Sofala Community Carbon Project

Project Design Document

According to CCB and Plan Vivo Standards

- WITHOUT ANNEXES -

version:

post CCB validation with observations incorporated

post PV validation and verification minor CAR incorporated.

.

Envirotrade

August 2010

TABLE OF CONTENTS

I EXECUTIVE SUMMARY

The Sofala Community Carbon Project (the Project) is developing sustainable land use and rural development activities in communities around and within the buffer zones of Gorongosa and Marromeu National Parks both in central Mozambique, to improve rural livelihoods, habitat restoration, forest management and conservation of biodiversity. The project is also generating verified emission reductions (VERs)[1].

A pilot to the project was initiated in 2002 with a group of 53 farmers in the wards of Nhambita and Munhanganha. This was followed by a research and development phase which was funded partly by the EU (contract B7/6200/2002/063-241/MZ) between August 2003 to August 2008. Since September 2008, the project has been financed primarily by carbon sales and investment from Envirotrade Carbon Limited (ECL). The project is managed by the local subsidiary Envirotrade Mozambique Limitada (EML).

The project is a flag-ship Plan Vivo project and has been operating under the Plan Vivo Standard since its inception. The project is working in two sites, Gorongosa and Zambezi Delta. Both sites include a large number of rural smallholders, and promotes the adoption of sustainable land use management. Individual smallholders can choose to adopt mitigation activities from a menu of 9 different land use systems (seven agro-forestry, one agricultural and one forestry). Each of these systems is defined by a Technical Specifications that provides all relevant information for implementation (i.e. establishment, management, site requirements and carbon sequestration potential). For each system that a producer decides to adopt, a contract is established between him or her and the project developer which includes a carbon calculator derived from the technical specification. The project developer provides guidance on how to adopt the system and monitors implementation thereby providing a basis for carbon payments. Annually the monitoring results must be submitted in a report to the Plan Vivo which is displayed on their website. After the report is approved, credits are issued to the buyers and retired on the public Markit Registry.

The agro-forestry and agricultural systems have been widely adopted. There are 3,968 contracts signed by 1,422 farmers in the Gorongosa site. In the Zambezi Delta there are 412 famers who have signed 605 contracts. In total, 1,834 farmers have signed 4,573 contracts. In addition, the Reducing Emissions from Deforestation and Degradation (REDD) system has been adopted on 9,599 ha in the Gorongosa site.

The project now intends to validate its voluntary emission reductions (VERs) according to the CCB Standard and validate and verify against the Plan Vivo standards. Both standards include criteria for additional community and biodiversity benefits. Agreements made with the community between 2002 and 2009 are estimated to yield the project 1,111,576 tCO_2e which are sold ex ante. Of these, a total of 201,719 tCO2e have already been sold. The balance of 909,857 tCO_2e, which are held in stock by the project developer, and all new VERs generated after the project was registered as a Plan Vivo in February 2007, are subject to the CCBA validation, all credits are subject to Plan Vivo validation and verification.

This Project Design Document (PDD) provides all information required for the Sofala Community Carbon Project to be validated against the Climate, Community & Biodiversity Project Design Standards (CCB Standards) of The Climate, Community & Biodiversity Alliance (CCBA) and the Plan Vivo Standards. The PDD complies with the criteria and indicators of the 2nd Edition of the CCB Standards (version December 2008) and Plan Vivo Standards version 2 (in force from 6th October 2008).

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[1] Based on its successful experiences, one further project has been prepared in 2007 in the buffer zone of the Quirimbas National Park (the Quirimba Project) by project developer Envirotrade Carbon Limited. The project described in the present document however only refers to the projects developed at the Gorongosa National Park and Marromeu Reserve.

The PDD was prepared by the project developer, Envirotrade, with support from UNIQUE forestry consultants.

II BASIC INFORMATION

Title of the Project:

Sofala Community Carbon Project

Project webpage: www.miombo.org.uk

Project information: http://www.planvivo.org/?page_id=259

Location of the Project:

Country: Mozambique

Province: Sofala

Physical Address of the Project:

Nhambita community, Chicale Régulado

Gorongosa, Mozambique

Tel.: +258 82 5099030

Delivery Address of the Project:

Envirotrade

Post Office Box 64

Chimoio

Mozambique

Project Developer (proponent):

Envirotrade Carbon Limited (ECL).

Webpage: http://www.envirotrade.net/

Project Operator (subsidiary of ECL):

Envirotrade Mozambique Limitada (EML)

Operational Start of the Project:

Pilot to the EU phase signing of contracts with farmers and sale to Future Forests: 2002 (funded by Envirotrade)

EU research and development phase: 08/2003 (EU/Envirotrade jointly funded project). During this phase the project was referenced by the EU as Miombo Community Land Use & Carbon Management: Nhambita Pilot Project. Contract B7-6200/2002/063-241/MZ. This was commonly shortened to the Nhambita Community carbon project.

Operational phase: 09/2008 (Envirotrade and carbon sales funded project)

III GENERAL SECTION

G1. Original Conditions in the Project Regions

General Information

G1.1. The location of the project & basic physical parameters (e.g., soil, geology, climate).

Location

The Sofala community carbon project (hereafter "the Project") is located in the central region of Mozambique in Sofala province.

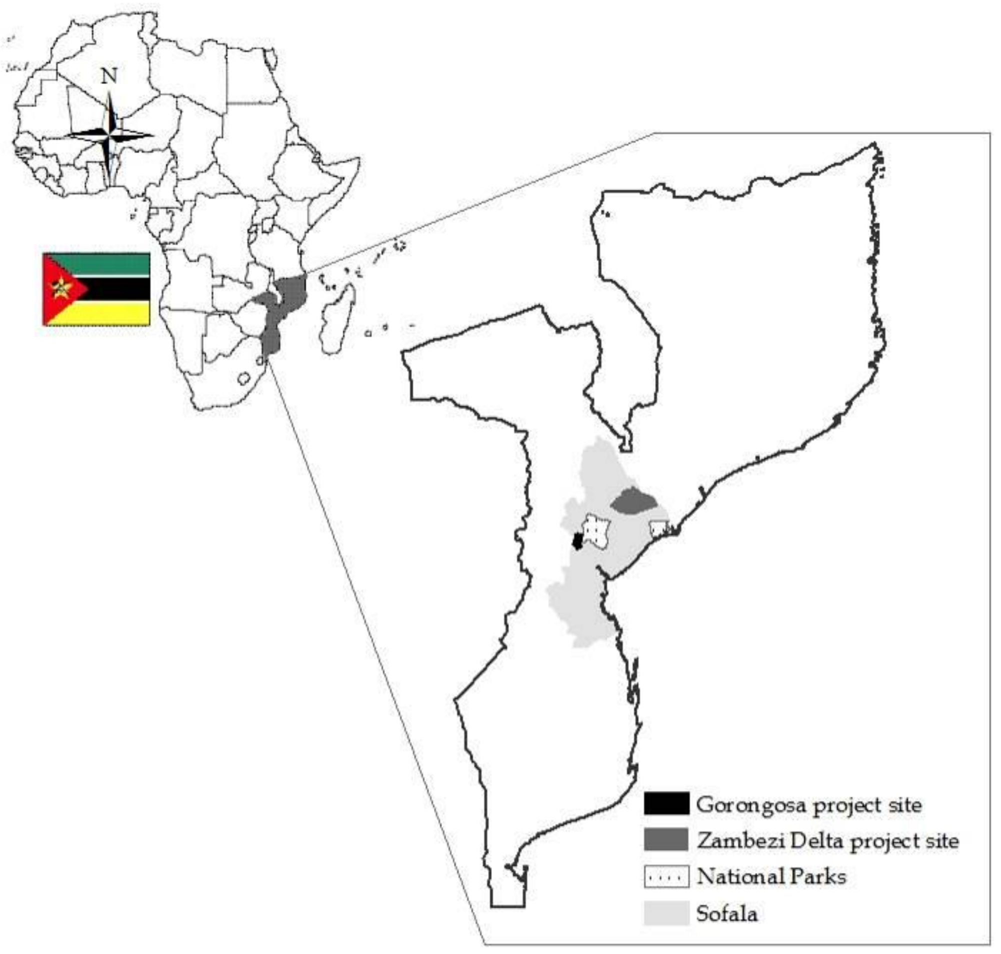

Figure 1. Location of project sites within Sofala province.

The Project is split into two sites, the Gorongosa and Zambezi Delta project sites .

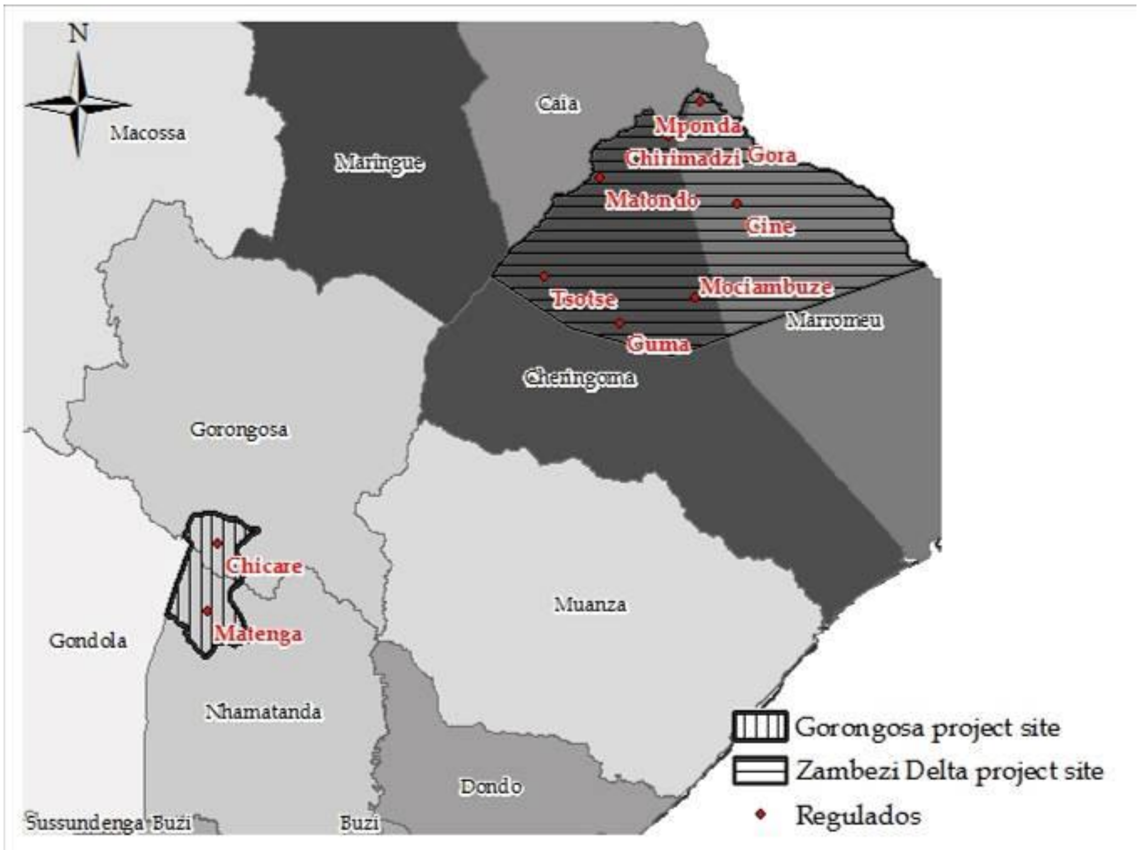

Figure 2. Map of districts and *Régulados*

The project sites straddle four different government districts, Nhamatanda, Gorongosa, Cheringoma and Marromeu and ten *Régulados* traditional land divisions similar to chiefdoms, Chicale, Mucombezi (often referred to locally as Matenga), Guma, Tsotse, Matondo, Chirimadzi, Mponda, Gora, Cine and Mociambuze. Further details on project boundaries are in section G1.3. The project also overlaps with two buffer zones around national parks the Gorongosa National park and the Marromeu National park (figure 3).

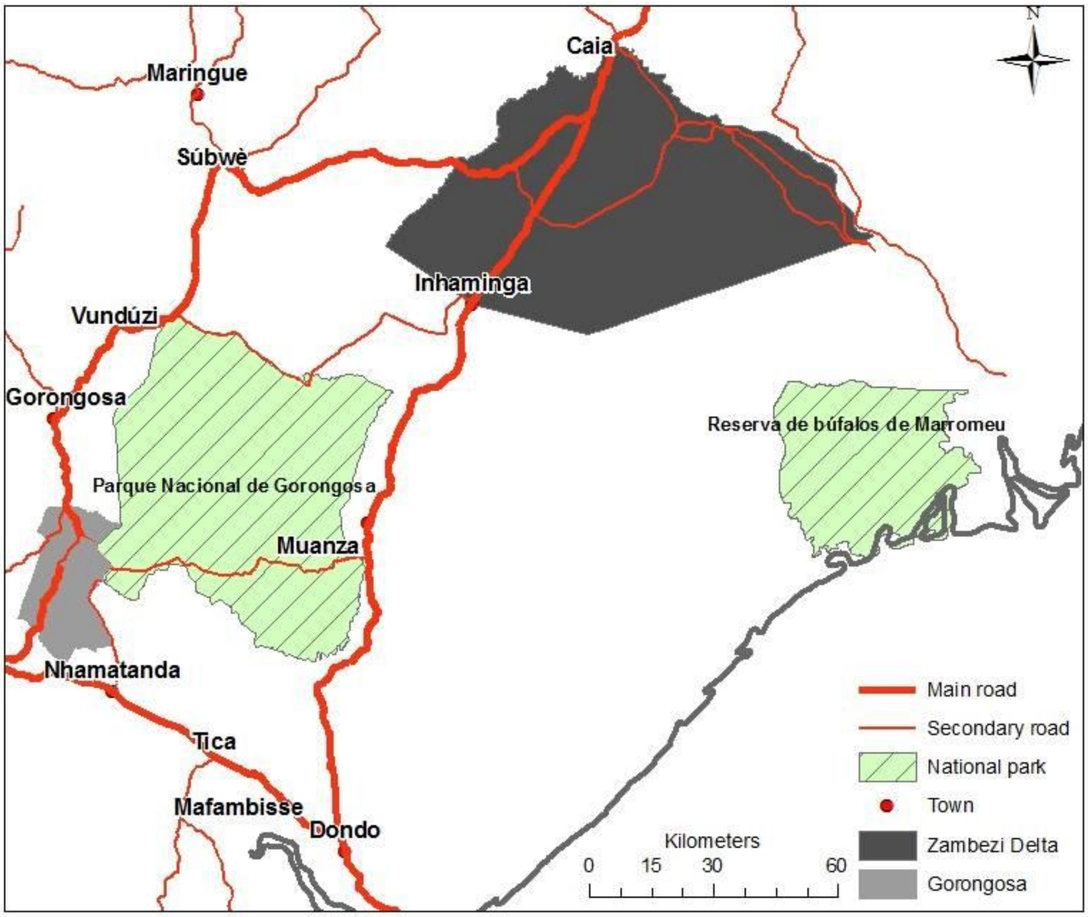

Figure 3.

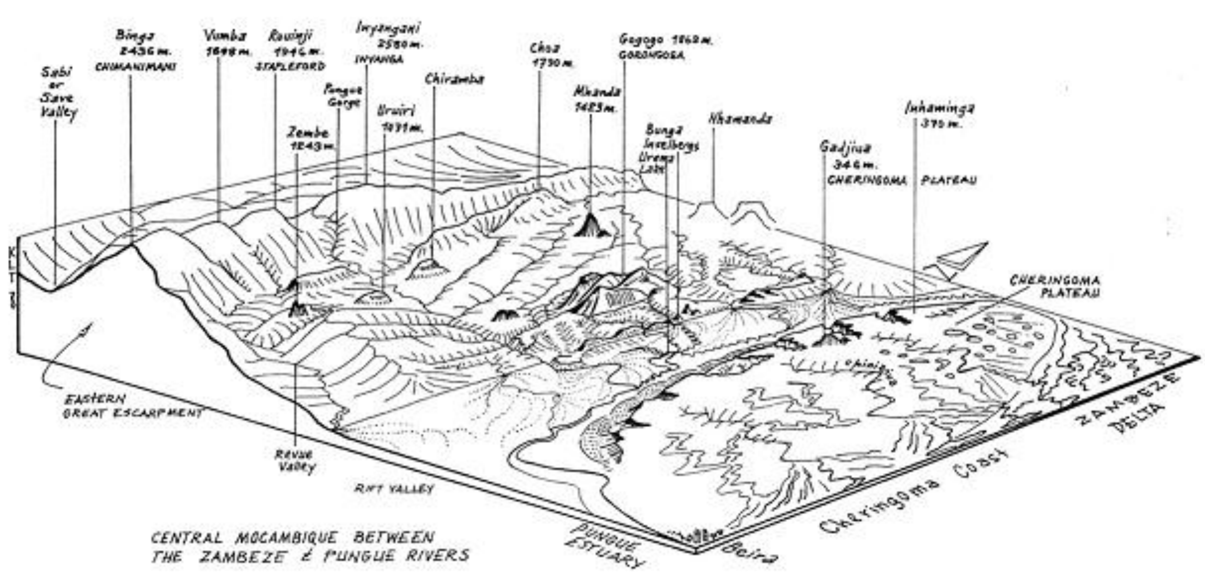

Figure 4. Topography and context of Sofala province, central Mozambique,.

Geology and topography

The project zone is part of the southern extension of the Great African Rift Valley; situated on the Barue plateau, and the Cheringoma plateau. Geologically, the land consists of eroded surfaces of granite and basaltic gneiss complex of Precambrian times. The landform is undulating to incised with elevations rising from about 40 m.a.s.l. on the flank of the rift valley (on the eastern part of the project zone) to 400 m.a.s.l. and more towards the western part of the project (see figure 5).

The crystalline bed rocks, low relief, moist climate and high temperature have produced a highly weathered soil which is often more than 3 m deep on the plateau[2]. Shallow stony soils also occur along escarpments. Loamy sand, sandy loam and sandy clay loam textures predominate with a marked increase in clay with depth. The miombo ecosystems generally occur in soils which are predominantly alfisols, oxisols and

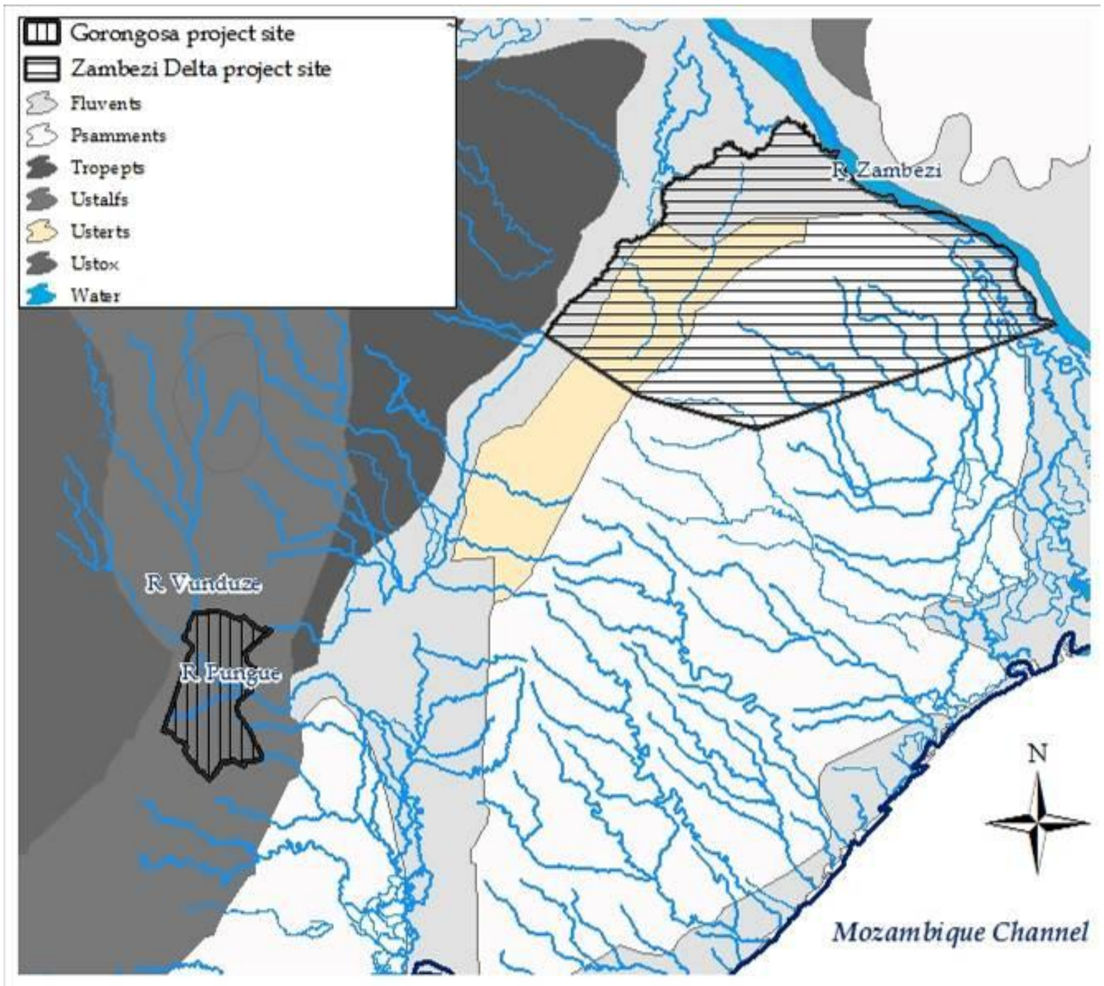

Figure 5. Soil cover in project sites and drainage patterns. National dataset (CARPE and MIOMBO projects) USDA classification.

