (IAPs), institutions and the general public about the key matters concerning the project implementation. During the Public Consultation, the IAPs had opportunity to raise questions, express their concerns, opinions and comments about any issues that they deemed important to be included in the EIS, as well as a chance to ask for explanation of aspects related to the project and its implementation.

Prior to the community meetings, invitation letters were sent to all members of the District Consultative council and representatives of the civil society[43]. Additionally, public announcements were made using local media such as the local newspaper - Faisca, and the Niassa provincial station of Radio Mozambique. The announcements provided information about the dates, time and place of

[41] Community consultation is a legal pre-requisite established under the land legislation for the land acquisition process

[42] Article 14 of the EIA regulations require that a public consultation should take place during the EIA process

[43] From the Civil Society Organizations were part of the EIA public meeting representatives of: Farmers Association, Water Aid, Associação dos Emprenteiros, Lipilichi Wilderness (Programa Chipanje Chetu), CEDES , Ligas de Direitos Humanos, Organização dos Trabalhadores Moçambicanos, Associação Progresso, Associação de Sanga, APDCN, Concern Universal, Forum Terra Niassa, GDI, Estamos, WWF, Embaixada da Suécia, Oikos, Grupo Moçambicano da Dívida, Intermon-Oxfam, Médicos Sem Fronteiras- África, PROANI/ASDI, Diocese do Niassa, União de Camponeses, Associação dos Antigos Combatentes, Organização Religiosa, Organização da Mulher Moçambicana (OMM), ADPP, Associação 25 de Junho

the public meetings as well as the means to get more information about the project proposed (including a short profile of MF and its partners, company's objectives, operations, and activities, summary of the EIS and the potential contribution of the projects towards local community development efforts). A full list with the details of participants to these meetings as well as their contact details is available for the validation and verification as a supporting document.

In the subsequent time during project development, the project participant has, in conjunction with local authorities, created representative committees for the involved communities and regular meetings are held with representatives of all stakeholders, project updates provided and comments addressed. Additionally, the company has established a formal mechanism for comments and complaints submission, along with a process for dispute resolution.

Methodology Used

Apart from the public meetings held on a regular basis, different methods were and are still used to collect stakeholders' feedback and feelings including: Participatory Rural Appraisal (PRA), group discussions, questionnaires and complaint boxes. These methods have been used in the different surveys such as the EIA, ecological assessment, socio-economic survey and the leakage analysis.

Figure H.1.1 Photos illustrating the interviews carried out during data collection for the socio-economic (top) and leakage analysis (bottom)

The Community Liaison Officer (CLO) is the person in charge of the stakeholders'[44] consultation processes including the identification of subjects and organizations interested, directly or indirectly,

[44] Within NGR operations, stakeholders are all individual or collective people that affect or are affected by the project activities either direct or indirectly including among others: NGOs, Govt. Organizations, private companies, research institutions working on environment and natural resources, social (forestry workers and their

in the forestry resources management (address, telephone, e-mail). The list of stakeholders is updated every three months with new names or organizations being inserted.

The CLO makes sure that the stakeholders are aware of the company plans/intents and the possibility to express their point of view as well as the mechanisms in place for the conflict resolution. Summaries of Forest Management Plans, EIA, Monitoring and research reports, any new document for stakeholders' update of the company operations and activities and questionnaires to gather stakeholders' comments are distributed among stakeholders.

Figure H.1.2. Photos illustrating the meetings held in 2011 with employees (left) and local authorities and communities representatives (right)

Once every year the CLO shall conduct a Participatory Rural Appraisal (PRA) for local level stakeholders to get their views or knowledge for management of the project and specific issues should be discussed with the management and acted upon appropriately.

associations, wood harvesting and wood processing companies workers, professional associations, local populations, etc), and economic matters.

F.2. Summary of the comments received

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To date only small comments with regards to the inputs and financial help required by the local community have been received and have been dealt with in a satisfactory manner. Following is a list of comments received at the various stakeholder meetings.