[2] Pg 130 EU final report. Miombo community land use and carbon management. Sofala Pilot Project.

ultisols; these are highly acidic, low in cation exchange capacity, low total exchangeable bases and low available phosphorus. These soils are formed by a catenary sequence of well drained, deeply weathered soils on higher areas, a narrow zone of sandy soils along the foot slopes and poorly drained vertisols in the wet areas i.e. the 'dambos' (Desanker et al. 1995). Generally they have low levels of organic matter as a consequence of the abundant termite activities and frequent incidence of fire (Chidumayo, 1997).

Hydrology

The drainage within the project is closely spaced, assumes a typically dendritic pattern and is oriented to the West, South and East. The smaller streams are seasonal and fast running. The Zambezi, Pungue and Vunduzi Rivers (respectively in the north, south and west of the project zone) are the only perennial rivers. Groundwater levels are generally very shallow and located either in the weathered regolith in valley bottoms or in fractures in the bedrock (Lynam et al, 2003; Tinley, 1969)[3].

Climate

The climate in Sofala is typical of central Mozambique, sub-tropical with alternating cool-dry winters (April-October) and hot-wet summers (November-March). May-July is the coolest period (20-30 °C) and October is the hottest month (30-40 °C).

There are two distinct seasons. The dry season extends from May to October and the wet season extends from November to April. Most of the rain falls between November and March. The driest months are July to September. Based on weather data from ARA-Centro (The Mozambican water board) at Chitengo (in the Gorongosa National Park) over the past seven years, mean annual precipitation is 749 mm and is distributed mainly between November and April but with high inter-annual variability. The project lie within the rainfall isohyets of 600 and 800 mm/yr and are generally influenced by the orographic effect of the Gorongosa Mountain (in the west).

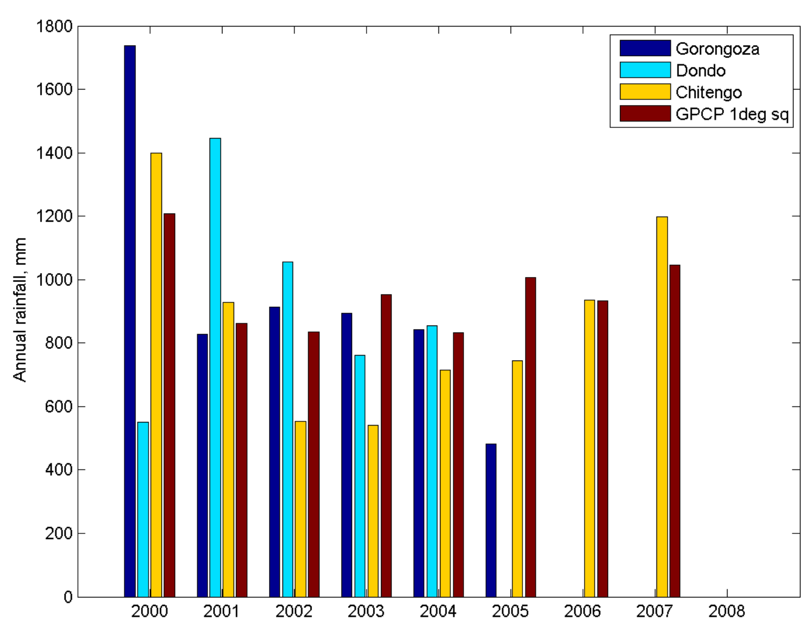

Figure 6. Mean rainfall from four weather stations closest to project regions and all within Sofala province (data from Casey Ryan, University of Edinburgh).

[3] Page 8 EU final report. Miombo community land use and carbon management. Sofala Pilot Project.

G1.2. The types and condition of vegetation within the project region.

The vegetation in the project can be is characterized by a woodland mosaic including miombo woodlands, Combretum woodlands, riverine woodland and dry forest. Multiple terms could be used to describe the different type of vegetation cover, the following will be used consistently in this document to avoid confusion.

Miombo Woodlands

The most widespread vegetation type within the project regions is Miombo Woodlands. These woodlands are dominated by species such as *Brachystegia boehmii*, *B. spiciformis*, *Julbernardia globiflora*, *Diplorhynchus condylocarpon*, *Erythrophleum africanum* and *Burkea africana*. Miombo shrub layer is dominated by *Bauhinia* sp., *D. condylocarpon*, *Pterocarpus rotundifolius*, *B. boehmii* and, occasionally, *Pterocarpus angolensis*. Collectively these species account for over 70% of the basal area in the miombo woodlands.

Miombo woodlands are threatened by clearance for agriculture, logging for valuable species and charcoaling. They are also utilised by the community for firewood collection and the construction of bark bee hives. In the project zone miombo is of better condition further from settlements.

Savannah woodlands

The Savannah woodlands is a broad vegetation category, into which structure and density are defining characteristics. Floristically these areas are dominated by *Combretum apiculatum* (29% of basal area), *Commiphora mossambicensis* (15%) *and P. rotundifolius* (15%) in the tree layer and by *C. apiculatum* (51%) and *P. rotundifolius* (36%) in the shrub layer. Some palms are found in the savannah woodlands, but not generally in the project zone. These woodlands are not of high biodiversity nor timber value. The major threat to them is from clearance for agriculture and charcoaling.

Riverine woodlands

The Riverine Woodlands tree layer is dominated by *Adansonia digitata* (26%), *Cleistochlamys kirkii* (10%), *A. nigrescens* (8%) *and Xeroderris stuhlmannii* (6%) while *C. apiculatum* (50%) *and Combretum molle* (24%) dominate the shrub layer. Riverine Woodlands are not widespread within the project region, given their fragile and vulnerable nature and association with drainage lines. These are the most important woodlands in terms of their biodiversity and the most threatened. The wetter, rich alluvial soil makes good farmland and contain valuable timber species like *Khaya anthoteca*.

Dry forest.

Closed canopy deciduous found in the Zambezi Delta site, populous trees include *Lecaniodiscus fraxinifolius*, *Spirostachys africana* and *Millettia stuhlmannii*. *Pterocarpus angolensis* woodland may be interspersed in a mosaic. This forest is managed for timber and hunting concessions in the Zambezi Delta site as it is both diverse and contains high value timber. Areas are being cleared for agriculture, in particular along the roadsides.

Carbon stocks of different vegetation covers	Average tC/ha above and below ground biomass
Miombo woodland	38
Savannah	20
Riverine forest	67
Secondary woodland	18

Figure 7. In the Gorongosa site, the different vegetation covers have inventoried to determine above and below ground carbon densities for the Plan Vivo REDD technical specification. These densities are recorded here.

Inventories for determination carbon stock of different vegetation covers

The carbon stocks of the vegetation covers are determined through field inventories, the development of a local allometrics and local root shoot ratios (Ryan 2009). Eighty seven plots of between 0.25 and 1.00 hectares were used to determine carbon stocks, 15 permanent sample plots were used to monitor changes in tree growth, burn regime and soil moisture (Ryan 2009).

Location of plots	Number
Chicare	73
Marrameu District	8
Qurimbas National park	6

Figure 8. Location of plots to derive carbon stocks in representative Miombo landscape vegetation covers. These plots were shown to be statistically independent of each other through a semivariogram analysis (Ryan 2009)

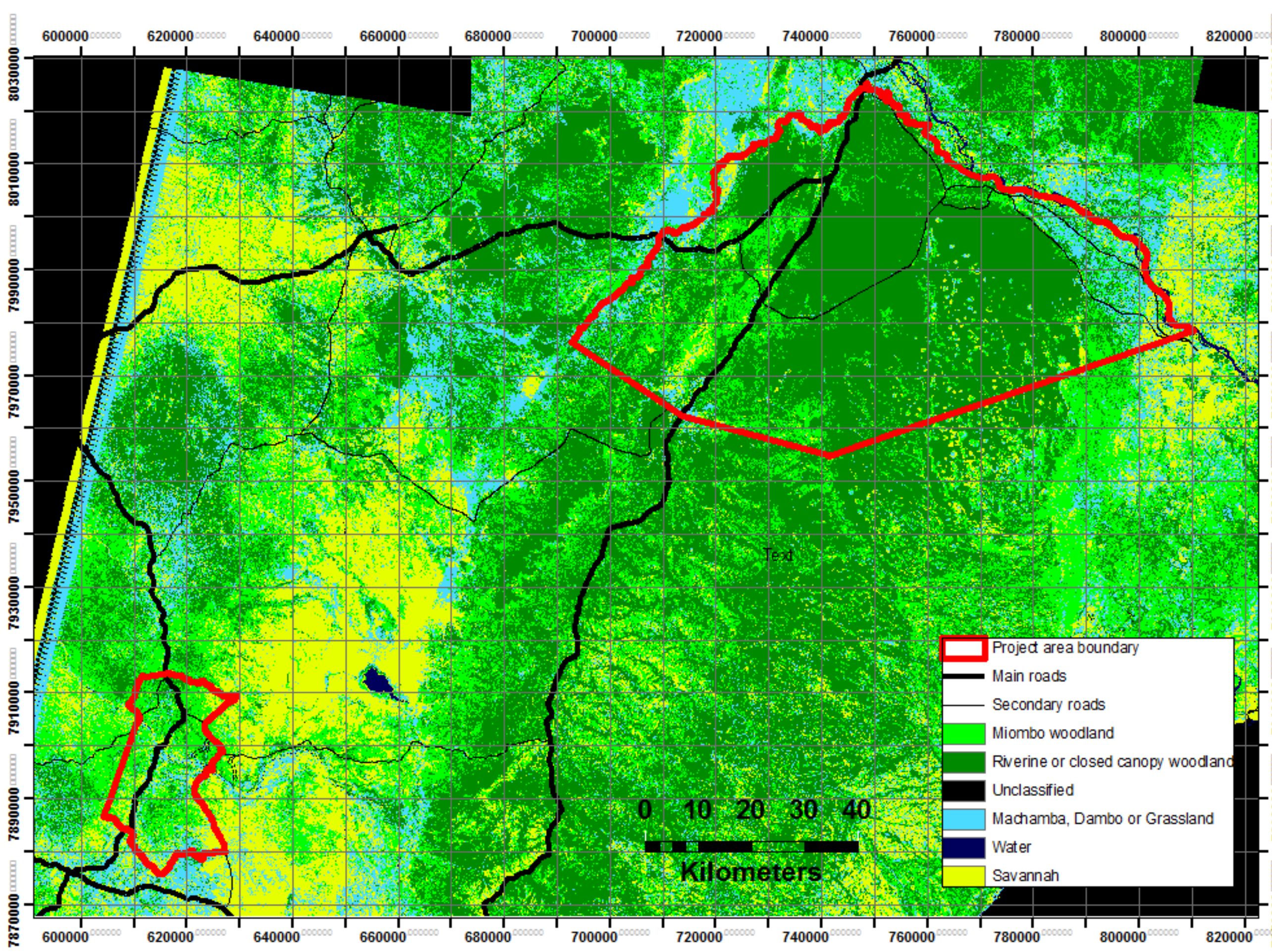

Figure 9. Vegetation map for the Sofala Community Carbon Project and surrounding area, derived from the Landsat ETM+ mosaic 2003 but trained from field plots and homogeneous areas chosen from a satellite radar-derived locally calibrated biomass map.

Three major inventories have been carried out in the project areas from which the information on vegetation types in figure above have been derived, these are detailed in Mushove 2004[4], Ryan 2009[5] and Falcao 2010[6]

G1.3. The boundaries of the project regions.

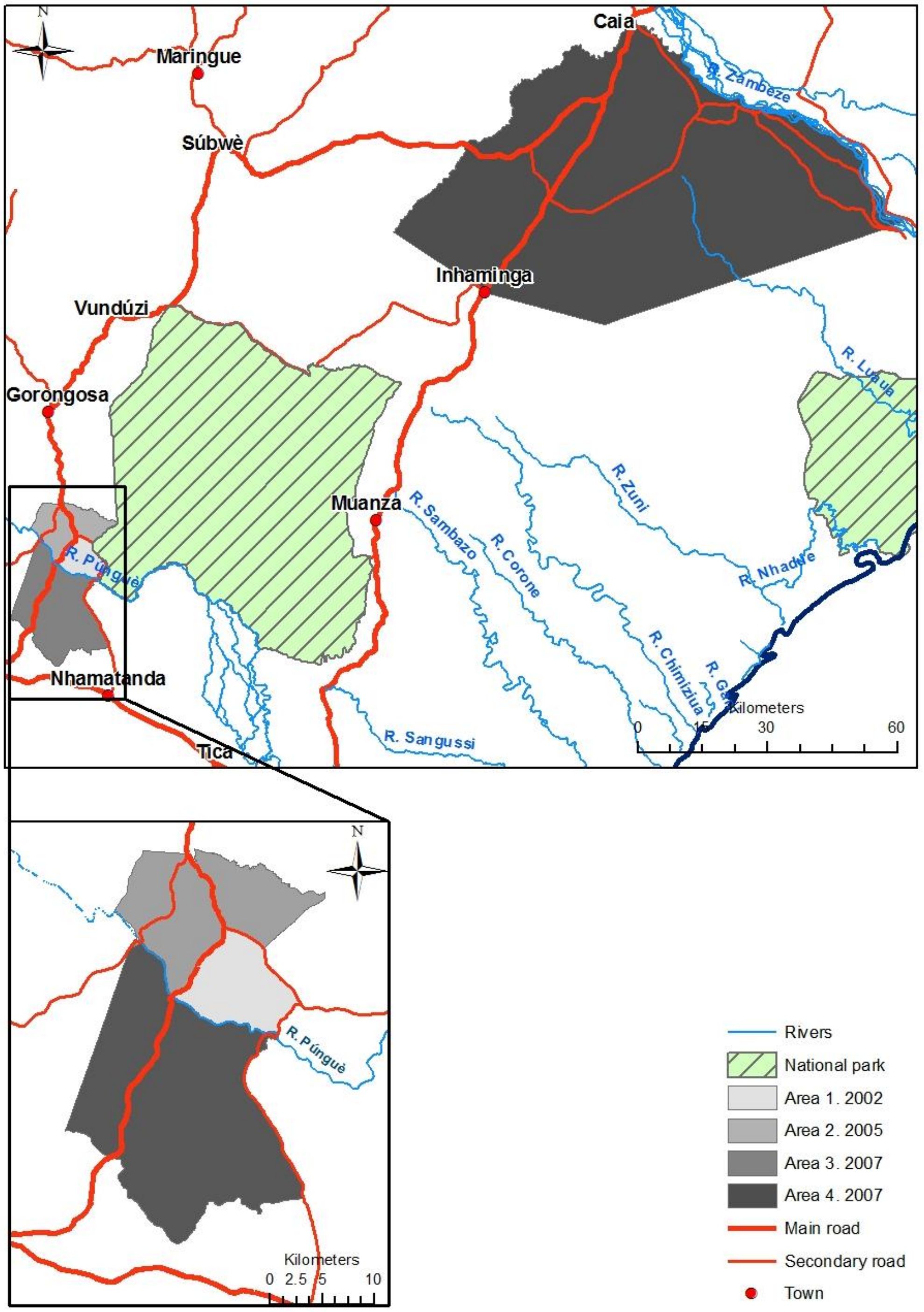

Figure 10. Dates of expansion of the project.

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[4] Mushove, P. (2004). Preliminary inventory of Nhambita Community Forest, Gorongosa District, Mozambique., ICRAF-Mozambique

[5] Ryan, C. (2009). Carbon cycling, fire and phenology in a tropical savanna woodland in Nhambita, Mozambique. GeoSciences Department, University of Edinburgh. **Doctor of Philosophy**. http://www.geos.ed.ac.uk/homes/cryan/thesis/

[6] Falcao, M. (2010). Area comunitária de inventário florestal, provincia de Sofala, Trabalho realizado pela miombo consultores, lda.

Boundaries of the project regions

The project zone of the project is the Sofala province (see figure 1 above in G1.1). Within this zone there are two distinct sites of project are the Gorongosa project site and the Zambezi Delta project site (see figure 3 above). Within sites there are over a thousand *machambas* (fields) of between 0.5 and 7 ha with an average of 1.03ha scattered in the landscape. Each *machamba* owner can have a contract with the project to carry out agro-forestry activities. The approach of the project is therefore programmatic and aggregates many carbon producers activities on individually managed land under one project umbrella. REDD management areas can be either wooded community areas or woodland owned by an individual community member, they do not have to have contiguous borders. The smallest REDD area is 2ha, the largest is 5,249 ha.

The initial pilot to the EU phase was geographically located only in the Nhambita, Munhanganha and Boe-Maria wards of the Gorongosa site, but during the EU research and development stage the project expanded to include more of the Gorongosa site and Zambezi Delta (see figure 10).

Gorongosa project site

The Gorongosa project site is defined by the borders of Chicale and Mucombezi *Régulados* (traditional community chiefdoms, see section G1.5 for traditional and administrative structures) located southwest of Gorongosa National Park. Chicale Régulado covers 6 wards, i.e. Pungue, Mbulawa, Bue Maria, Mucinhawa Antigo, Munhanganha, and the Nhambita ward. Chicale *Régulado* has been misidentified as the Nhambita *Régulado* on institutional documentation including the the community DUAT (see section G.1.6 for more details). Mucombezi *Régulado* has the wards of Chiro, Bairro 3, Bairro 8, Bairro 2, Mucombeze Ponte, Muchurue and Divinhar.

The Northern project boundary is the Nhanichido river until the main tar road (EN1), from there a straight line to the waterfall on River Naminshinda, a tributary to the Vunduzi river which marks the most Western edge of the Northern boundary. The Eastern boundary is the Gorongosa national park edge and the edge of Nhamatanda district. The Metuchira River forms the Southern boundary and the rivers intersection with the boundary of Manica province marks the most south westerly edge. The Manica province boundary, Pungue and Vunduzi Rivers and mark the Western boundary.

Gorongosa site is crossed South-North by the national road (EN-1) running from Inchope in the south to Vila Gorongosa in the north and East-West by the rural road ER-418 that serves as the access to west gate of the Gorongosa National Park.

The total area of the Gorongosa project site is 55,877 ha. Within the 55,877 ha, 9,599 ha are being managed for carbon sequestration through Reducing Emissions for Deforestation and Degradation (REDD) and approximately 1,500 ha are been managed for Agro-forestry.

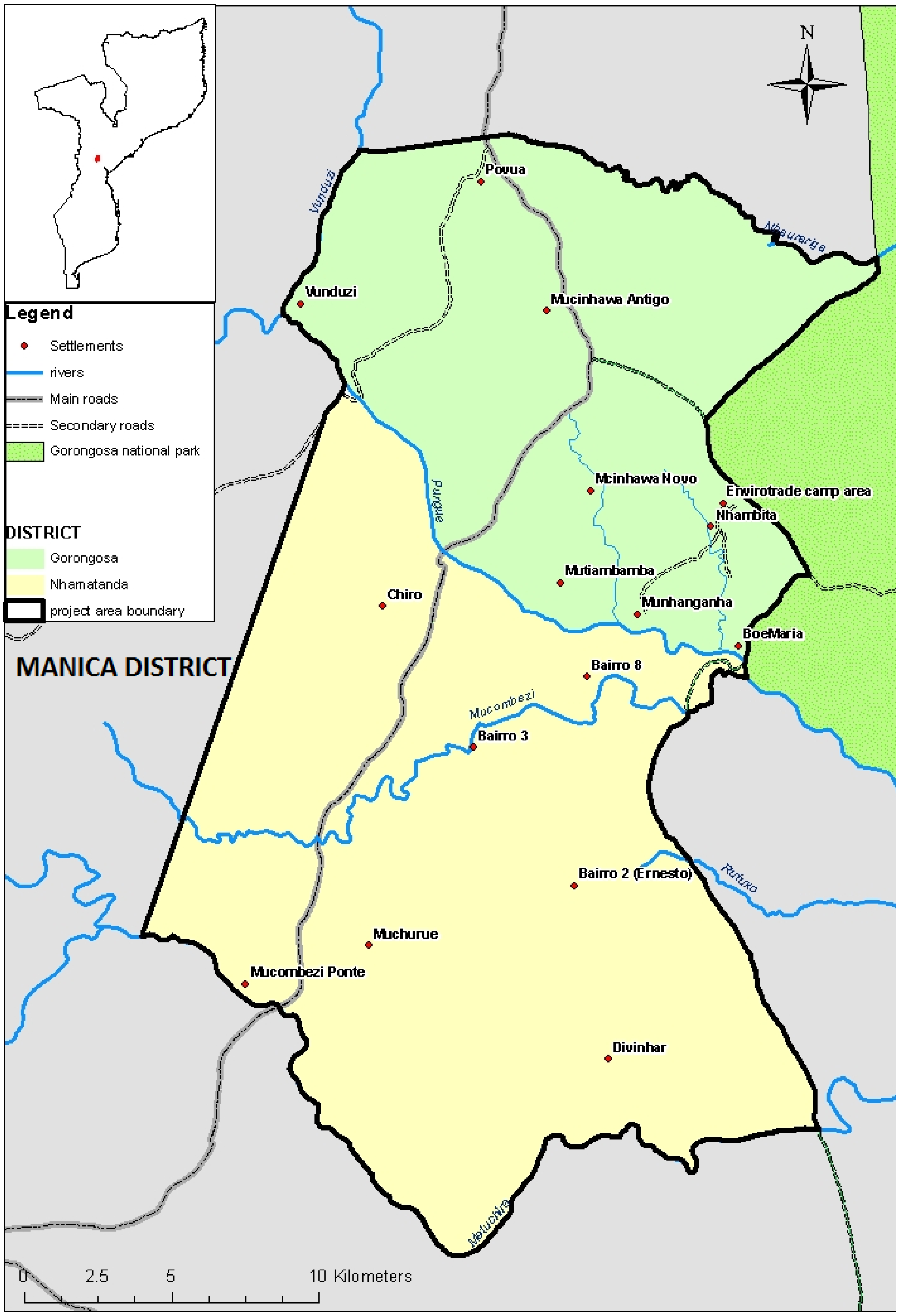


Figure 11. Boundaries of the Gorongosa project site: Project boundary is in black.

Zambezi Delta project site

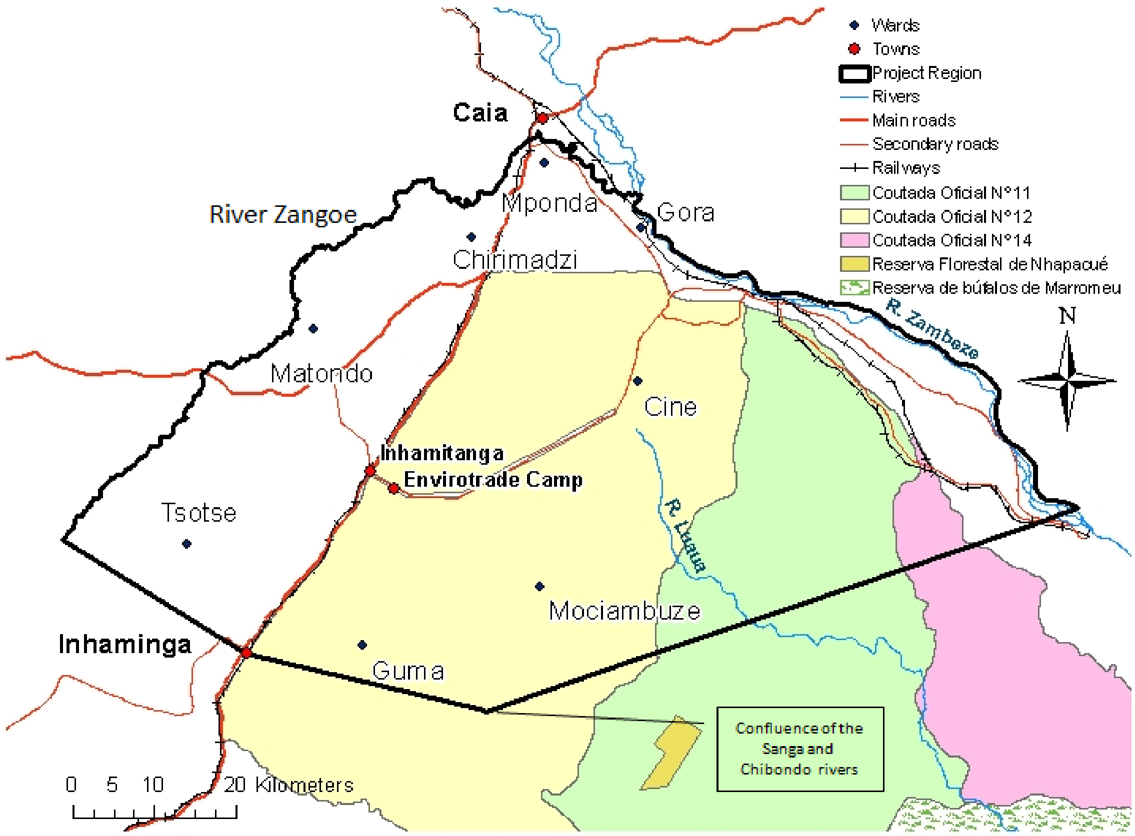


Figure 12. Boundaries of Zambezi Delta project. Coutada's are not managed by the project but some farmers who have Plan Vivo contracts are in these areas and they are therefore included in the project area.

Northern Boundary, Zambezi River from Caia to Chupanga administrative post. Southern Boundary, Inhaminga town to the confluence of rivers Chibondo and Sanga, Eastern Boundary, Chupanga administrative post to above the same confluence. Western Boundary, length of River Zangoe to Inhaminga town.

The Zambezi Delta project site is an area of 455,515 ha, only agro-forestry and no REDD activities are carried out in the site. Agro-forestry currently occurs in only 300ha as the site has only been part of the Sofala project since 2007. There is the potential to start agro-forestry in all the *machambas* in the project boundary the majority of which are outside of the Coutadas and close to the settlements of Inhaminga and Caia (see figure 11). Current project *machambas* are in started in Chirimadzi, Cine, Guma, Mociambuze, Matondo, Tsotse, Gora and Mponda *Régulados*.

G1.4. Current carbon stocks within the project area(s), using land-use stratification and methods of carbon calculation (such as biomass plots, formulae, default values) from the Intergovernmental Panel on Climate Change's 2006 Guidelines for National GHG Inventories for Agriculture, Forestry and Other Land Use (IPCC 2006 GL for AFOLU) or a more robust and detailed methodology.

Plan Vivo uses technical specifications (carbon methodologies) which include a carbon calculator, a management regime and monitoring protocol. The project's technical specification were researched and written by the Edinburgh centre for carbon management (ECCM) and approved by the Plan Vivo foundation. Envirotrade is committed to informing the technical specifications with the latest research and inventories, as such they are currently in review or in the case of the REDD technical specification in submission for third party review. The technical specifications are on the website www.miombo.org.uk. Any new technical specification versions in use are submitted annually to the Plan Vivo foundation with the annual report required for credit issuance.

The technical specifications have been informed by an investigation of carbon dynamics in the Miombo ecosystem, stem inventories and carbon modelling using CO2fix[7]. Inventory data was collected within Sofala province but some default values were also used, the carbon stocks can therefore be considered tier 2 under the IPCC 2006 guidelines.

In total eight different activities or plan vivo systems are carried out to sequester and protect carbon homestead planting, *Faidherbia* dispersed interplanting, *Gliricidia* dispersed interplanting, non-burning of agri-residues, field boundary planting, mango orchard growing, cashew orchard growing, woodlot creation and finally REDD.

Each of the agro-forestry and agricultural technical specifications defines a baseline carbon density related to the land use of the area before its conversion to the carbon sequestration activity. The five baseline strata are in the table below.

Carbon sequestration activity	Baseline land use
Cashew orchard	Recently fallow machamba
Gliricidia inter-planting	Machamba
Homestead planting	Homestead
Mango orchard	Recently fallow machamba
Woodlot	Fallow machamba
Field boundary planting	Machamba
No burning of agri-residues	Machamba*

*Soil organic carbon is considered in the baseline land use of this technical specification, where the others only consider biomass, see section G2.3.

An estimate of the current carbon stocks in the adopted project areas in agricultural land can be defined by multiplying the activity area by the baseline carbon density in the technical specification:

Baseline land use	tCha-1
Fallow machamba	1,167
Machamba (soil organic carbon)	16,209
Recently fallow machamba	334
Machamba (biomass)	0
Homestead	0

For the REDD project areas the current carbon stocks can be based on the stratification of vegetation types described on in section CL1.1 and carbon densities in G1.2.

[7] Mohren, F., P. van Esch, et al. (2004). CO2FIX-V3.

Vegetation types	Hectares	tC above and below ground biomass
Degraded Miombo	254	4,687
Machamba	79	220
Miombo	7,033	269,634
Riverine	618	41,269
Savannah	1,615	32,106
Total REDD area	9,599	347,916

Table: The total current carbon stocks in the project adoption areas is the combination of REDD and agro-forestry and agricultural carbon 365,626 tC.

G1.5. A description of communities located in the project regions; including basic socio-economic and cultural information that describes the social, economic and cultural diversity within communities (wealth, gender, age, ethnicity etc.), identifies specific groups such as Indigenous Peoples and describes any community characteristics.

Traditional structures in Sofala

Characteristic of the rural population is the local institutional three-tier structure. Traditionally, rural areas in Mozambique were managed by local chiefs (*Régulos*), who also collected annual tax on behalf of the colonial administrat**ion.**

The *Régulo* is chief of the entire *Régulado*. Each community unit, typically a ward, is administered by a *Sapanda* who reports to the *Régulo*. Each community in turn is divided into smaller administrative units, called Chissa which are managed by *Fumos* who report to the appropriate *Sapanda*. However, it is not a rigid system as *Fumos* can often approach the *Régulo* directly. All posts are hereditary in nature as most people were appointed by their fathers. However, in rare cases, the *Régulo* may exercise his right to nominate a *Sapanda* or *Fumo* of his choice. The *Régulo* also appoints a Secretary who is responsible for preparing any written reports that are sent to the district administration. The *Régulado* has a local messenger in the form of a *Caboterra* who relays important information from one leader to another.

In terms of hierarchy and power, the *Régulo* is at the highest level within the community, followed by the *Sapandas* and then the *Fumos*. It is the *Régulo* who usually interacts with Chief-de-Post, the local government official who is in charge of several *Régulados* in the area.

Other institutional structures

Apart from this traditional institution of *Régulo*, *Sapandas* and *Fumos*, there are local representatives of the national parties who are mainly active during elections. In addition, there are common interest groups in the community, bee-keepers, charcoal makers and NTFP collectors, which have been formed by various agencies including the Provincial Forest Department and ORAM (Rural Association for Mutual Support) - a national NGO.

A powerful structure within the Sofala project are the Community Associations (CA) who are formed in conjunction with ORAM. The Chicale CA was registered in March 2002 as part of a national government programme to recognise traditional communities and to prevent land-use conflicts. The CA is organised in a democratic way and holds regular meetings based on an established legislation. Some CA's are more active than others, those in the project area are key to its implementation.

Differences between regions

The socio-economic and cultural information of the project area can be divided into the two project sites, as they represent two different national park buffer zones, one Gorongosa national park buffer zone (Gorongosa site) and one the Marromeu national park buffer zone (Zambezi Delta site).

Gorongosa site - wealth, gender and ethnicity.

Chicale *Regulado* is located in the buffer zone of the Gorongosa National Park. Like several other communities, Chicale people were relocated to the buffer zone after the establishment of the National Park in 1948.

During the colonial period, employment in the form of road construction and cotton farming for export was available. This ceased after independence in 1975. Shortly afterwards, the Gorongosa area became one of the most intense areas of conflict during the civil war (1976-1992). Farming was limited by civil war, landmines and a breakdown of infrastructure. Due to severe food shortages most of the population was displaced for many years before they were able to return in the mid-1990s.

Within the Gorongosa site, there are differences between wards (see section G1.3) are not due to ethnicity but rather religion and cultural practice. Wards of Bue Maria, Nhambita and Pungue are mainly affiliated to the Catholic Church and the Mbulawa side of the EN1 road is affiliated to the African Apostolic Church. The most widely spoken language in the area is Sena, though many local people can understand Portuguese as well.

In a typical ward, families live in widely scattered homesteads, each with several buildings made of bamboo, grass and mud. Each family has some livestock (chicken, ducks, goats, pigs) and a few fruit trees (mango, banana, papaya) with a central area for cooking.

Overgrazing which may result in project leakage is not an issue in the project region because livestock has been limited by invasion of tsetse fly and other diseases. Commercial agriculture was not practiced in Chicale *Regulado* but there is a small amount of commercial agriculture in the South-East of Mucombezi *Regulado*, while this is within the project area it does not have any contracts through the Plan Vivo System.

Subsistence farming and hunting are historically the main income generating activities. Until recently there were no shops and school houses were primitive lacking roofs.

Females outnumber men by about 1.1 to 1 and many men have more than one wife. About 20% of households are headed by females. Detailed census data is not available for the whole Gorongosa project site, but a masters student carried out a survey for the project in 2004 in Nhambita, Munhanganha and Boe-Maria. At this time there were 203 households and a total population of 1039 people in these wards. In 2009 when Envirotrade carried out a follow up survey there were 245 households and 1,190 people in the same area, representing an increase of 2.91% per year (see Figure 12). All three wards surveyed have refuges returning after the war but the key attraction of the project area was found to be the availability of land[8].

8 Impact assessment of the Nhambita Community Carbon Project, Mozambique. Pg 368 of the EU final report. www.miombo.org.uk..

Part of the project strategy is to draw people into sustainable livelihoods in the area to reduce pressure for agriculture on the Gorongosa national park[9].

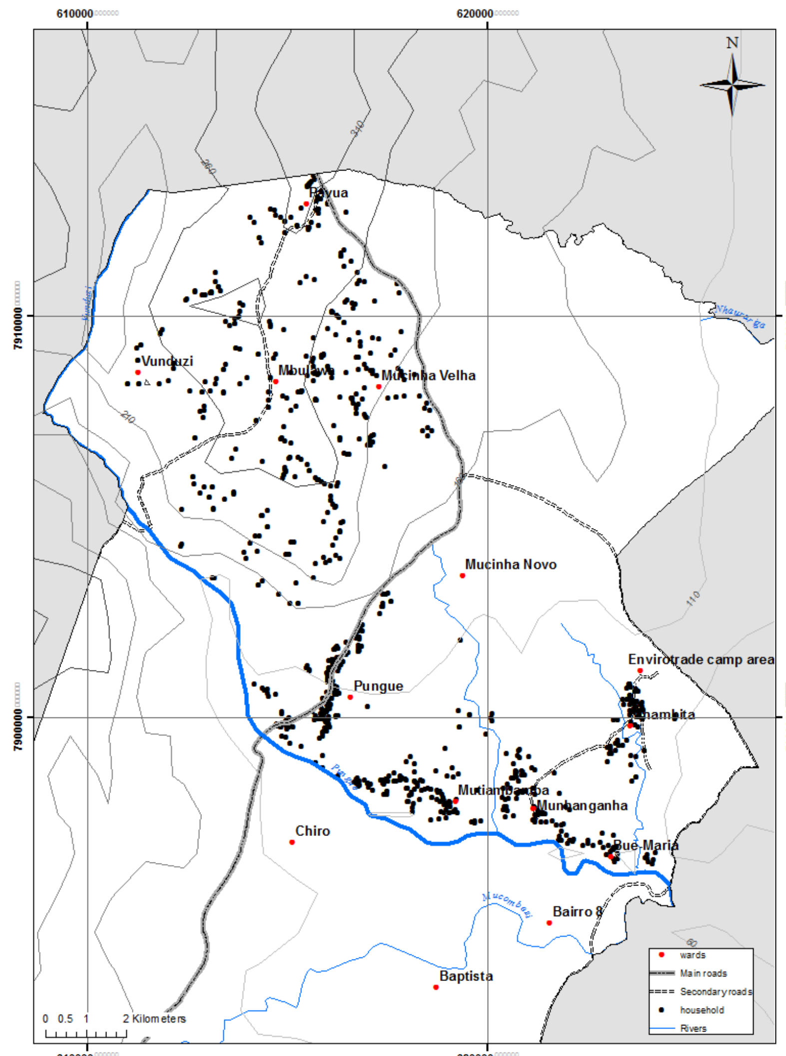


Figure 13. Household locations in Chicale *Regulado* from 2009 census.

The baseline research in 2004 revealed that households suffer from a widespread deprivation, major problems include:

- There is no investment by the government or any private organisation in the area except for sporadic effort by some NGOs to organise local communities and initiate some income generating activities. Otherwise, the local infrastructure is poorly developed with no access to electricity, transportation and modern communication systems.
- Most households are very poor with no regular source of income. This is indicated by low levels of ownership of durable items and by visual observations of the living conditions in the area. In order to bring some cash into the household, most people depend upon casual labour which may either be available in nearby towns or in bigger wards in the area. Other sources of income are through the selling

9 More detail in " Envirotrade, Communities and Forest Conservation in Africa" by Philip Powell.

of agricultural products such as food crops, fruits, vegetables etc.; selling of animal products such as chickens, eggs etc.; selling of non-timber forest products (NTFPs) such as bamboo, honey etc. and selling of locally made products such as clay pots, bricks and alcohol. Regular income from a permanent job is very rare.

- Apart from subsistence agriculture, most households share a close relationship with the forest and utilise many edible (particularly in times of low food availability) and non-edible, non-wood forest products. However, only a few households are able to add any value to these products or to sell them in the market.
- Malaria and water borne diseases, such as cholera and diarrhoea, are major threats to human health in the area. Since the local clinic does not have the required facilities to diagnose AIDS, its prevalence could not be ascertained. However, in general, about 10% of adults are infected with AIDS in Mozambique which is a huge threat to human welfare in the entire region.
- Literacy levels are extremely low and in single digits for some communities such as Munhanganha. Among women, literacy levels are lower than among men.

Chicale *Regulado* traditional structure

	District Administrator		
	Chief de Post, Pungue		
	Regulo (Maneca Luis Chicale)		
Sapanda, Nhambita (Chiringa Ranguisse)	*Sapanda*, Mbulawa (Joao Miguissene)	*Sapanda*, Bue Maria (Jonal Thole)	*Sapanda*, Pungue (Torge Melo)
1. *Fumo*, Nhanduzu (Florindo Chonze Sande)	1. *Fumo*, Mbulawa (Joao Miguissene) 2. *Fumo*, Povoa (Manuel Comujoma) 3. *Fumo*, Mussinha (Manuel Massuila) 4. *Fumo*, Hussinha (Bene Megue)	1. *Fumo*, Munhan-ganha (Jaime Saize) 2. *Fumo*, Bue Maria (Lucas Melo)	1. *Fumo*, Cuacua (Francisco Quembo) 2. *Fumo*, Nhamhu (J Augusto Massamba) 3. *Fumo*, Chicuro-wawe (Tomas Francisco Charles) 4. *Fumo*, Mussamba (Goncalves Oliveira Godzo) 5. *Fumo*, Mussinha (Zacaria Alberto S.)

Figure 14. Typical Hierarchy in the Local Institutional Structure, Chicale *Régulo*.

Most of the local issues such as thefts, extra marital affairs, petty fights etc. are resolved at the appropriate level of the hierarchy. In case of any violent criminal offence such as stabbing etc., a *Régulo* will report the case to the Chief-de-Post and the district police. However, such instances are rare and most conflicts are resolved within the community itself, e.g. in 2007, only one case was referred to the Chief-de-Post at Pungue.

Zambezi Delta project site - wealth, gender ethnicity.

People living in the Zambezi Delta site are ethnically Sena like the Gorongosa site and this is also the predominate language spoken. The area has a different history in its slightly greater distance from conflict in the Gorongosa national park (GNP) and proximity to timber and hunting concessions and the Marromeu national park (MNP) (see figure 11). Income is available from working in these concessions. Of the two districts, Marromeu and Cheringoma, Marromeu is the more populous within the project area - see tables below both derived from the 2007 provincial census:

MARROMEU DISTRICT

REGULADO	**No INHABITANTS**	**No HOUSE HOLD**
CINE	80	12
GOMBE-GOMBE	3,716	555
GORRA	1,961	293
MANGAZE	1,628	243
MPONDA	6,331	946
NZOU	1,845	276
	15,561	**2,325**
Average per household	6.7	

The total population of the Marromeu District is 119,718 of which 70.5 % are rural dwellers.

CHERINGOMA DISTRICT

REGULO	**No INHABITANTS**	**No HOUSEHOLDS**
CHIRIMADZI	2,822	432
GUMA	6,630	1,015
MATONDO	1,510	231
	10,962	**1,678**
Average per household	6.5	

The total population of the Cheringoma District is 34,133 of which 90% are rural dwellers.