Primary stakeholders

In the various meetings held, the local communities expressed that they feel happy and welcomed the project because:

- The project would provide them employment opportunities for both skilled and unskilled workers[45]
- The project would lead to development of community infrastructure near the project area (e.g. improved access roads, water points, schools, health centres, bore holes, millers, schools, health clinics)
- Even being a profit company, apart from the employment the company also provides support[46] for the local development
- The communities would acquire new knowledge and skills in tree planting and others (e.g. improved agriculture technologies)
- The income generated from the employment opportunities would lead to the improvement of their livelihoods and life conditions (e.g. better houses, capacity to acquire the goods[47] needed)
- The project would lead to community development with the investment from the sale of carbon credits
- Provision of seedlings to communities will help them establish their own woodlots
- The project management team is open to communication and allow for the community participation and contributions to the project implementation
- Establishment of plantations will benefit the environment of the area that is currently degraded due to bad management practices[48]
- The objective of acquiring the FSC™ certification ensures them that the company operates using high standards that protect them and the natural environment[49]

Despite these good/favourable/positive perceptions about the implementation of the proposed project, the following concerns were raised by the local communities:

- The total extent of lands required for the project implementation and the impact that this would have in the areas needed (for agriculture, housing, grazing) by the population considering their nomadic behaviour
- The need to ensure the community participation in the indication/delimitation of areas for the project to avoid future conflicts

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[45] In a recent meeting carried out in Malulu, the local communities stated that the presence of the company in the area reduced the unemployment rates and along with it reduced the amount of burglars in the area

[46] To date apart from the school desks, the alphabetization classes and IT room the company also contributes with 1USD/ha/year for the Community development fund as agreed with MF

[47] In the meetings the stakeholders mentioned that they notice an improvement in the livelihoods of those employed by the company (e.g. better houses-built with bricks and zinc roofing, radios, bicycles, farm utensils and clothes)

[48] In a recent meeting held in March/April 2011, some members of the local communities acknowledged that they are aware that some of their current practices (frequent wild fires, fish poisoning) contribute to damage the environment (e.g. the changes in the land cover ; they remembered that in the past, the project area was forested which is not)

[49] Stated on a meeting with the stakeholders March 2011

- Some community members felt that the project would deprive them of land for cultivation and grazing[50] and asked for alternative areas to be set aside for agriculture, a compensation for the fields located in the project area and negotiated to keep ownership and access to the fruit trees[51]
- Other concerns expressed by the local communities were related to fears of restrictions to the access to places within the project area namely: holy places (cemeteries), rivers, lowlands/wetlands used for agriculture and natural resources collection places which would in turn increase the walking distances to access these resources (firewood, charcoal, construction materials, medicinal plants)
- Impacts of the project implementation on the water quality due to pesticides use
- Concerns about possible population movements resulting from the project that could result in socio-cultural conflicts
- Reduction of the water table and the water levels of nearby rivers because of the forestry plantations
- Decrease of temperature (too cold) due to eucalyptus plantation
- Distrust about methods normally used for hiring staff involving the chiefs
- Levels of wages to be paid in the forestry plantations
- Concerns about the replacement of native forests to give place to the exotic forest plantations as well as the impacts usage of exotic species instead of natives and the impacts that that would bring to the environment
- The potential increases in the forest fires due to the project implementation

Secondary stakeholders

The secondary stakeholders also endorsed some of the local community fears but congratulated the A/R CDM project mainly because it would:

- Help the environment by increasing the supply of forest products from fast growing species as well as reducing the pressure over the natural forests
- Aid the environment (e.g. soils) restoration and enhance biodiversity conservation in the region
- Generate revenues for the government through taxes and contribute for the poverty alleviation
- Provide income for the employed people from the local communities and investments from carbon sales to support the communities' development projects.

F.3. Report on consideration of comments received

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To ensure the local communities would not be adversely affected by the project implementation, all the comments/ concerns raised on the various stakeholders meetings were noted and registered in reports (documents that support the forest management such as the management plan, the socio-economic assessment, EIA, meeting reports, and Standard Operating Procedures) and, recommendations developed to avoid them sent to the management team to guarantee they are implemented by the company. Following is described how some of the concerns raised by the local communities were overcame/solved.

- To avoid the conflicts over the inexistence of farmlands the company has, in conjunction with the local Government (SDAE) and local community structures, identified lands for agriculture development. Additionally, NGR has decided for the implementation of an agriculture programme that will promote settled agriculture and reduce the current shifting cultivation

[50] With the project implementation, some farmers decided to abandon the plantation areas and moved to teh other side of the Luchimua river which are more fertile however, the access to that area is difficult therefore they requested the NGR to help them build a bridge to facilitate their access to the new farmlands

[51] Negotiated with MF in the land acquisition process

practices which are damaging the environment. This is also a contribution towards the food security problem that affects most of the populations in the country