Information on gender is not available from these districts. However as part of Envirotrade's expanding activities in the region a census will be carried out by a masters student from Eduardo Mondlane University.

Household surveys carried out in 2008,[10] show wealth to also be limited in the area. Only 26.5% of rural residents receive a formal wage, occasional wage or remittance. The formally employed residents amount to 15% of the rural community and have a median wage of between 1,000 and 1,500 MTZ (USD 40-60) per month. Owning a bicycle is considered a sign of prosperity in the communities and 67% of households do own at least one.

G1.6. A description of current land use and customary and legal property rights including community property in the project zone, identifying any ongoing or unresolved conflicts or disputes and identifying and describing any disputes over land tenure that were resolved during the last ten years (see also G5).

Current land use in the project zone is characterized through subsistence agriculture and the use of forests and its natural resources.

Subsistence agriculture

Most people in the project region farm on two kinds of land – *machambas*, which were forest land that has since been cleared around homesteads, and Dimbas, which are flood plains of the various seasonal and perennial streams. The average area of a *machamba* is about 1 ha which is about twice as large as an average Dimba with an area of 0.49 ha.

Important food crops grown in the area include maize, sorghum, rice, beans, pumpkins, cassava, sweet potato and pigeon pea. Most households also grow fruits and vegetables, which are as diverse as the food crops. Common fruits and vegetables grown in the area include mangoes, bananas, papayas, lime, guavas, cabbage, tomatoes, onions, and peppers.

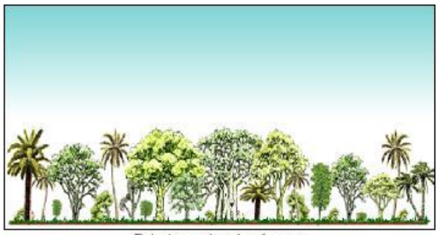
The major problem with agriculture is low productivity which is exacerbated by frequent failure of crops in the dry season. Most farmers still follow the shifting cultivation system with no use of manure or fertilisers and do not have access to irrigation.

Shifting cultivation restores nutrients to the soil during the fallow period. An under shifting cultivation is cleared by cutting down standing vegetation and burning the site (slash and burn) before it is cultivated. Farmers grow crops on a piece of land for a few years and then leave it fallow for 10 – 20 further years. Crops are rotated every 2-3 years. With the current system, a farmer requires at least 3 ha of land, approximately one third of which is used for crops while the remaining land lies fallow.

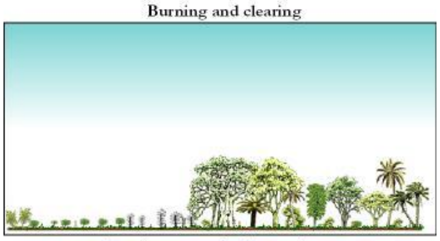
As a result of the large-scale exodus of people during the civil war, most of the *machamba*s were left fallow for several years. After the war, people returned to fertile soil. Howell and Convery (1997) point out that this new generation of farmers had little knowledge of traditional agricultural practices. Most current agricultural farms were set up in recent years and none of the farmers has had need to abandon any *machamba*s. *Machamba*s in wards in Chicale *Regulado* have now been worked for between 5 and 15 years and are likely to be worked longer as land conversion pressure increases (Ryan 2009).

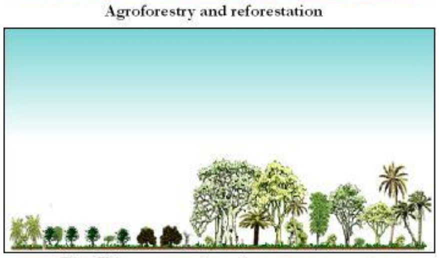
The project is designed to both restore land degraded through shifting cultivation and reduce pressure on remaining woodland through the planting of nitrogen fixing trees to enrich the soil. This is illustrated in the figure below:

[10] Linking the Future of Environmental Flows in the Zambezi Delta – Daniel Thá and Danny Seger 2008 and is based on the 2007 Census and the household questionnaire conducted by its authors


Pristine miombo forest


Burning and clearing


Agroforestry and reforestation


Plan Vivo community carbon management

Community forest, management and natural resources

The forest inside the community boundary is owned by the whole *Régulado* as a common resource which can be used by community members for subsistence purposes. If members of the community want to utilise forest products for a commercial purpose, e.g. making charcoal or selling timber, then she/he has to acquire a licence from the district administrator. The forest outside the community boundary and within the National Parks is managed by the Provincial Forest Department and the Ministry of Tourism.

All natural resources are managed as common property resources, although once a piece of land has been allotted for agriculture, it is de facto privatised. In the project regions, experience has shown that people have a very good idea about who owns all agricultural land including that which has been fallow throughout the war. People have returned to claim land where secondary forest cover has grown in the 20 years since they left but they still are conscious of where their land boundaries are. The *Régulo* (see section 1.6) normally recognises such claims.

The forest provides many resources such as firewood, medicines, construction materials, grass, roots and tubers, fruits and nuts, bush meat (baboons, rats, gazelles), honey and wax. Women spend a large part of their time collecting firewood. O'Keefe et al (1984) estimated firewood consumption for savannas to be 1.1 to 1.7 m3 per year per person and the population is steadily growing. Some of the woodland was high graded.

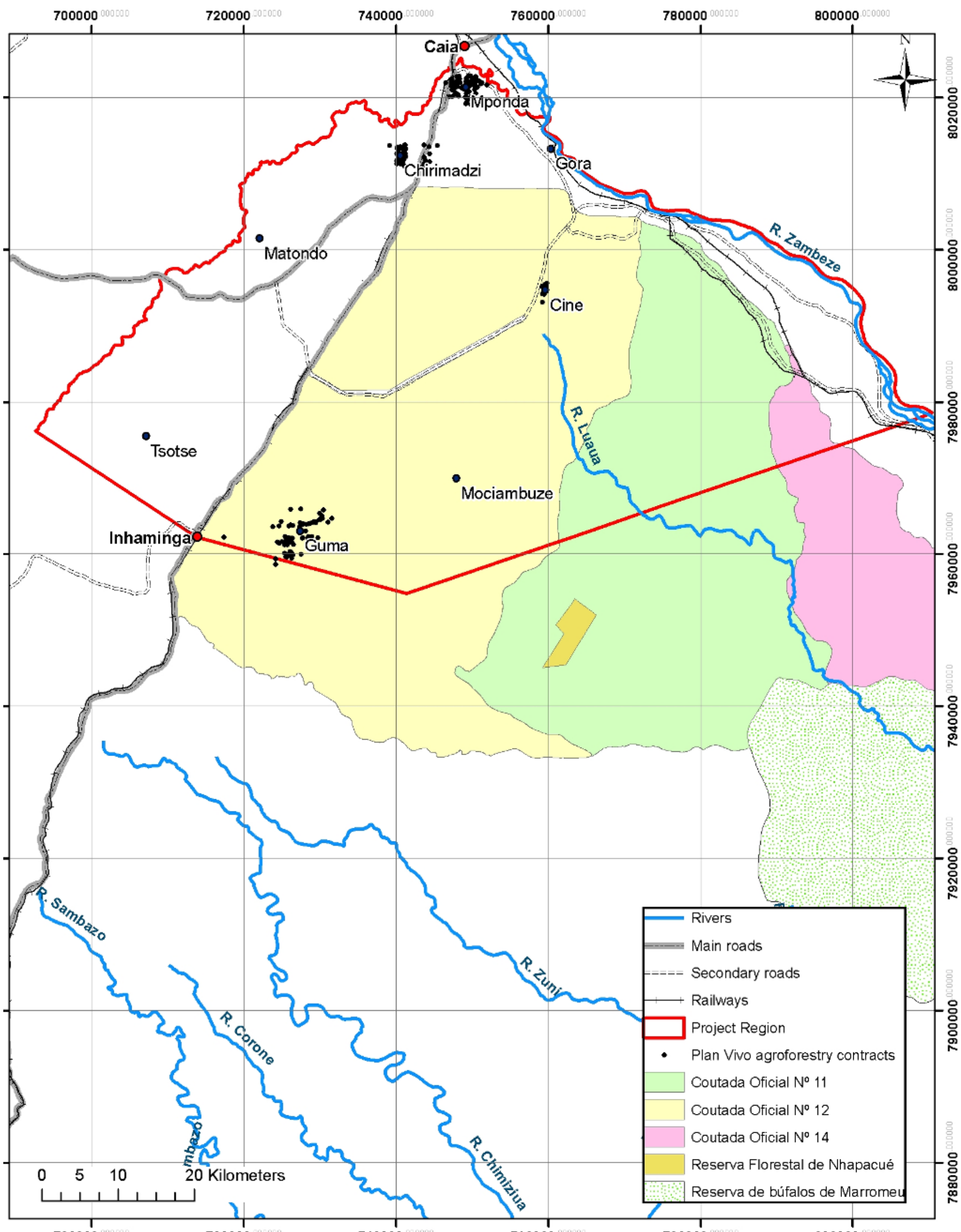


Figure 15. Land use in Zambezi Delta site. Logging and hunting concessions (*Coutada*) are present in the project region. The Plan Vivo contracts with respect to the concessions are also shown.

in earlier times in Gorongosa site but there are currently no large scale, commercial logging activities there. In Zambezi Delta there are a number of licensed commercial logging companies operating such as Concessõe TCT Catapu (figure 12).

The DUAT

The *direito de uso e aproveitamento da terra* (state-granted land right) is currently Mozambique's single form of land tenure right. It is exclusive, inheritable and transmittable (subject to state approval). Irrespective of the means through which it is acquired, the resulting DUAT right is exactly the same.

DUAT's can be acquired by:
1. Recognition of long-standing occupancy

a) customary (traditional) occupation: the occupation of land by individual persons and by local communities, in accordance with customary norms and practices, so long as these do not contradict the Constitution;

b) good faith occupation: the occupation of land by individual national persons who have been using the land in good faith for at least ten years;

2. Award on a concessionary basis
c) award: new rights to land, awarded with the authorization of an application submitted by an individual or corporate person (renewable 50-year state leasehold).

From - IMPROVING TENURE SECURITY FOR THE RURAL POOR : MOZAMBIQUE – COUNTRY CASE STUDY; Simon Norfolk and Christopher Tanner ; LEP Working Paper # 5 Workshop for Sub-Saharan Africa; 2007

Community management of fire in the forest has a long history in Africa well documented in other literature[11]. The vegetation differences mean that the burn and therefore management regime is different between different sites. In Gorongosa site most areas will burn every 1 to 3 years while in Zambezi Delta some areas have not burned for over 10 years and when they do they are small brush fires.

Fishing is an important activity with 39% of households fishing on a regular basis in the Zambezi Delta. Charcoal making is not as prevalent in the Zambezi Delta region as in the Gorongosa region. *Regulado* Mucombezi (see Figure 2 page 4) has been heavily degraded for charcoal.

Land tenure.

While all land in Mozambique is owned by the state, since the introduction of the **New Land Law** (Lei de Terras, July 1997), communities can claim land-use rights on traditional lands on which they have lived for at least ten years. These land use rights are linked to the Community DUAT (see text box).

The state grants use rights to individuals, communities and companies in the form of leases that can last up to 100 years. These leases can be transferred but not sold or mortgaged. Use rights emerge either through occupancy or by a specific grant through the state. The government can issue land-use rights documents to individuals, companies or entire communities and groups, although those who occupy the land for more than ten years acquire permanent use rights without the need for title documents. This particularly benefits peasants and returnees who often do not possess actual title documents to prove their occupancy of land. One of the land law's mechanisms, for improving the rights of those who lack title documents, is the requirement that courts accept verbal evidence from community members regarding occupancy of land. This acceptance of verbal evidence is particularly important because of the high level of adult illiteracy among Mozambican peasants and returnees.

The law also protects the rights of small landholder returnees against the often conflicting claims of large landholders by creating requirements for development plans before the issuance of title. The government will grant 100-year use rights two years after issuing title but only when there is evidence that the development plan is actually being carried out on the land. By requiring a development plan, the law diverts the intentions of high officials who registered land speculatively in the past with the expectation that they

[11] Laris, P. and D. A. Wardell (2006). "Good, bad or 'necessary evil'? Reinterpreting the colonial burning experiments in the savannah landscapes of West Africa." The Geographical Journal **172**(4): 271-29

would sell the land for high profits when the government eventually submitted to foreign investment pressure and privatized land.

Using this law, in *Régulados* with DUAT's all the land in the *Régulado* belongs to the community as a common property resource while the *Régulo* (see section 1.5) and other local leaders have the power to allot small pieces of land to various families for subsistence farming. In the pilot to the EU phase the Project worked closely with a Mozambique registered NGO (ORAM) and the community to register the Chicale community's legal status in terms of Mozambique land law. The Mucombezi Régulado have also acquired a DUAT and formed a community association. In Zambezi Delta site, the Mponda *Regulado* have a DUAT.

A person who wishes to set up a new *Machambas* approaches the local Fumo or *Régulo* and requests for his permission. In Nhambita, where the *Régulo* is based, most people go directly to the *Régulo* to ask permission for a new *Machamba*. Once the permission has been granted to set-up a new *Machamba*, the family is free to clear the forest around the specified area and build its house and plant crops in the field. Although no written records are kept of the transaction, most community members respect this verbal agreement and the particular *Machamba* is de facto privatised. Permission to set-up a new *Machamba* can be given to people both from inside the community and those who come into the community and settle. In the post-civil war years, most of the people that came back to the Régulados were original inhabitants of the area who had migrated to nearby cities during the war. There is also immigration into the project region.

The most detailed immigration data in the project region has been collected in Nhambita, Munhanganha and BoeMaria which have been part of the project since the pilot to the EU phase. Immigration in this area peaked in 1996 as migrants settled after the war. Main causes of immigration today into the project areas are the availability of land, the presence of relatives and the good quality forest[12]. New people have also arrived to work in the Gorongosa national park.

Conflict management

To prevent conflicting land claims created by overlapping issuance of title, the New Land Law prevents the state from granting new occupation rights when others already hold use title over the land in question. To prevent incidences where one agency grants land rights over a certain property while another agency grants land rights to someone else over the same property, the law creates a more structured system for delegating power to grant titles for land use in particular areas. The law also provides that titles identify the scope of the land occupied. When conflicts emerge about which claims over a certain piece of land are legitimate, the new land law provides court remedies that take into account the verbal testimonies of community members.

One of the most important provisions of the new law is an increased role traditional leaders as well as the formation of official resource management communities composed of local people. Local communities exercise considerable discretion in the management of natural resources, resolution of conflicts, the implementation of titling processes and the definition of the limits of land they occupy. This provision allows the use of local customary law in determining local land-rights policies. Furthermore, to determine whether the land in question is occupied, the state must consult local authorities before granting leasehold titles that last up to 50 years. However, the July 1997 Land Law contains a provision that seeks accountability from local authorities by requiring that they give a legal statement that specifies "the representation mechanisms" of their local communities. Community associations for resource management are set up during or prior to the DUAT process. They are democratically elected and in charge of ensuring the responsible use of communal natural resources.

[12] Rohit 2008, Pg 369 Final report available at www.miombo.org.uk

Ongoing or unresolved conflicts or disputes

There are no land-use conflicts within the communities because there is sufficient land available for all to use. However, there is resentment about exclusion from use of the Chicale *Regulado* that falls within the Gorongosa National Park boundary. Most of the people that have returned are refugees who fled the regions or their families and dependents that have grown up outside the regions.

Land tenure and carbon

The project has sought legal opinion on the land law in Mozambique and its impact on Plan Vivo carbon rights. The following table summarises the findings:

Event which conflicts with communities ability to own and sell carbon rights	**Legal defence available**	**Course of action and contact for instigation**
Logging concession sold in community carbon conservation area.	Law requires full community consultation in the event of non DUAT and approval in DUAT areas	Community Association have legal recourse against authority that by-passed them in granting concession.
Commercial farming concession sold ontop of agroforestry contract	Law requires full community consultation in the event of non DUAT and approval in DUAT areas	Community Association have legal recourse against authority that by-passed them in granting concession.
Illegal logging in community carbon conservation area.	Punishable under law.	Community Association report to Chef de Post and Administrator for action.
Land dispute between two relations over one machamba with a plan vivo contract.	First level of dispute resolution through traditional leaders, second level through Chef de Post.	Trigger dispute resolution procedures.
Death of a contract holder.	Mozambique Laws of Inheritance	Inheritance
Government intervention programme which collectivises and agriculture across machamba boundaries.	DUAT and traditional land rights which amount to a DUAT give community legal protection but issue would be a political one.	Legal challenge through courts
Legal charcoaling in community conservation areas in buffer zone/outside buffer zone	Commercial extractive practices not legal in the buffer zone, licences to be issues by Forestry Department subject to approval by Community Association	Licensing procedures under Forestry Regulations
Illegal charcoaling (without a licence) in community carbon conservation areas, in buffer zone/outside buffer zone.	Commercial extractive practices not legal in the buffer zone, licences to be issues by Forestry Department subject to approval by Community Association	Prosecution by Forestry Department
Shifting agricultural incursion into community carbon conservation area.	Legally constituted Community Association would have authority if land use plan registered with the government to prevent access supported by the law.	Criminal prosecution by authorities.
Death of the community association leader.	The authority of the person rests not in his or her legal persona but in the office held	New election
Death of the Regulo	Succession	n/a
Purchase of the land duat by a third party	Sub-DUAT's must be granted by DUAT holders	Legal recourse
Nationalisation of carbon sales	Contracts enforceable by law.	Legal challenge in court

The DUAT process is at different stages in the different *Régulados* under the project areas. The table below summarises whether a community has a DUAT and or a community association responsible for natural resource management. Currently the project will not create REDD areas in communities which do not have DUATs as their legal status is less certain.

COMMUNITY	LEGAL ASSOCIATION	BANK ACCOUNT	LAND DUAT	COMMUNITY ASSOCATION
CHICALE	Yes	Yes	Yes	Yes
MUCOMBEZI	Yes	Yes	Yes	Yes
GUMA	No	Yes	No	Yes
MATONDO	No	Yes	No	Yes
CHIRIMADZI	No	Yes	No	Yes
MPONDA	No	Yes	No	Yes
GOMBE-GOMBE	No	No	No	No
GORA	No	Yes	No	Yes
CINE	No	Yes	No	Yes

Figure 16. Land tenure and DUAT process in different *Regulados* in the project area.

Biodiversity Information

G1.7. A description of current biodiversity within the project zone (diversity of species and ecosystems) and threats to that biodiversity, using appropriate methodologies, substantiated where possible with appropriate reference material.

Diversity of woody species and ecosystems in the project regions

Two hundred and seven trees have been found during inventories of the project areas. All of these trees have been identified by Meg Coates-Palgrave, author of Trees of Southern Africa. An initial survey of 2003 assessed the different land cover and vegetation types resembling distinct ecosystems and have been characterized through the Shannon index (H'):

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

where S is the number of species, p_i is the relative abundance of each species calculated as $p_i = n_i/N$, where n_i is the number of individuals in each species and N is the total number of individuals.

This biodiversity indice shows the highest biodiversity values to be in the Riverine woodland as per the following table:

Land cover and vegetation types	Shannon index
Tropical (miombo) woodland	2.0 ± 0.4
Savannah	1.2 ± 0.5
Riverine or riparian forest	2.2 ± 0.5
Secondary Woodland	2.1 ± 0.6

Table 1. Shannon index of the different land cover and vegetation types in the project regions to estimate biodiversity.

Conservation programmes

The GNP very rich in biodiversity[13] birds are particularly most famous, there are about 600 species. The wildlife in the area is recovering from years of Civil War (1981-1994). The park management are currently carrying out a restoration programme of buffalo, wildebeest and elephant.

The GNP and Marromeu national parks hold many large mammals and reptiles such as hippos, Nile crocodiles, lions and zebra in small numbers.

Threats to biodiversity and ecosystems

The recent history of miombo woodland loss in central Mozambique provides strong evidence that additional efforts to protect this habitat are required, to protect this ecosystem. While some protection is given to designated areas, i.e. Nature Reserves and National Parks, there is strong evidence that further efforts are required to conserve the remaining fragments of miombo woodland inside and outside of these designated areas in order to maintain biodiversity corridors and step stones in central Mozambique.

The key drivers for miombo degradation and deforestation are:

- ***Encroachment – land clearances for agriculture:*** This is observed to occur throughout and beyond the project regions, in particular in the plains with water access.
- ***Charcoal production:*** Informal charcoal production is often cited as the key driver of deforestation throughout sub-Saharan Africa. There are specific local markets for charcoal, e.g. at Beira, Chimoio, Gorongosa, Caia and Inchope. Herd (2007) discovered that the majority of charcoal production occurs within a 2 km wide corridor along main roads in the project region.
- ***Wild fire:*** Prior to the introduction of a fire management regime (which commenced within the managed area in 2005) almost the entirety of the Gorongosa site were burned annually (by uncontrolled fires). Frequent burning will prevent natural regeneration (and hence stand recovery) and the accumulation of carbon both in biomass as well as in the soils.
- ***Logging:*** The majority of selective logging, cherry picking of the most valuable timber tree species occurred within these areas prior to the 1980's. In Zambezi Delta there are a number of logging concessions, proximity to saw mills may relate to an incentive to log outside of these areas. Remaining large trees are still be targeted in particular in along the vulnerable riverine areas.

*G1.8. A*n evaluation of whether the project zone includes any of the following high conservation values (HCV) and a description of the qualifying attributes:

63.7 % of the Sofala Community Carbon Project's area should be considered High Conservation Value Forest (HCVF), as set out by the ProForest HCVF-toolkit. Four different forest types were considered of High Conservation Value (HCV):

[13] http://www.gorongosa.net/en/page/florafauna/flora-and-fauna

- High biodiversity closed canopy forests, such as gallery/riverine forests and dry tropical forests
- Protected areas (Inhamitanga Forest Reserve)
- Woody vegetation on steep slopes
- Culturally important areas

The key management recommendations are to limit deforestation and degradation of these areas, and potentially to restore or encourage tree growth in some gallery forest and steeply sloping areas that have been degraded.

The ProForest High Conservation Value Forest (HCVF) toolkit is designed to enable forest managers to rigorously define the areas of forest within their project which have the highest conservation value. It also sets out guidelines as to how to monitor, conserve and enhance the conservation value of these HCVs. We applied this toolkit to the Sofala Community Carbon Project and surrounding areas in order to delineate the forested areas that are key to maintaining and enhancing the conservation value of the project.

The HCVF framework identifies six High Conservation Values (HCVs) that a forested area could potentially contain. Having any one of these HCVs is sufficient to award a forested area HCVF-status. In summary these six HCVs are:

HCV 1: Globally, regionally or nationally significant concentrations of biodiversity values (subcategorised into protected areas, rare or threatened species or endemic species).

HCV 2: Globally, regionally or nationally significant large landscape level forests

HCV 3: Forests that contain rare, threatened or endangered ecosystems

HCV 4: Forests that provide basic services of nature in critical situations (e.g. acting as fire breaks, to prevent erosion or to protect water catchments)

HCV 5: Forests fundamental to meeting basic needs of local communities

HCV 6: Forests critical to local communities' traditional cultural identities

All the HCVs listed above can be found within the Sofala region. For example some of the Zambezi Delta project area is within a forest reserve, and therefore falls under HCV 1. The riverine forests fall under multiple HCVs as they are rare and threatened ecosystems (HCV 3), protect the water catchments (HCV 4.1) and prevent erosion (HCV 4.2), and in some cases provide water and other products to the local communities (HCV 5). There are other forested areas that are also HCVs, for example because they are on steep slopes and therefore fall under HCV4.2 (erosion control), or are culturally important sites (HCV 6).

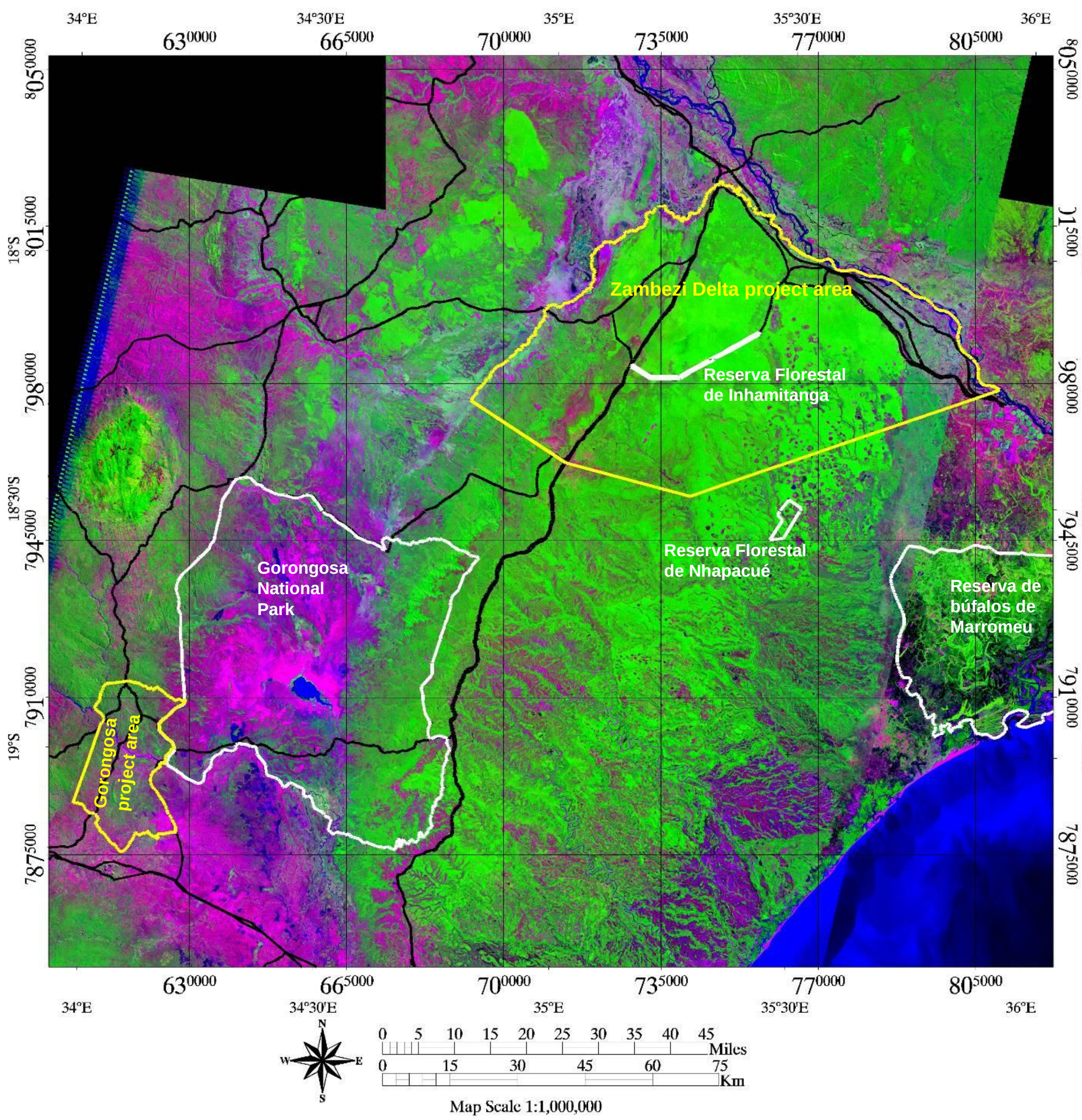


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Figure 17. Location of the Sofala Community Carbon Project (yellow), and the National Parks and Forest Reserves and national parks (white) in the surrounding area, over a Landsat ETM+ mosaic derived from images from 2003. The road network is also shown (black lines).

Methods to determine HCVs

The first step involved classifying and subdividing the whole of the area under SCCP management into different forest classes and non-forested areas. It was thought important to delineate forest areas in such as way as to be fairly homogeneous, such that they could be managed as one unit, but not too small to be manageable. In addition to classifications based on vegetation it was also important to consult with the local community so that socially and culturally important areas were correctly delineated.

To classify the area we therefore used an inclusive approach involving local field plots, discussions with community leaders, vector data giving roads, rivers, and national park boundaries, and radar and optical satellite data.

We used a network of 56 biomass sample plots measured 2004-2007 to produce a biomass map for the Gorongosa region using L-band radar data from the ALOS PALSAR satellite in 2007[14]. This map of biomass values is estimated to give local biomass readings correct to +- 20% for each 100m x 100m (1 ha) pixel. This is a considerably higher accuracy than could be achieved through optical data, as radar data responds to the three-dimensional structure of vegetation rather than its colour. However, unfortunately we do not have access to radar data for the whole region, and therefore aimed to use the radar data to train a classification procedure for the whole region using optical data. This would not be a biomass map, as producing this from single-date optical data would result in too low accuracies, but instead is a classified map dividing the vegetation into classes. The class boundaries were chosen based on the descriptions of vegetation cover and their corresponding biomass values from the field plots (see Table below).

Aboveground live biomass ranges chosen to define the different vegetation classes (note these are tonnes biomass not carbon; these numbers should be divided by two to give Mg C ha^{-1}). The biomass range of different vegetation covers were defined through a combination of inventories described in G1.2, and areas of of known vegetation cover in the project region.

Class	**Biomass range**
Closed canopy forest (riverine/gallery or dry tropical forest)	> 74 Mg ha^{-1}
Miombo woodland (open canopy)	28 – 74 Mg ha^{-1}
Savanna woodland or fallow machamba	10 – 28 Mg ha^{-1}
Machambas or grassland	< 10 Mg ha^{-1}
Waterbodies	0

Three Landsat ETM+ scenes from 2003 were atmospherically corrected, cross-calibrated and mosaiced together. Fifteen training areas were then chosen for each vegetation type derived from homogeneous areas of the radar-derived biomass map. Eight additional areas were also used, from 8 field plots measured in the Zambezi delta region in 2007. The classification was performed using a Forward Neural Network procedure using the software package ENVI-IDL (ITT Systems). It achieved an accuracy of 97 % when compared to the training data. There was obvious confusion evident with farmed regions, especially machambas, with some being classified in with the savanna woodland rather than grassland class. Given the optical data is from 2003 and only from one season there is not thought to be any way to improve the classification of the machambas, but given most high value forest will be for the higher biomass classes (miombo and closed canopy forests) this is not thought to be a major problem with the analysis. The classified map is shown on page 10.

Additional data was also needed to enable an assessment of which of the delineated forested areas within the project contain HCVs. These included the boundaries of protected areas (to enable assessment of HCV 1), species lists and consultation with ecologists with knowledge of the flora of the area (HCV 3), a digital elevation model (DEM), discussion with experts in the area on the importance of forests in preventing natural disasters and protecting water supplies (HCV 4), and information from the local communities about

[14] Mitchard, E. T. A., S. S. Saatchi, I. H. Woodhouse, G. Nangendo, N. S. Ribeiro, M. Williams, C. M. Ryan, S. L. Lewis, T. R. Feldpausch, and P. Meir, (2009), Using satellite radar backscatter to predict above-ground woody biomass: A consistent relationship across four different African landscapes, *Geophysical Research Letters*, 36, L23401.

which forested areas are essential to their local needs (HCV 5) and cultural heritage (HCV 6). Species lists were obtained from the SCCP, Gorongosa National Park and a local Field Guide[15]. The DEM was obtained from the NASA Shuttle Radar Tropography Mission (SRTM) data, which is a free global DEM at 90 m spatial resolution.

Results of HCV

In total 63.7 % of the area in the project was given HCV status. This is divided unequally among the two sites, with 16 % of the Gorongosa site being classified as HCVF (8,983 ha of the total 56,020 ha), compared with 69.6 % of the Zambezi site (317 325 ha of the total 455 552 ha) (Figure 3). A number of different HCVs were applied to four major classes of forest. Each of these are listed below, along with the area of each found in each of the SCCP-managed areas.

a) Closed canopy forests (riverine/gallery and dry tropical forests)

Gorongosa: 8394 ha *Zambezi delta: 316 998 ha*

Closed canopy forests occur in both sites. In Gorongosa they are mostly gallery/riverine forests, which occur across the area around the major rivers, their tributaries, and around seasonal rivers and streams. Their species composition is different to Miombo woodland, featuring a diverse range of evergreen species[16,17]. These forests are highly threatened from deforestation and degradation[18], as they contain the largest, least fire-damaged trees in the area, and the trees are thus often felled for construction, and also because they are often cleared for agriculture, as they exist on good soils with the best water security of any land in the area. In the Zambezi site in addition to gallery forests there is also a large expanse of dry tropical forest. In addition to having a closed canopy and much higher biomass value than the surrounding Miombo woodland, it has a far higher biodiversity and includes two species that are listed as 'vulnerable' under the IUCN Red List[19,20] (*Cola mossambicensis*
and *Sterculia appendiculata*). We are unable to confidently separate the dry tropical forests from gallery forests using this remote sensing methodology, hence why they are treated together here.

It is essential that these forests are preserved as they contain three different HCVs. Firstly they are the most threatened ecosystems in the landscape, and thus should be protected under HCV 3[5], with the case for inclusion in HCV 3 stronger for the Zambezi dry tropical forests due to the presence of two species classified as Vulnerable by the IUCN Red List. All these forests help protect and maintain clean water catchments, and it has been shown in other areas that removing such forests reduces the water-security of communities by increasing the chances of a river running dry and reducing its quality, placing the forests under HCV 4.1[21]. In addition, the gallery forests are well known to prevent erosion and thus help prevent flooding, a relatively common occurrence in this area where extreme precipitation events occur every 5-10 years, classing them under HCV 4.2. Finally these forests contain species not found elsewhere in the landscape, giving the communities access to medicinal plants, pollinators and nectar-sources for the bees kept by many farmers in

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[15] Meg Coates-Palgrave (Trees of Southern Africa)

[16] Project species list, developed by Meg Coates-Palgrave.

[17] Keith Coates-Palgrave, Meg Coates-Palgrave, 2003, 'Trees of Southern Africa', 3rd Edition, Struik Publishers

[18] This is based on consultation with people who have worked in the area and the reports by Envirotrade

[19] Meg Coates Palgrave, Nhagutu botanical transect, October 2009.

[20] The IUCN Red List of Threatened Species, www.iucnredlist.org, accessed 13th April 2010.

[21] J. M. Cardoso Da Silva & J. M. Bates, (2002), 'Biogeographic Patterns and Conservation in the South American Cerrado: A Tropical Savanna Hotspot', *BioScience*, 52: 225-233.

the area which would otherwise not be present. This means that those forest near local communities will also fall under HCV 5.

The tropical dry forests in the Zambezi sites are threatened from logging and agriculture[22], but are still relatively contiguous and undisturbed, contain high diversity and we believe represent a 'nationally significant large landscape-level forest', and therefore should be additionally considered as an HCVF under HCV 2. Contiguous large areas of high biomass forest are rare in southern Africa, and if the proejct can protect this area from degradation that will prevent much of the potential reduction in conservation value that could potentially occur in the area.

b) Forests and woodlands within protected areas *Gorongosa: 0 ha* *Zambezi delta: 1714 ha*

The Zambezi Delta project area includes the Inhamitanga Forest Reserve. This is a small reserve, extending 32 km along, and 250 m either side of, a road. As such it is very prone to deforestation, degradation and disturbance, and is severely threatened[9]. Being a nationally protected area it is automatically included as an HCVF under HCV 1. It contains the full range of forest types, from low biomass savanna woodland through miombo into dry tropical forest[9].

c) Forested slopes *Gorongosa: 552 ha* *Zambezi delta: 228 ha*

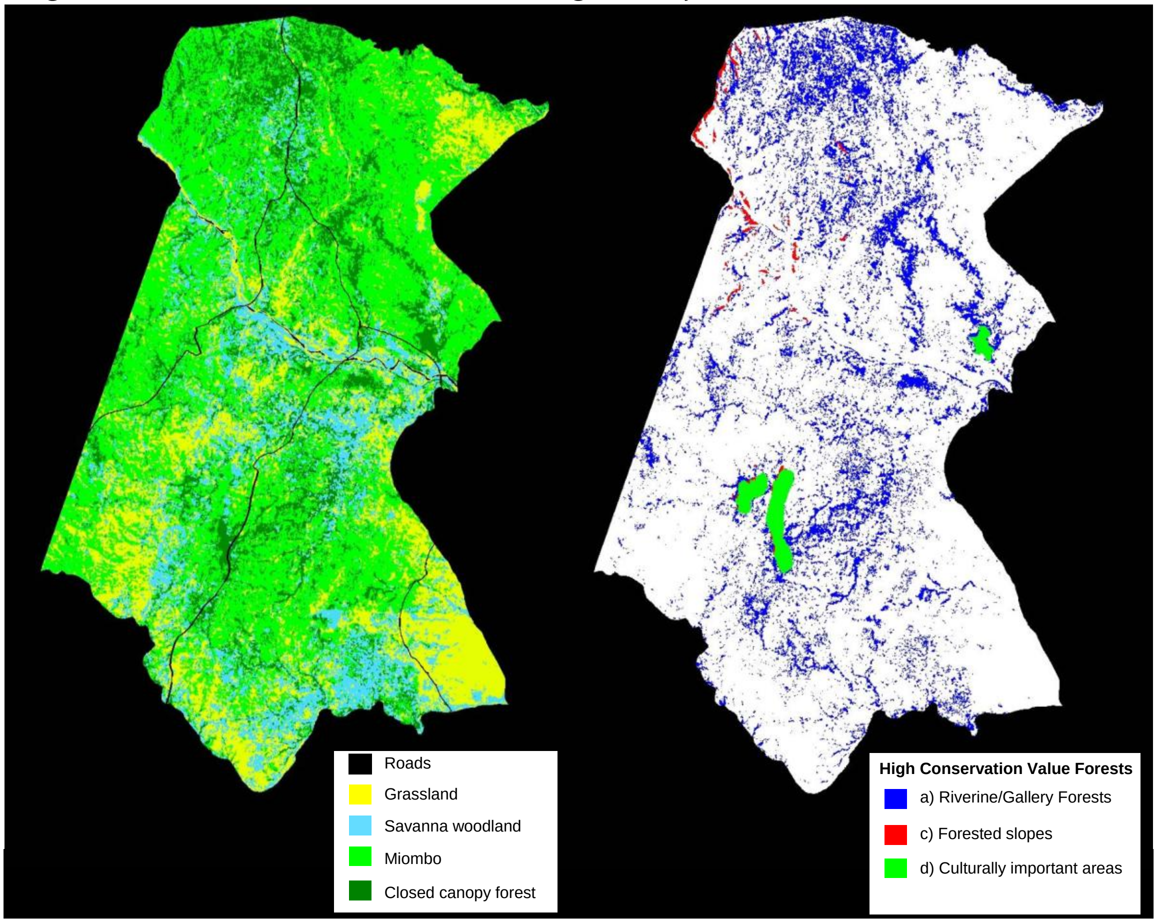
These are forested areas found on slopes of 15 degrees or more. The local communities have cleared some steep slopes in the area to use for agriculture in the past, so these are clearly not protected by the community alone. However it has been shown that this is not a good long-term use of the land as landslides are much more likely if a slope is used for agriculture rather than being tree-covered. Such areas have thus been delineated as HCVs under HCV 4.2.

d) Important traditional and spiritual sites *Gorongosa: 645 ha* *Zambezi delta: 0 ha*

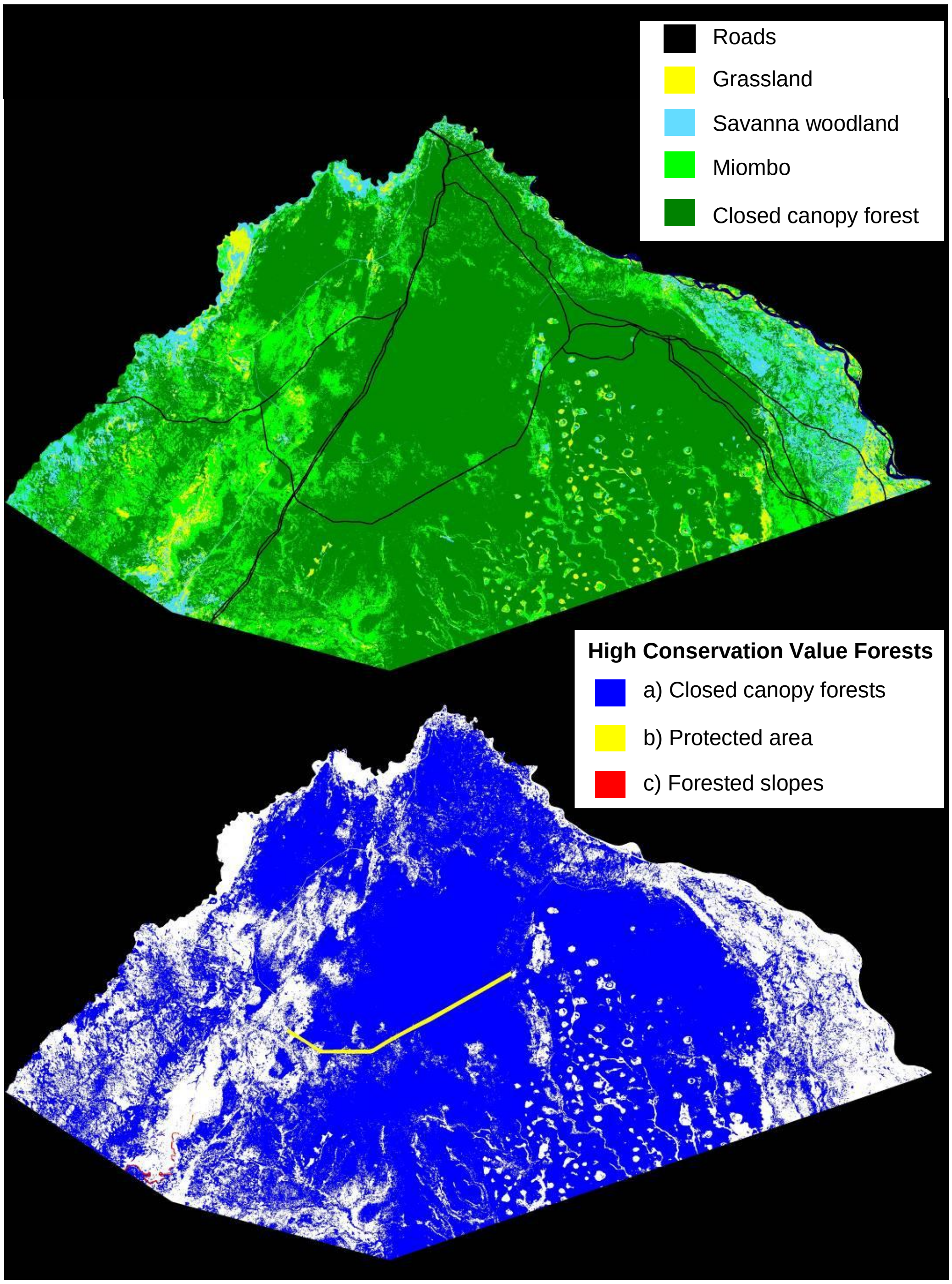
There are two areas in the Gorongosa project area that are important to the culture and spiritual identity of the local community: the mountains in Mucombezi and riverine forest in the drainage line of the Nhambita river, the *Guasha*. The mountains contain a spiritual lion and the *Guasha* is used for collection of traditional medicine, burial and ceremonies. Such forested areas are given high conservation status under HCV 6, and should be given the utmost protection from outside influence. Already the lion mountains have been dug into for gravel by a road construction company. It is probable there are forested areas in the Zambezi delta region that are also culturally important but further consultation is needed with the local community before they can be delineated.