- To avoid occupation of unauthorised areas, the land demarcation process is carried out together with the Local Government, SPGC (cadastre) and local community leaders and representatives of the Local management committee
- A compensation scheme has been developed and is being implemented in coordination with the local authorities for the farmers that voluntary leave the plantation areas
- To reduce the level of uncontrolled fires, NGR has established, equipped and trained a fire prevention and fighting team that supports the communities during the incidents, but also raises their awareness for the use of cold fires and fire breaks. Community members willing to use fire in the land preparations should inform the company so that the team can advice and supervise the farmer about the best ways to do it and be ready to help control the fire in case it escapes from the farmer control
- A grievance and conflict resolution system (SOP-3) has been established which entails the procedures to be used for handing the conflicts with local communities, employees and other stakeholders
- To ensure there would be no interference with sacred/holy places or other areas of interest to the local communities, NGR has established a procedure (SOP 10-HCV areas including SSI) for their identification in collaboration with the local communities. The location of these sites were identified, the coordinates recorded with a GPS, maps produced and signage posted in the field and documentation produced and disseminated to ensure that NGR employees are fully aware of their existence and avoid any damages to them. A buffer has been put around these sites and the management of the sites has been left in charge of the local communities as it always happened.
- The river banks areas are part of the partial protection zone and as such a buffer zone of 50m is left around them where no activities are carried out, therefore, local communities can have full access to the lands. Additionally, NGR will not plant in the wetlands therefore no restrictions are taking place for the local communities to access them. Furthermore, the forested areas where firewood, charcoal, construction materials and other NTFPs are being collected are not eligible for the forest plantations and as such the access to these areas by the local communities remains as it always was. However, considering that NGR is willing to contribute for the sustainable use and conservation of all the forest resources within its DUAT areas, a management plan for the woodlands is being developed for these areas. The management plan will set up the sustainability levels of forest resources extraction based on the resources capacity to regenerate/recover, thus, if current extraction levels are beyond the sustainability levels, some restrictions may have to be imposed on the resources users but alternatives will be sought in collaboration with them to avoid negative impacts on their livelihoods as well as future conflicts
- The EIA has developed mitigation measures to avoid impacts on the water quality and levels and NGR is fully implementing them
- To avoid big population movements and the impacts that this may bring NGR is prioritizing the employment of local community members and is also implementing the mitigation measures recommended by the EIA and other reports produced
- To avoid the nepotism in the hiring process, the HR department is implementing the GRAS handbook that determines how the employees selection process should be carried out and ensure a fair/competitive wage (equal or above the minimum wage) is paid to the company employees
- NGR is only planting in areas that do not fulfil the forest definition and as such there will be no conversion of native forests to exotic plantations
- To improve the community participation, there is continuous dialogue and interaction with the stakeholders at different levels. NGR has developed procedures (SOP 1-stakeholders consultation) that guide how the stakeholders consultation should be carried out. This is done

through consultative meetings, courtesy calls, planning meetings and sharing of information. Additionally, NGR has helped MF to set up community management committees (CGC) that were elected by the local communities to represent them and make the link between the company and the local communities. Furthermore, a Community Liaison Officer (CLO) that speaks the local language[52] has been hired to work in close relation with this committee and the local communities.

SECTION G. Approval and authorization

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The letter of approval from the Mozambican DNA is in the application process and is unavailable at the time of submitting the PDD to the DOE that is carrying out the validation.

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[52] Avoiding misunderstandings caused by wrong translations/interpretation of issues because of the language barrier

Appendix 1: Contact information of project participants

Organization	Niassa Green Resources SA
Street/P.O. Box	36 Av. Do Trabalho
Building	
City	Lichinga
State/Region	Niassa
Postcode	
Country	Mozambique
Telephone	+258 2712 1272
Fax	+258 2712 8011
E-mail	hrmozambique@greenresources.no
Website	www.greenresources.no
Contact person	
Title	
Salutation	Mr
Last name	Sotomane
Middle name	Elias
First name	Inocencio
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	inocencio.sotomane@greenresources.no

Organization	Green Resources AS
Street/P.O. Box	Strandveien 35, 1366 Lysaker
Building	
City	Oslo
State/Region	
Postcode	
Country	Norway
Telephone	
Fax	
E-mail	Info@greenresources.no
Website	www.greenresources.no
Contact person	
Title	Group Carbon Manager
Salutation	Ms
Last name	Meyer
Middle name	Verissimo
First name	Ana
Department	Mapping and inventory department
Mobile	
Direct fax	
Direct tel.	+44 207 250 1418
Personal e-mail	ana.meyer@greenresources.no

Appendix 2: Affirmation regarding public funding

Letter by NORAD is provided as evidence to the DOE.