[22] Thomas Müller, Almeida Sitoe and Rito Mabunda, 2005, 'Assessment of the Forest Reserve Network in Mozambique', WWF.

High Conservation Value Forests – Gorongosa Project Area



High Conservation Value Forests – Zambezi Delta site



Management recommendations

The primary aim of the management of HCVFs should be to ensure that their conservation value is maintained or increased. Nothing should be done that could risk reducing their conservation value. With this principle in mind the following management recommendations are made for each of the areas identified above.

a) Closed canopy forests

In the case of the gallery forests in the Gorongosa site, the project managers must stress to the local community how important these regions are to the biodiversity, ecosystem diversity, and water security of the area; it is also important to show how threatened they are. Felling of trees should not be entirely prevented, but should be performed only by the local communities and limited to below the most conservative sustainable harvesting level. Similarly the large expanse of high biomass forests identified in the Zambezi Delta sites must be protected from deforestation and degradation. Most of the area falls within national hunting reserves (Coutadas Oficials 11, 12 & 14): it is possible that the protection of the conservation value of this forest might be best maintained through a joint management plan with the managers of the hunting reserve: this possibility should be investigated. There should be monitoring of the two tree species identified as Vulnerable by the IUCN Red List assessment. This should not be seen as the only management priority for the Zambezi Delta HCVFs, as it is the whole forest ecosystem that needs to be preserved, and in all likelihood there are many more species that are just as, if not more, threatened, within the area. However an estimate of the population level and degree of threat of these species within the site could be a useful in developing an integrated management plan.

In the case of the gallery forests it is imperative that these forests are not cleared for agriculture or for any other purpose, apart from in exceptional circumstances agreed upon by the Project Manager and local community leaders. Ideally areas that used to be gallery forest but have since been degraded should be set on a path to restoration. An increase in the area of gallery forest within the SCCP over time should be one of the management objectives of the project, as it will greatly increase the conservation value of the area as well as the water security and flood protection of the local communities.

b) Forests and woodlands within protected areas

Inhamitanga Forest Reserve is severely threatened by deforestation and degradation. Its position directly along a road makes it acutely vulnerable. Management should involve fire protection as well as protection from logging, but will be difficult given its position. Discussing the matter with local communities may not resolve the issue as given the easy access to the reserve non-locals could be responsible for at least some of the degradation.

c) Forested slopes

It must be made clear to the local community that these areas should not be used for farming or cleared for any other reason, because the trees are essential for preventing erosion. These would be ideal areas for REDD management. There could also be some of these areas where attempts should be made to increase the tree cover, provided water is not thought to be a limiting factor, this is particulary relevant for the enrichment planting activities carried out in the REDD management. This should particularly apply to degraded or cleared slopes near settlements, or to slopes with a history of landslides. The carbon benefit of planting trees on such slopes are greater than on flat land because, by preventing landslides and erosion, less soil will be exposed to the atmosphere and its carbon oxidised and lost as carbon dioxide.

G2. Baseline Projections

G2.1. Describe the most likely land-use scenario in the absence of the project following IPCC 2006 GL for AFOLU or a more robust and detailed methodology, describing the range of potential land-use scenarios and the associated drivers of GHG emissions and justifying why the land-use scenario selected is most likely.

An historic baseline approach was used to anticipate the business-as-usual scenario assuming that deforestation and unsustainable land use would continue unimpeded across the project regions. The baseline for REDD was determined using satellite analysis of past deforestation rates combined with the most likely land use in absence of the project. The baseline for agro-forestry was determined using the most likely carbon sequestration rate in absence of the project for the system in question.

REDD baseline

For the REDD Plan Vivo technical specification a detailed analysis of deforestation rates was carried out by the University of Edinburgh in the project regions and surrounding areas based on satellite imagery time-series analysis (see section G2.3 for a detailed description). The analysis found that the annual deforestation rate is 2.4% per year and, in the absence of the project, it can be expected that the forest would disappear within 43 years. The figure below shows the speed of deforestation depending on the deforestation rate.

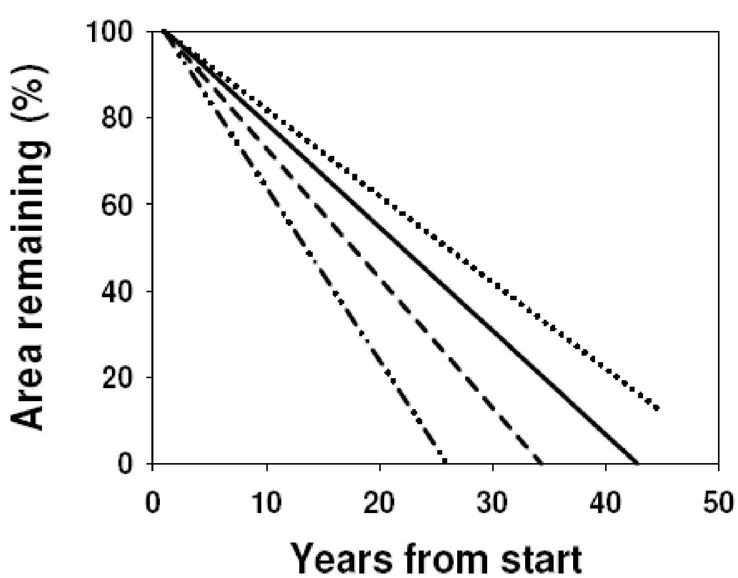


Figure 18. The solid line shows the decline in woodland area based on 'business as usual'; the dotted line shows 2 % per annum deforestation, the dashed line shows 3 % and the dashed and dotted line to the right shows 4 % deforestation.

The main deforestation threat in the project region is clearance for agriculture. Biomass found on a typical *machamba* is therefore considered the baseline biomass per hectare in the project region. An investigation in 2009, showed the biomass on a typical machamba to be 2.77 tC/ha[23].

Agro-forestry baseline

[23] Claire Ghee, Master's thesis at the University of Edinburgh assesses the success of pigeon pea intercropping.

The agro-forestry baselines were determined as per the technical specifications[24] written by Edinburgh Centre for Carbon Management for the project region. They incorporate information from a survey[25] carried out on growth rates of trees in the Chicale *Regulado* and can therefore be considered tier 2 under the IPCC guidelines.

Likely fallow period was used to determine how much carbon would be sequestered in the absence of the project. The longer a site will be left fallow the higher the baseline will be. Biomass accumulates in Miombo in the project region at a rate of 1.1 t biomass / ha / yr was found in fallow sites. This corresponds to 0.55 tC / ha / yr.

The baseline for dispersed interplanting, boundary planting and homestead planting is zero. These activities are not happening in the baseline due to financial and technical barriers and would not otherwise occur. It is assumed that dispersed interplanting and boundary planting will primarily be used on cropped land (where the carbon sequestration rate is considered to be negligible) and homestead planting which will largely be on bare ground surrounding the house.

The baseline for the fruit orchard systems (cashew and mango) is 2.8 tonnes of carbon per hectare. This calculation is based on the average accumulation of biomass in sites which have been fallow for between 0 to 10 years. This is the assumed without project activity on land which is converted to fruit orchard. It is a conservative assumption as increasing land pressure in the region will lead to shortened fallow.

The baseline for the woodlot system is 11.3 tonnes of carbon per hectare. This calculation is based on the average accumulation of biomass at sites which have been fallow for between 11 to 30 years, the assumed baseline activity. This is considered conservative for the same reason as fruit orchard.

The baseline for not burning agricultural residues is assumed to be 9.6 $tCha^{-1}$ which is the organic soil carbon content on sandy granitic soils after clearance for conventional agriculture (Zingore et al. 2005).

Technical specification – summary of expected baseline carbon stocks.

Land use system	Baseline $tCha^{-1}$
Intercropping (*Faidherbia* or *Gliricidia*)	0
Boundary planting	0
Fruit orchard (cashew or mango)	2.8
Homestead tree planting	0
Woodlot	11.3
No burning of agri-residues	9.6

Figure 19.

As more research is carried out in the project region, both the agro-forestry and REDD baselines may be updated and improved. This research is already under way.

[24] Nhambita Carbon Crediting Technical Note available www.miombo.org.uk

[25] Sambane, E. (2005). Above Ground Biomass Accumulation in Fallow Fields at the Nhambita Community - Mozambique (Evelina Sambane 2005)

G2.2. Document that project benefits would not have occurred in the absence of the project, explaining how existing laws or regulations would likely affect land use and justifying that the benefits being claimed by the project are truly "additional" and would be unlikely to occur without the project.

A barrier analysis has been carried out to help in understanding why the project activities have not been adopted prior to the project start.

Financial barrier: Farmers in the region do not have access to capital to invest in agro-forestry or forest management. Only by providing carbon revenues, which are partly distributed upfront, can farmers receive the financial means for implementing the proposed alternative land-use activities. Project costs are presented below, highlighting the substantial investment demand to adopt sustainable land management practices. Implementation costs for alternative land use activities.

Costs for implementing	**Establishment costs (year 1)**	**Maintenance costs (year 2-5)**
Boundary planting	25 $/100m	10 $/100m/year
Dispersed interplanting	145 $/ha	62.5 $/ha/year
Fruit orchard with cashew	480 $/ha	200 $/ha/year
Fruit orchard with mango	520 $/ha	200 $/ha/year
Homestead planting	480 $/ha	200 $/ha/year
Woodlot	1,100 $/ha	430 $/ha/year
Forest protection	Loss of income from forest protection comes from not cultivating land, extracting fuel wood or timber or live plants and controlling forest fires are significant but have not been quantified	

Note: the above costs include the purchase of seedlings and the time the farmer would spend on establishment and maintenance of the trees.

Capacity barrier: In the absence of the project, farmers would not have adequate knowledge and skills to restore agricultural productivity by adopting agro-forestry, mulching or other sustainable land management practices. Similarly, shifting cultivation would still be the main method for providing agricultural land suitable for feeding the family.

Compliance with land law: After the land law of 1997 all land is owned by the state but the rights of communities to use the land are respected[26]. According to the existing land law, it is not forbidden to clear forest for establishing *Machamba*s in the buffer zone of the national park, the carbon contract protects the forest from conversion (*Muteia* 1997) to *machamba* and is respected legally through the same land law.

G2.3. Calculate the estimated carbon stock changes associated with the "without project" reference scenario described above. This requires estimation of carbon stocks for each of the land-use classes of concern and a definition of the carbon pools included, among the classes defined in the IPCC 2006 GL for AFOLU. The timeframe for this analysis can be either the project lifetime (see G3) **or the project accounting period**, whichever is more appropriate. Estimate the net change in the emissions of non-CO2 GHG emissions such as CH4 and N2O in the "without project" scenario. Non-CO2 gases must be included if they are likely to account for more than 5% (in terms of CO2-eq.) of the project's overall

[26] DFID 2008. http://www.dfid.gov.uk/casestudies/files/africa/mozambique-land-laws.asp

GHG impact over each monitoring period. Projects whose activities are designed to avoid GHG emissions (such as those reducing emissions from deforestation and forest degradation (REDD), avoiding conversion of non-forest land, or certain improved forest management projects) must include an analysis of the relevant drivers and rates of deforestation and/or degradation and a description and justification of the approaches, assumptions and data used to perform this analysis. Regional-level estimates can be used at the project's planning stage as long as there is a commitment to evaluate locally-specific carbon stocks and to develop a project-specific spatial analysis of deforestation/degradation using an appropriately robust and detailed carbon accounting methodology before the start of the project.

The accounting period for both REDD and agro-forestry systems is 100 years. The average sequestration rate per hectare of land under each technical specification is estimated over 100 years and entered into a carbon calculator developed by ECCM. The area size under each system therefore is used to determine sequestration potential in the project. The method of carbon baseline estimation which goes into the calculator depends on whether it is a REDD or a agro-forestry system Both will be described here.

Carbon pools included in the stock calculations

Carbon pool	Included/excluded	Comments
Above-ground biomass	Included	Local allometric defined for estimation of above ground biomass from diameter at breast height.
Below-ground biomass	Included	Local ratio of above ground to below ground biomass defined
Dead wood	Excluded	In the with project scenario like to be increasing as woodlots and boundary planting can be used for firewood
Litter	Excluded	Small proportion of total biomass is expected to be less than 1%
Soils	Excluded - with exception of no burning calculation	Exclusion in agro-forestry and REDD calculations is very conservative as 40% of soil carbon is expected to be lost as a result of deforestation (Walker and Desanker 2004[27]), over two thirds of the carbon is expected to be found in the soil (Ryan 2009[28]). Further in agro-forestry there is a strong relationship between increased soil organic carbon and inputs from tree leaf litter particularly as sandy granitic soil like the project zone (Chivenge et al., 2006[29]). Soil carbon pool is the only pool included for calculation of incorporation of otherwise burning of agri-residues as this is the most significantly affected pool

[27] Walker, S. M. and P. V. Desanker (2004). "The impact of land use on soil carbon in Miombo Woodlands of Malawi." Forest Ecology And Management 203(1-3): 345-360.

[28] Ryan, C. (2009). Carbon cycling, fire and phenology in a tropical savannah woodland in Nhambita, Mozambique. GeoSciences Department, University of Edinburgh. Doctor of Philosophy.

[29] Chivenge, P. P., H. K. Murwira, et al. (2006). "Long-term impact of reduced tillage and residue management on soil carbon stabilization: Implications for conservation agriculture on contrasting soils." Soil and Tillage Research 94: 328–337.

Carbon pool	Included/excluded	Comments
		by the project activity.
Harvested wood products	Excluded	8% of the maximum sustainable yield of the Chicale *Regulado* (Falcao 2007[30]) has been removed by the community saw mill. As this is below the maximum sustainable yield derived from an inventory of the Chicale woodlands it is expected not to have a net impact on carbon stocks.

Reducing emissions from deforestation and degradation.

Key drivers for deforestation

The main drivers of deforestation are agricultural encroachment and charcoal manufacture (Herd 2007). The former is caused by the increase in population, in turn resulting from by immigration in the last ten years. The; the latter results from an increased demand for charcoal by the nearby urban population, most notably in Gorongosa. The population increase in Chicale *Régulado* has been quantified by Rohit Jindal in 2004 and the project in 2009 as 2.91% per year.

Burning and logging also are significant drivers of deforestation in the region. Prior to the introduction of a fire management regime in Chicale by the project in 2005, most of the zone was affected by uncontrolled fires every year. Frequent burning hinders regeneration (hence stand recovery) and thus reduces the accumulation of carbon in biomass and soils, annual burning will eventually lead to the formation of grassland[31]. Although many of the most valuable timber trees in the Chicale *Régulado* were harvested prior to the 1980s, logging remains a key threat to the remaining woodland.

Impact of population growth

Detailed information has been collected for population growth in Chicale *Regulado* which is where the REDD is being implemented. The population is known to have surged between 1990 and 2000, with peaks in 1997 and 1999, when some 126 additional households arrived in the area (EU final report 2009). The process of immigration has continued, albeit at a lower rate, with 3 to 5 households joining each year between 2004 and 2009 years. Since 2004, the number of households has increased by 1.7% per a year in 3 wards of the Chicale *Régulado*[32]. No emigration has been noted. At the same time, household size has grown significantly from 4.2 to 5.9 and, with 1092 households in Chicale *Régulado*, the population size is estimated to be 6,449 distributed over 14,228 ha. The annual population growth, between 2004 and 2009, was 2.9% per year, much higher than the average for the country as a whole, which is estimated as 1.79 % (CIA 2008). When the population growth rate of 2.9% per annum is modelled again the current agricultural land available (11,927 ha) relative to forest land (39,473 ha) (as derived from the SPOT 2007 imagery), total forest loss has been modelled to be between 30 and 40 years. Extraction rates per capita do not include charcoal[33] in this scenario but do include firewood use and agricultural land requirement.

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[30] Falcao, M. (2007). Area comunitária de inventário florestal, provincia de Sofala, Trabalho realizado pela miombo consultores, lda.

[31] Burning will cause the gradual conversion from woodland to grassland where there is annual fires leaking from hunting and agricultural activities[31].

[32] Paper copies of this are available onsite, and include GPS locations, gender and relationship of household member. Baseline 2004 data taken from a master thesis carried out in 3 wards of the Chicale *Regulado*.

[33] „Modelling deforestation rate on population size, John Grace"

Probability of deforestation in relation to towns, roads and slopes: Wallentin (2006) used Landsat imagery to examine the onset of deforestation in the period 1991-2000. This was an important period, coinciding with immigration of households into the community. The survey covered the towns of Gorongosa and Inchope and the intermediate rural areas, some of which in 1991 were relatively unpopulated. From this, the probability of deforestation could be assessed and related to proximity of towns and roads (see following figure).

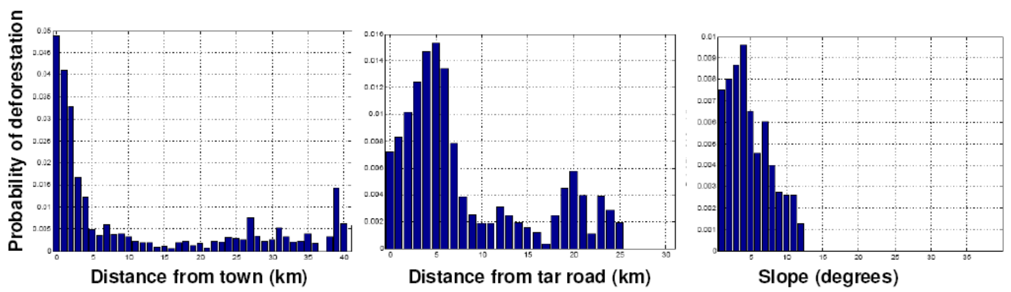

Figure 20. Probability of deforestation in relation to towns, roads & slopes (Wallentin 2006).

It is apparent that the relationship is strong but confounded by several factors, the most important of which is slope. An attempt to build a statistical model to predict deforestation was not successful and we were able to explain only 17% of the deforestation using the available drivers. At present, it seems unwise the use a probabilistic model. The 83% unexplained difference is probably attributable to variation in population size, age of residents and the specific traditional practices within the villages, as also suggested by the later study covering the period 1999-2007. In this study, large differences are seen between the villages. A new factor, which arose in this period, is the use of charcoal manufacture; this practice contributes to deforestation along roads and is driven by external factors, notably the growing affluence of the urban population (Herd 2007).

REDD baseline and carbon stock estimation

At all times the project has followed the Plan Vivo standards. These and the technical specifications have evolved. As the project has improved its knowledge of the systems and drivers of deforestation in the area, the REDD modelling has improved. In 2006 when REDD management was first introduced 73.3 tCO_2ha^{-1} was used to calculate carbon credits based on the expert judgement of the ECCM and the University of Edinburgh. Since 2009 a REDD technical specification superseded this conservative estimate.

Local calculation of deforestation rate in Gorongosa project site based on historic data for REDD technical specification.

SPOT satellite imagery from 1999 to 2007 was used to analyse the historic deforestation rate. The future scenario based on the conservative assumption that the deforestation rates are constant in the future. Currently REDD is only applied in the Gorongosa site - which is where the analysis of deforestation in the project region is therefore focused. REDD will also become part of activities in Zambezi Delta site, at which point a new technical specification will be written.

A detailed description of the methodology applied is provided in the Final report of the EU funded Nhambita Pilot Project (later the Sofala community carbon project), which was published in September 2008 (see Chapter on "Analysis of Land Use Change using SPOT images"). It is also detailed in the Avoided deforestation technical specification currently in peer review.

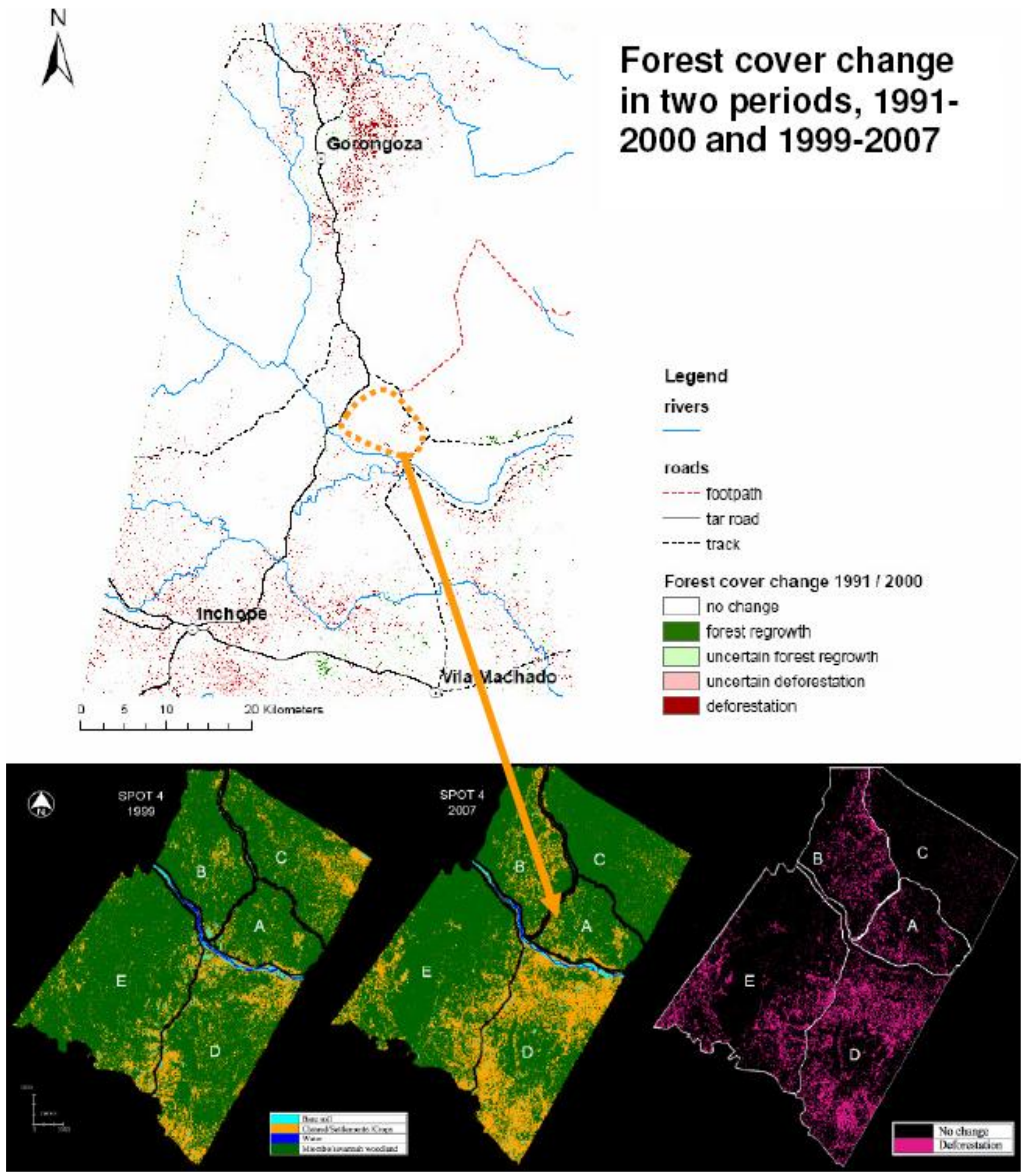

Figure 21. Upper figure shows deforestation from 1991-2000 (Wallentin 2006). The), lower figure shows the more recent deforestation rates (1999-2007), based on 20 m resolution SPOT imagery (Flaherty 2008). The zones are: A, Nhambita, Bue Maria and Posta Da Pungue; B, Pavua and Mbulawa; C, a zone only which includes part of the park and Mudoda; D, Mucombeze; and E, part Mucombeze and part Pinganganga Area A is the first phase of Sofala project, B is the second and D is the third. REDD areas are in the extreme A, B and South East of C.

The analysis of SPOT images derived vegetation cover above show the pattern of deforestation in the areas A, B, D and E. In 1999 the forest area consisted of covers 48,952 ha of woody vegetation. Combined remote sensing and ground truthed observations indicate that woodlands declined to 39,473 ha by 2007, corresponding to an annual decline of 2.4 %[34].

The deforestation rate in the area is much higher than the official national average deforestation rate submitted to FAO by the Government of Mozambique in which country-wide deforestation is reported as

34 Analysis of Land Use Change using SPOT images explores this further and rationale behind which blocks were used and why for the reference point..

0.3% between 2000 and 2005[35] and that of 'other wooded land', including miombo, is stated as 0.24%. A FAO report in 2003 suggested that 50-70 % of roundwood production in Mozambique is clandestine.[36] Other countries in the region have rates that are comparable with those reported from the project region. Deforestation rate is correlated with the population growth rate in the project region. Area growth has recently been higher than the national average as a result of high immigration and returning refugees in the period immediately before the project began and continuing immigration, albeit at a lower rate, in recent years.

It is possible that the deforestation rate in the project regions will increase over time due to the pressures described below under key drivers for deforestation. A future annual deforestation rate of 2.4% in the absence of intervention is therefore likely to be a conservative estimate.

The initial biomass of agricultural land was derived through 32 inventories of individual *machambas*[37], a locally derived allometric was then used to calculate the above and below ground biomass of 2.77 $tCha^{-1}$. Agricultural land is the expected without project scenario given it is the strongest driver of deforestation, the remaining carbon stock on agricultural land is therefore deducted from the total carbon stock available for sale in the ECCM REDD carbon calculator in CL1.1.

The carbon stock on agricultural land is assumed to be static after attempts to model drivers in did not arrive at statistically significant results[38]. Charcoaling, while a significant driver (Herd 2007), is excluded from the without-project scenario as it is illegal in the buffer zone of a national park.

Calculation of vegetation loss without project activities

Year	Degraded Miombo (ha)*	Miombo (ha)*	Riverine (ha)*	Savannah (ha)*	Remaining carbon stock in the project area (tC) **
2006	254	7,033	618	1,615	347,916
2007	248	6,864	604	1,576	340,204
2008	242	6,695	589	1,537	332,492
2009	236	6,526	574	1,499	324,780
2010	230	6,358	559	1,460	317,068
2011	223	6,189	544	1,421	309,357
2012	217	6,020	529	1,382	301,645
2013	211	5,851	514	1,344	293,933
2014	205	5,682	500	1,305	286,221
2015	199	5,514	485	1,266	278,509
2016	193	5,345	470	1,227	270,798
2017	187	5,176	455	1,189	263,086
2018	181	5,007	440	1,150	255,374
2019	175	4,839	425	1,111	247,662
2020	169	4,670	411	1,072	239,950

[35] FAO (2007). State of the World's Forests 2007, Food & Agriculture Org.

[36] Gatto, F. D. (2003). Forest Law Enforcement in Mozambique An Overview. Maputo, Mozambique, DNFFB & FAO.

[37] Claire Ghee, Master of Science thesis, University of Edinburgh.

[38] Wallentin, G. (2006). Carbon change rate and assessment of its drivers in Nhambita, Mozambique, University of Edinburgh.

2021	162	4,501	396	1,034	232,238
2022	156	4,332	381	995	224,527
2023	150	4,163	366	956	216,815
2024	144	3,995	351	917	209,103
2025	138	3,826	336	879	201,391
2026	132	3,657	322	840	193,679
2027	126	3,488	307	801	185,968
2028	120	3,319	292	762	178,256
2029	114	3,151	277	724	170,544
2030	108	2,982	262	685	162,832
2031	102	2,813	247	646	155,120
2032	95	2,644	233	607	147,408
2033	89	2,476	218	568	139,697
2034	83	2,307	203	530	131,985
2035	77	2,138	188	491	124,273
2036	71	1,969	173	452	116,561
2037	65	1,800	158	413	108,849
2038	59	1,632	143	375	101,137
2039	53	1,463	129	336	93,426
2040	47	1,294	114	297	85,714
2041	41	1,125	99	258	78,002
2042	35	956	84	220	70,290
2043	28	788	69	181	62,578
2044	22	619	54	142	54,867
2045	16	450	40	103	47,155
2046	10	281	25	65	39,443
2047	4	113	10	26	31,731
2048	0	0	0	0	26,590

Figure 22. The expected vegetation loss in the protected REDD areas based on analysis of statellite imagery between 1999 and 2007. Remaining carbon stocks in the baseline are the average carbon stocks on agricultural land. * Assuming a deforestation rate of 2.4%, uniform across different vegetation types. ** Using carbon densities per hectare from G1.2.

Agro-forestry and agricultural system baselines

The project has established baselines for the different land-use systems as recorded in figure 18. These are assumed to be static throughout the project timeframe. This is probably conservative as increasing land pressure shortens fallows therefore fruit orchard and woodlot baseline carbon stocks will be reduced. The total carbon stocks included within the baseline are determined from the total area which is under different land use systems. As previously described in G2.1, carbon sequestration potential on land use systems which are converted to fruit orchard where determined to be 2.8 $tCha^{-1}$ and 11.3 $tCha^{-1}$ for woodlot in absence of project activities by local research carried out by ECCM. No burning of machambas was determined to be 9.6 $tCha^{-1}$ as derived from the miombo literature. Combining the system area size with baseline system sequestration potential over the project lifetime gives a total of 17,710 tC in the agro-forestry systems.

Baseline carbon stocks in the adopted areas - * These are contracts which have been signed in and prior to 2009. Some systems such as homestead have a sequestration potential of 0, as the without project scenario is bare ground.

Technical Specifications	Area (ha) under system	Number of contracts	Expected tC sequestered in absence of the project
Cashew	64	95	180
Gliricidia	54	65	0
Homestead	57	330	0
Mango	55	57	153
Woodlot	103	103	1167
Boundary Version 1	74	51	0
Boundary Version 2	1547	1377	0
Faidherbia Version 1	923	821	0
No burning of agri-residues	1688	1674	16208
Total	4565	4573	17710

The Plan Vivo system calls for a transparent dialogue over any changes intended to be made to technical specifications in light of recent evidence. Research carried out to inform the REDD technical specification baseline will also be incorporated into new versions of the agro-forestry technical specifications which will then be peer reviewed after changes are included.

G2.4. Describe how the "without-project" scenario would affect communities in the project zone, including the impact of likely changes in water and soil and other locally important ecosystem services.

If the project were not implemented, communities would be affected as follows:

Indicators	Socio-economic impacts in the "without project" scenario	Method of measurement

Indicators	Socio-economic impacts in the "without project" scenario	Method of measurement
Sources of income	Local incomes will remain low irregular and unstable, in the short term. Incomes will continue to be available in certain groups of the community only (i.e. most probably not in women groups). In the long term, commercial activities are not likely to increase significantly as there is not likely to be any investment by Government or private organisations in these regions.	Regular socio-economic surveys will be carried out by university students to assess the availability of income from the project. So far on Gorongosa sites two surveys have been carried out in 2004 and 2008. One is planned for 2010 in Zambezi Delta site.
Local food production / Average productivity of land / Awareness of land use practices	Agricultural productivity will remain low as management systems will remain stagnant and slash and burn will still be necessary. Food security will be endangered since most farmers will not produce enough from their farms and will have to buy food from local markets. Local food production will be less diverse and more insecure due to poor soil fertility.	As part of socio-economic monitoring above, varieties of crops grown, access to market and food security will be assessed. As well as social analysis, soil samples will also be analysed to determine the success or otherwise of management practices. Productivity will also be determined. The first survey was carried out in 2009 and the results will be published in 2010[39].
Natural resource utilization / Awareness of forestry practices	Natural resources are likely to diminish as there is a general perception among local people that there is abundance of forest and that continued slash and burn will not significantly affect resources.	The perception and impact of the project will be assessed in the socio-economic studies on forest resource use. Further a study was carried out in 2009 to determine whether the payments for ecosystem services from the project outweighed the possibilities for unsustainable forest resource use. [40]
Gender	There is a lack of employment opportunities for women in the project regions and, consequently, high poverty levels among households.	The database used by the project to record systems and producer details includes gender. This will be used to generate figures to include within the annual report to ensure that sufficient women have access to the project.

[39] Ghee 2010. Nitrogen and carbon dynamics in Mozambican smallholder agroforestry systems. In submission *Agroforestry Systems*.

[40] Spiric, J. (2009). Investigating the socio-economic impact of REDD scheme implemented in the Nhambita community carbon project, Mozambique. Barcelona, Universitat Autònoma de Barcelona. **Master of Sciences**.

Indicators	**Socio-economic impacts in the "without project" scenario**	**Method of measurement**
Soils	Soils are likely to degrade as a result of continued shifting cultivation with shortened fallows as there is an increased immigration rate into the region.	Soil samples will be taken at 5 year intervals to monitor the impact of management interventions: • Agro-forestry • Legume intercropping • Integration in the soil of and no burning of agri-residues • Composting and weeding advice given by the community technicians.

The project will continue to invite students to assess the impact of the project to disseminate information through peer review publications, build capacity and monitor the social impacts of the Plan Vivo system.

G2.5. Describe how the "without project" scenario would affect biodiversity in the project regions (e.g., habitat availability, landscape connectivity and threatened species).

Indicators	**Impacts on biodiversity in the "without project" scenario**
Threatened species	Globally Miombo woodland is increasingly threatened between 1990 and 2005. 74% of the wooded land class which contains miombo was deforested in Tanzania. Without the project this threatened habitat is expected to further shrink within Mozambique and with a result threaten miombo specialist species In the projects zones there are 4 threatened animal species and 2 trees species have been identified: • *Hippopotamus amphibius* (vulnerable) • *Lycaon pictus* (Endangered) • *Panthera leo* (Vulnerable) • *Trigonoceps occipitalis* (Vulnerable) • *Cola mossambicensis* (Vulnerable) • *Sterculia appendiculata* (Vulnerable) These species are expected to become increasingly threatened as the buffer zones and areas surrounding the protected areas are degraded.
Species abundance	Deforestation would continue at a high level. A deforestation rate of 169 ha / year from historical trends 1999-2007 is probably a conservative estimate, since it does not take into account the increase in population and the corresponding increased need of additional areas for new agricultural areas. Deforestation would reduce species abundance as total habitat area is reduced.

Indicators	Impacts on biodiversity in the "without project" scenario
Population size	Without-project forest is expected to become more fragmented which will, in turn, fragment species populations which will reduce their population size and viability. This will be particularly relevant to those species which have small population size already, like *Lycaon pictus.*
Species diversity	Hunting will probably increase which, added to the use of fire in hunting activity and increase of human population, poses a severe threat to the forest resource and the associated biodiversity. Poaching pressure on the hunting concessions, national parks and forest reserves found in the project regions is all likely to increase in absence of alternative livelihoods.
Habitat area, availability, quality and diversity	With high deforestation in the without-project scenario, habitat area, quality and therefore diversity is expected to decrease. This is particularly relevant in the HCV riverine forest, which is rich in biodiversity but also has good alluvial soil suitable for farming and so is under high threat.
Landscape connectivity	With increased deforestation, increased fragmentation is expected to reduce connectivity which will have a negative effect on biodiversity – particularly rare and threatened species with highly dispersed populations.
Forest fragmentation	The miombo ecosystem will increasingly be more unstable, and more fragmented over time. Habitats will be reduced and more fragmented. Edge effects are likely to exacerbate any increase in fire intensity and frequency from farming and hunting, this will cause miombo woodland to eventually convert to farmland[41].

G3. Project Design and Goals

G3.1. Provide a summary of the project's major climate, community and biodiversity objectives.

The Sofala Community Carbon Project is a holistic project, addressing climate, community and biodiversity aspects. Its overall objective is to develop sustainable land use practices and rural development activities in the Gorongosa and Marromeu National Park buffer zones which have the potential to provide significant socio-economic benefits for local communities, to protect and restore forest resources and to generate verified emission reductions.

The project is based on the premise that activities that protect and restore forests have the potential to sequester or conserve carbon and that this can become another source of income to rural communities.

Project activities were piloted first in the Nhambita community in the Gorongosa National Park Buffer Zone and serve as a demonstration model that has been and will be replicated in other communities in the project sites (see figure 10 for location of Nhambita within the Gorongosa site).

The principal objectives of the project are to:

1. Develop sustainable land use practices, in participation with the community which have the potential to provide socio-economic benefits and protect and restore forest resources, including:

[41] Ryan, C. and M. Williams (2010). "How does fire intensity and frequency affect miombo woodland tree populations and biomass?" Ecological society of America

- Reducing deforestation and adopting sustainable land management activities including reforestation and agro-forestry.
- Generating sustainable livelihoods through diversification of agriculture, soil improvement, employment generation, use and sale of forest products.
- Contributing to biodiversity conservation through restoring and protecting natural ecosystems, saving species from extinction, maintaining productive natural life support for communities.

2. Produce research outputs that contribute to the implementation of the above objectives based on targeted and user driven research
3. Build capacity in provincial organisations, including the Forest and Wildlife Department, so that they can advise on land use activities and assess potential carbon benefits from projects in the province.
4. Uplift the community through:
   - Environmental education and extension through the community technicians.
   - Improved infrastructure, health and schools through funds flowing in to the Mozambique Carbon Livelihoods Trust (MCLT) an independent trust.
   - Diversify employment activities directly through the project and micro-businesses such as bee keeping, carpentry, sustainable saw mill and vegetable gardening.

G3.2. Describe each project activity with expected climate, community and biodiversity impacts and its relevance to achieving the project's objectives.

The project activities broadly consist of the development of sustainable land management, associated research on land use and carbon and the development of institutional capacity in Sofala State to verify carbon offsets for land use activities. The main project activities are described in the following.

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

REDD activities are planned in participation with the appropriate community, currently Chicale *Regulado*, Gorongosa site are the only *Regulado* carrying out REDD in Sofala province. Community forest workers have been encouraged to develop a sense of community ownership of forest planning and implementation activities throughout the project regions. Community members sign contracts with the community association to patrol and make fire breaks in the forest management areas[42]. The involvement of the community association is part of the exit strategy (see section G3.11) by the project management and the long term permanence of management interventions. Annual monitoring[43] of these areas is carried out by community technicians who are subject to checks by the University of Eduardo Mondlane.

Plans for all land-use activities are developed with the community with support from project staff and are used to assess the carbon offset potential[44] of these activities by the project technical team. Fire management by early burning is an important component both for the conservation of wildlife and woodland but also to prevent wild fires from spreading into the community's fields and homesteads.

The community is given assistance in organising management planning. A forest management has been written, informed by community input on existing data gathered by the forest inventory and updated over

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[42] All ccontracts available on site. Also scanned copies from 2009.

[43] Forestry payment and monitoring reports 2006-2009 available in digital copy

[44] AD carbon stocks excel workbook.

the course of the project[45]. Simple, verifiable outputs have been identified and community agreement is required for each management unit[46] (G3.3 shows management units on a map).

REDD incentive finance is provided directly into the trust fund per hectare of land protected. The finance is overseen by the Chicale community association who manage the community trust fund and sit on the board of MCLT. The finance is split into that guaranteed by ECL for compliance activities and an extra trust fund top up directly related to sales. See section 3.11.

The community forestry technicians are provided training in all aspects of miombo forest management including identification and selection of tree species, collection of seed, identification, planting and maintenance of seedlings, nursery techniques, plant handling, planting and maintenance of trees, forest mensuration and inventory techniques, sustainable yield calculation, planning of harvesting operations and basic tree felling techniques[47].

REDD enables forest conservation in the buffer zone where resources are low and land pressure for agriculture is high. Miombo woodland is a valuable habitat for species such as elephants, lions and antelope. Fragmentation of that habitat around the park leaves a matrix which is less sympathetic to biodiversity. In future the project plans to add an extra incentive to those people and communities who protect their riverine areas. Particularly as the project incorporates Mucombezi *Regulado* and Zambezi Delta site within the REDD management scheme.