Appendix 3: Applicability of selected methodology

N/A

Appendix 4: Further background information on ex ante calculation of removals by sinks

Determination of leakage

Figure 1.a. Classification of Unango parish

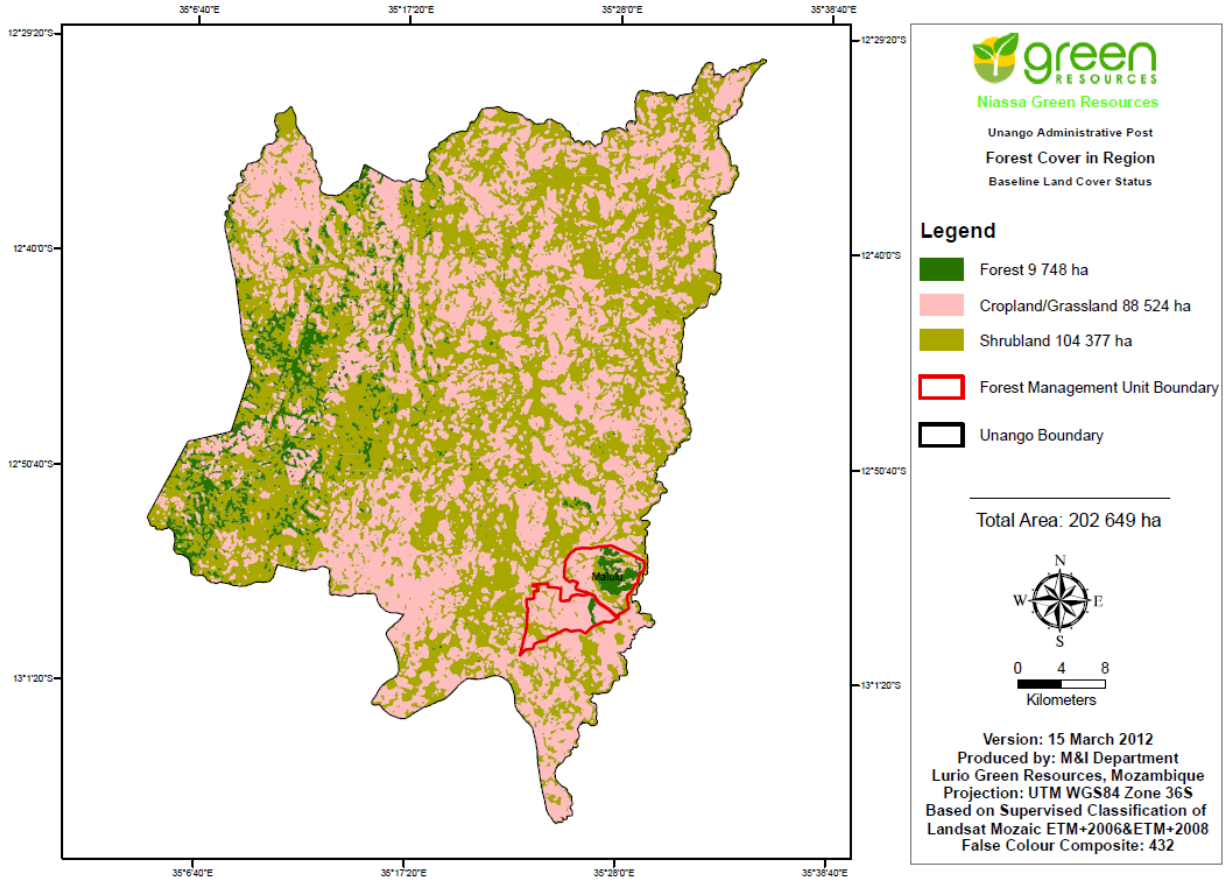
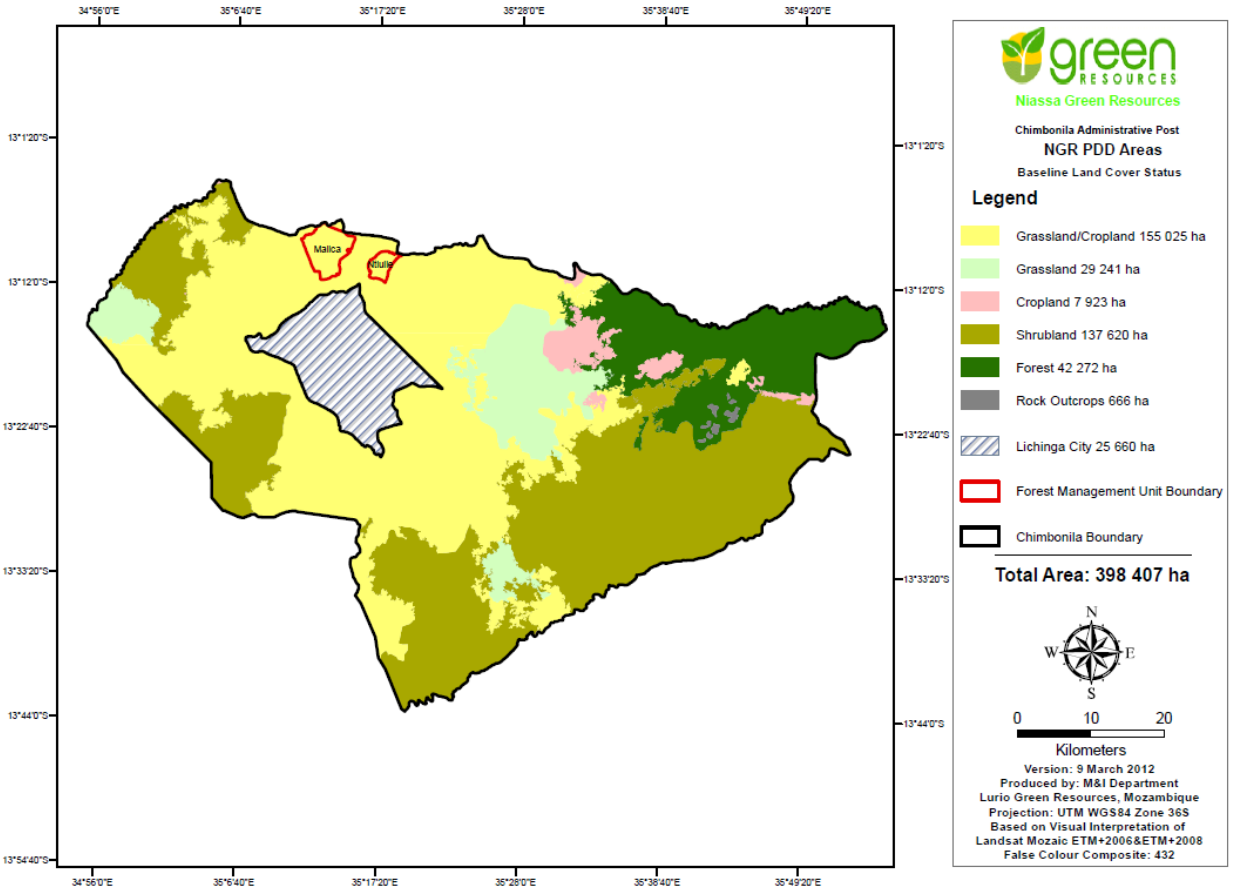


Figure 1.b. Classification of Chimbonila parish



Appendix 5: Further background information on monitoring plan

N/A

Appendix 6: Geographic delineation of project boundary

Covered in A.2.5.

Appendix 7: Summary of post registration changes

N/A

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History of the document

Version	Date	Nature of revision
06.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for afforestation and reforestation CDM project activities" (EB 66, Annex 10).
05	EB 55, Annex 22 30 July 2010	Restructuring to reflect changes applied in the design of approved A/R CDM baseline and monitoring methodologies. Due to the overall modification of the document, no highlights of the changes are provided.
04	EB 35, Annex 20 19 October 2007	• Restructuring of section A; • Section "Monitoring of forest establishment and management" replaces sections: "Monitoring of the project boundary", and "Monitoring of forest management"; • Introduced a new section allowing for explicit description of SOPs and quality control/quality assurance (QA/QC) procedures if required by the selected approved methodology; • Change in design of the section "Monitoring of the baseline net GHG removals by sinks" allowing for more efficient presentation of data.
03	EB 26, Annex 19 29 September 2006	Revisions in different sections to reflect equivalent forms used by the Meth Panel and facilitating the transparent selection of an approved methodology for the proposed A/R CDM project activity.
02	EB 23, Annex 15a 24 February 2006	Inclusion of a section on the assessment of the eligibility of land and the Sampling design and stratification during monitoring.
01	EB15, Annex 6 03 September 2004	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		