Project activity: Timber utilisation and sustainable harvesting

As part of the micro-business enterprises a sustainable community saw mill in Gorongosa was set up 2005 and became independent of the project in 2009. Timber extraction is carried out based on a local maximum sustainable yield forest inventory in the area[48]. Initially dead wood was collected from the forest and from development land clearance in the GNP, collecting dead wood reduces the bush fire intensity (Furley, Rees et al. 2008). A community felling license was then obtained from the Forest Service in 2008[49]. The main purchaser of timber is the Gorongosa community carpentry shop, another independent micro-business set up by the project. Both of these micro-enterprises have created business plans[50].

The micro-enterprises have received equipment, training and advice from the project. The saw mill team has been provided with the following equipment, a Jack-saw sawmill, a blade setter machine, blade sharpening machine and safety equipment. The sawmill operator received training on the operation and maintenance of the saw, sharpening and blade setter machines. The saw mill was assisted in acquiring its dead wood licence and logging licences from the Agriculture Department at Gorongosa district. The saw mill has a simple logging licence, under the forest and wildlife law (article 14). The maximum annual cutting allowed under this licence type is 500 m3 of logs.

Under the special dead wood licence, the Sawmill Enterprise group collected 150 m^3 of dead logs of different species (*Pterocarpus angolensis, Khaya anthotheca, Cordyla africana, Burkea africana* and *Brachystegia spiciformis*) between August 2006 and July 2009. Under the simple licence issued to the community for 75 m^3 of *Pterocarpus angolensis*, *Khaya anthotheca*, and *Afzelia quanzensis* the community cut 62 m^3. The annual allowable cut for Chicale *Regulado* is 771 m^3 as determined by an inventory carried out in 2007.

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[45] Gorongosa Forest Management Plan

[46] Forest management plan

[47] Training presentations, manuals and examination records available, as well as list of those trained.

[48] Área Comunitária De Nhambita, Inventário Florestal. Trabalho Realizado Pela Miombo Consultores, Lda

[49] Paper copy and tax receipts kept by the Community association and sawmill workers. Logging licence

[50] Carpentry and Sawmill business plans. Scanned signed copies available and soft copies in English or Portuguese.

A GPS reference has been taken for each stump and each stump also has a management record form which monitors regrowth and coppice[51]. Map of stumps cut will be recorded in the forest management plan.

While these enterprises are independent of the project, a consultant is hired by the project to give them business and technical advice.

Project activity: Agro-forestry

Reforestation of agricultural land is carried out as part of the boundary planting, intercropping and woodlot systems[52]. Areas that have been cleared for agriculture or degraded are enriched with native tree species to increase the potential for future timber production. Agro-forestry activities span the whole of the project areas on both sites.

Nine nurseries have been established and are run independently by the community providing additional incomes. Nursery workers have received training in grafting, seedling rearing, seed collection and soil mixing. The nurseries are self-sustaining commercial entities producing grafted fruit cultivars as well as a wide range of other trees. Nurseries provide employment for women.

Currently, farmers use about one third of their land (1-3 ha/farm) for crops, the remainder lying fallow. Crops are rotated at 2-3 year intervals. When the land is exhausted, the farmer clears a new patch of forest. Agro-forestry activities are promoted in order to maintain soil fertility in agricultural land so that the need to clear woodland for new agricultural land is reduced. *Faidherbia* and pigeon pea are intercropped with cereal crops, both are nitrogen fixing trees. Part of the training given to the farmers is the incorporation of agri-residues from agro-forestry into the field rather than burning. Pigeon pea is expected to have climate benefits through the increase of soil organic carbon from its litter inputs, however it is not claimed as a carbon methodology at present until further research is carried out.

Community technicians, one per hundred farmers, are equipped with bicycles and employed by the project to help project staff train farmers and promote agro-forestry techniques.

Participatory analysis of results of agro-forestry are used to demonstrate to farmers the advantages of using new techniques and to encourage increased uptake[53]. Results are discussed and reviewed with farmers along with observations on factors such as soil erosion and performance of different systems or species. Recommendations to the farmers are recorded in the monitoring forms and co-signed both by the technician and the farmer. Appropriate use of exchange visits to other areas, where farmers have already started using agro-forestry activities, are used to provide farmers with opportunities to discuss the pros and cons of systems with other farmers. Visits by outlying communities to project demonstration farms are facilitated.

The specific agro-forestry techniques promoted and implemented by the project include intercropping, reforestation with fruit and indigenous trees, boundary planting to stabilise soils and bank stabilisation through tree planting. Intercropping involves the planting of nitrogen-fixing trees (*Faidherbia* and *Gliricidia* the latter system is now discontinued)[54] into fields being used for other crops. The trees are planted in lines at a density determined by the technical specification. *Gliricidia* are cut back regularly (twice per year) and the green matter incorporated into the soil. Fruit trees provide cash income on maturity and can increase soil stability and improve the microclimate. Tree planting along river-banks helps reduce soil loss through runoff and river bank erosion.

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[51] Ficha De Registo De Toiças

[52] Quantification of area, sizes, locations and mortality of trees is available through the project database which can be interrogated on site.

[53] Minutes on community meetings available on site in "Atach" folder

[54] Locations and quantities can be elucidated by interrogation of project database on site.

Annual monitoring of these agro-forestry activities is carried out by community technicians and is linked to payments for carbon sequestered in trees. The technicians' reports are then spot checked by supervisors. Monitoring reports, in their paper form, include the signature or mark of both the community technician and the farmer[55]. Payment records, which are linked to monitoring, are also signed or marked by the farmer.

Individual land-use systems deployed by the project for carbon sequestration, carbon calculations and management proposals are described in detail in the Technical Specifications: Boundary Planting, Dispersed interplanting (with *Gliricidia or Faidherbia),* Fruit Orchard, Cashew, Fruit Orchard, Mango, Homestead planting, Woodlot.

Through this project activity, rural livelihoods are supported by employment generation, training, increased agricultural productivity, stabilisation and security of food supply. Climate benefits are generated through planting of trees, which increases carbon sequestration, and through reducing the pressure on remaining woodland, which decreases carbon emissions. These activities, at the same time, positively contribute to biodiversity conservation measures. Diverse agro-forestry belts, around forest fragments have been identified as potential buffers for diversity habitats in the tropics (Schroth et al., 2004) because they contribute to reducing pressure on forest resources and improve the living standards of the rural population living around the protected area (Nair, 1993). In an independent study carried out in the area, agro-forestry and innovative farming techniques have caused, in just 5 years, an increase in soil nitrogen and crop yield[56].

Description of the proposed Plan Vivo technical specifications and methodologies				
Title	**Type of activity**	**Objectives**	**Brief Description**	**Target areas / groups**
1. Boundary Planting	Agroforestry	Fodder, timber	Native species for fruit and timber, planting around the machambas; this will be a good introduction to Plan Vivo for farmers as it involves least effort	Farmers
2. Dispersed interplanting with *Gliricidia*	Agroforestry	Soil improvement	Widely introduced species which is a good N-fixer and so will improve soils. Requires management by cutting back regrowth.	Farmers
3. Dispersed interplanting with *Faidherbia*	Agroforestry	Soil improvement	Native species, N-fixer and also attracts bees.	Farmers

55 Monitoring reports are also keyed into the project database which can be interrogated on site.

56 Claire Ghee, Master of Science thesis, University of Edinburgh.

4. Fruit Orchard, Cashew	Agroforestry	Nuts	Useful protein source and cash crop.	Families
5. Fruit Orchard, Mango	Agroforestry	Fruit	Useful vitamin source and cash crop.	Families
6. Homestead planting	Agroforestry	Fruits, fooder, firewood and timber	High in Vitamin C and anti-oxidants, shade trees and branches can be used for fire wood.	Families
7. Woodlot	Agro-forestry (occurs on fallow machambas)	Timber, fuel wood, potential for sustainable charcaol manufacture.	Need to relieve pressure on native woodland	Families
8. No burning of agri-residues	Agricultural soil carbon sequestration	Incorporation of agri-residues into the soil to improve productivity and reduce carbon emissions	Agri-residues such as straw are traditionally burnt at the end of the season after harvest. The project incenvises farmers not to do this.	Farmers
8. REDD	Forest Management	Conserve biodiversity and carbon stocks.	Needed to promote conservation of carbon stocks and biodiversity and reduce fragmentation of the woodland around Gorongosa.	Entire community

Project activity: drip irrigation and bush meat

Drip irrigation vegetable gardening and bush meat substitution decrease dependency on clearing new forest for fertile land and burning the forest to hunt. Drip irrigation for cash crops are run as small micro-businesses by community members. In Chicale *Regulado* drip irrigation units are already in use, in 2009 a study on this units recommended that in future the barrels on the units purchased should be smaller, this will allow them to be more appropriate to the needs of the farmer. In expansion of this activity this analysis will be taken into account[57]. So far, 59 people have started keeping guinea fowl, a bush meat substitute from eggs received from the project. Eggs are replaced to the project to pass on once a brood has reached a sufficient size.[58]

Project activity: Non-timber forest products (NTFPs)

[57] Barbir, J. (2009). Socio – Environmental Approach to Drip Irrigation System Implementation as a Climate Change Adaptation Measure within Nhambita Community Carbon Project Area, Mozambique. Geography Department, Universitat Autònoma de Barcelona.

[58] Summary beekeeping, demo farms, guinea fowl, nurseries.

NTFPs are promoted to increase local income, diversify production systems and reduce pressure on forest resources. The management of NTFPs also has the potential to involve other groups of society not involved in forest management and timber utilisation. A bee keeping programme has been ongoing in the Gorongosa site for five years and is now starting in Zambezi Delta site.

There are 233 top bar hives in the Gorongosa community. These generate cash income and also reduce ring-barking of trees for bark hives thereby reducing human induced mortality of trees. Early burning, as part of the forest management plan, increases honey flow so beekeeping is an extra incentive for sustainable forest management.

Training is provided in better hive management and extraction techniques to increase honey quality, prevent loss of bee colonies during harvest and spread of fire from the smoking process used to calm bees before harvesting honey. Trainees become trainers and are encouraged to disseminate techniques learnt and help in the training of subsequent groups in the community. Individuals supplied with training and equipment are expected to help supply new trainees with breeding stock. Equipment includes hives, extractors and bee suits, the bee keeping team also have a motorbike to reach the whole of the Gorongosa site. Top bar bee hives are produced in the community carpentry shop and their purchase by the farmer is subsidised by the project (50%). The producer may receive a loan to buy his hive (of 250 *Meticals)* which he or she can pay back in cash or honey once their hives have started producing sufficient income.

Marketing activities initially focus on honey, wax and other hive products. As the quality of these products is improved it will be possible to help bee keepers target different markets and achieve better prices. By organising beekeepers into groups, it will be possible to achieve economies of scale. The project will also explore the possibility of marketing other hive products such as propolis, pollen and wax. An abandoned church, on the road to the Gorongosa National Park, was refurbished to form a shop for tourists where honey would be sold. However, once refurbished, the church was claimed by the Catholic Church for the Pope and has since become overgrown. There is now a plan to build another building next to the Church to sell community crafts not just limited to honey but also pottery and weaves.

Through NTFP production, poverty will be alleviated by starting up micro-industries, developing a business ethos in the community, imparting business skills (such as record keeping and accounting) and imparting new technical skills (for example bee-keeping and carpentry). This in turn will take pressure off natural resources (including a reduction in hunting). Significant impacts in the community have already been felt[59].

Summary of activities and benefits

The sustainable use of, restoration and protection of forest resources impact all CCB objectives. It also forms the basis for conserving and sequestering carbon. It supports local income and reduces biodiversity loss especially reducing the pressure on the GNP and protected forest reserves in Zambezi Delta through protecting and managing woodland. It is expected that project activities will serve to relieve damaging actions on the Park, and contribute to conservation.

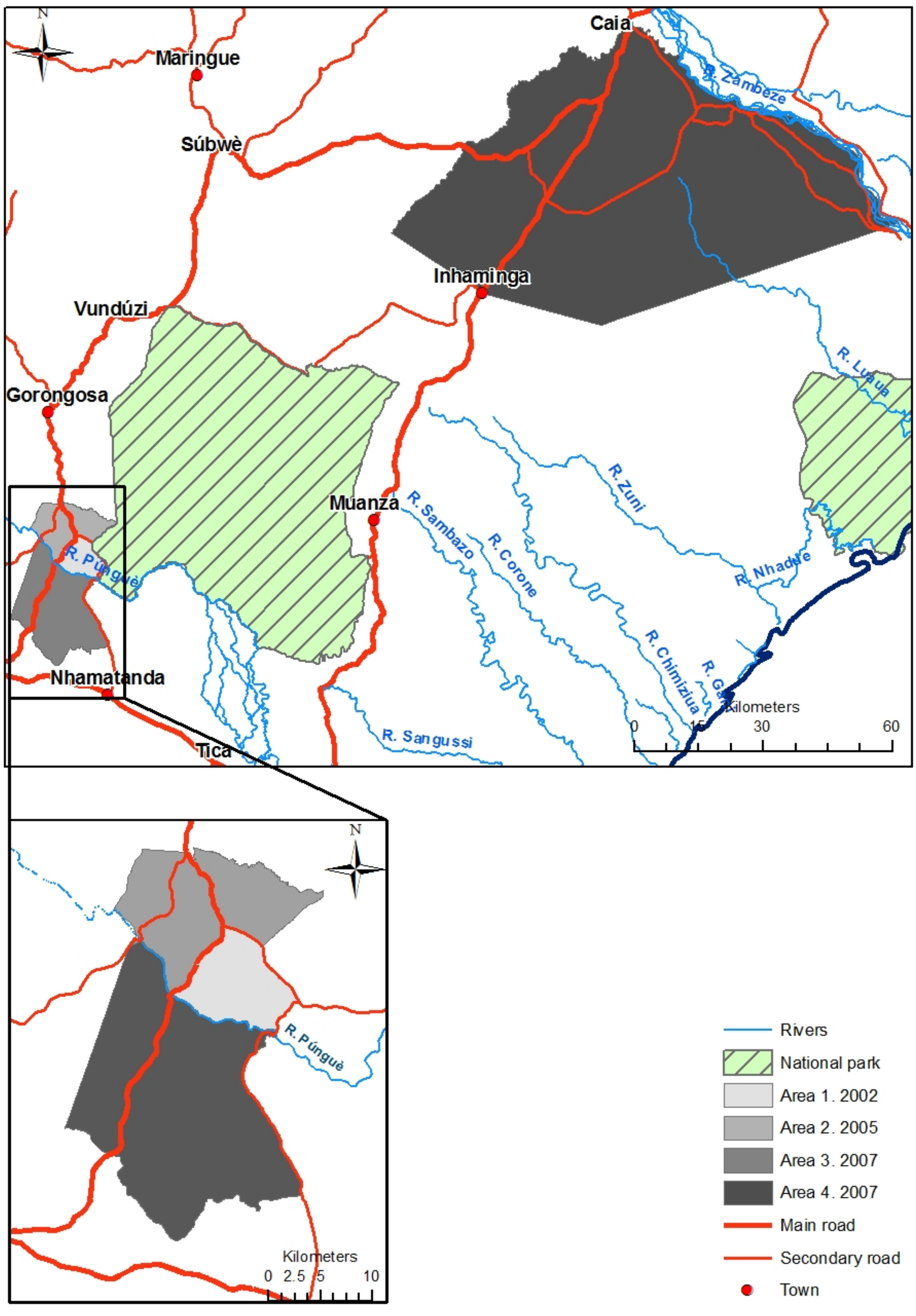
G3.3. Provide a map identifying the project location and boundaries of the project area(s), where the project activities will occur, of the project zone and of additional surrounding locations that are predicted to be impacted by project activities (e.g. through leakage).

For the project regions, their location and boundaries, see maps provided under G1.1 and G1.3 respectively. For the phases of project expansion see Figure on following page.

The pilot to the EU phase was located in or close to the buffer zone of the Gorongosa National Park (see section 1). Specifically the project was created in Nhambita village, where the headquarters and base camp are located. The EU research and development stage was carried out in areas 1-4 (however 4 was funded

[59] Rohit Jindal, PhD thesis focusing on the impact of the community carbon project on the Chicale *Regulado*.

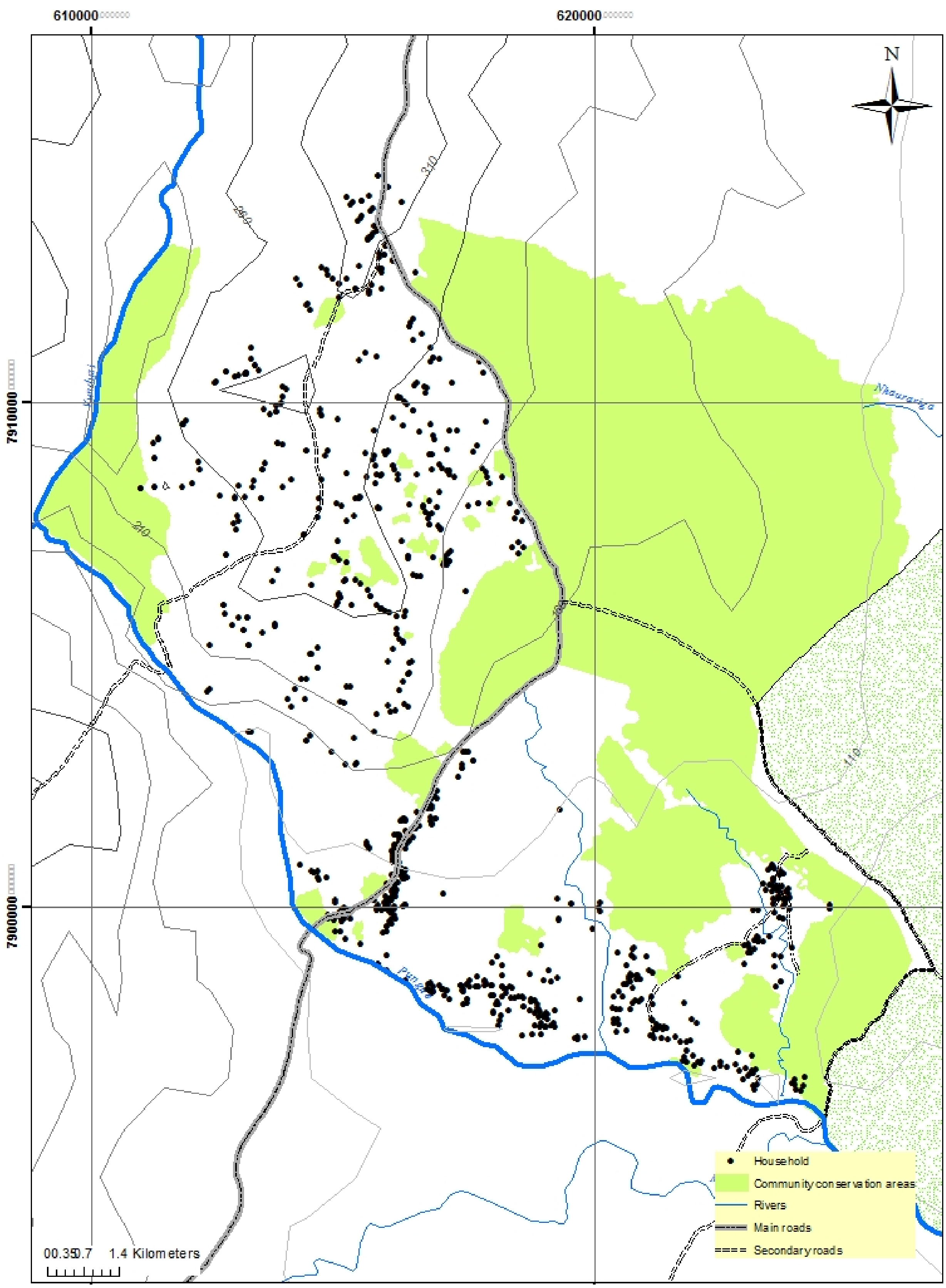
solely through carbon credit and investor finance) and the operational phase covers all of these areas.From a legal viewpoint, there are three types of land in the project regions: protected land, buffer zone and community land. Protected land in this project is in the Gorongosa Park and Marromeu Park, the first is managed by the Carr Foundation, a US organisation in agreement with the Mozambican government; it cannot be cultivated or planted. The second is managed by the forestry department.



The buffer zone, immediately adjacent to the Parks boundary, is jointly managed by the government, village communities and other stakeholders. Subsistence farming is allowed in the buffer zone, but no other commercial activity, including hunting or extraction of forest products for commercial production, is allowed except under licence. A licence is needed, for example, for gathering dead trees for the saw mill. Community land is managed by the communities under the Land Act which allows subsistence farming, charcoal production, fishing and hunting. There are hunting and timber concessions in and around Phase 4 of the project in the Zambezi Delta. These could be taken over by a commercial entity and exploited under a management plan.

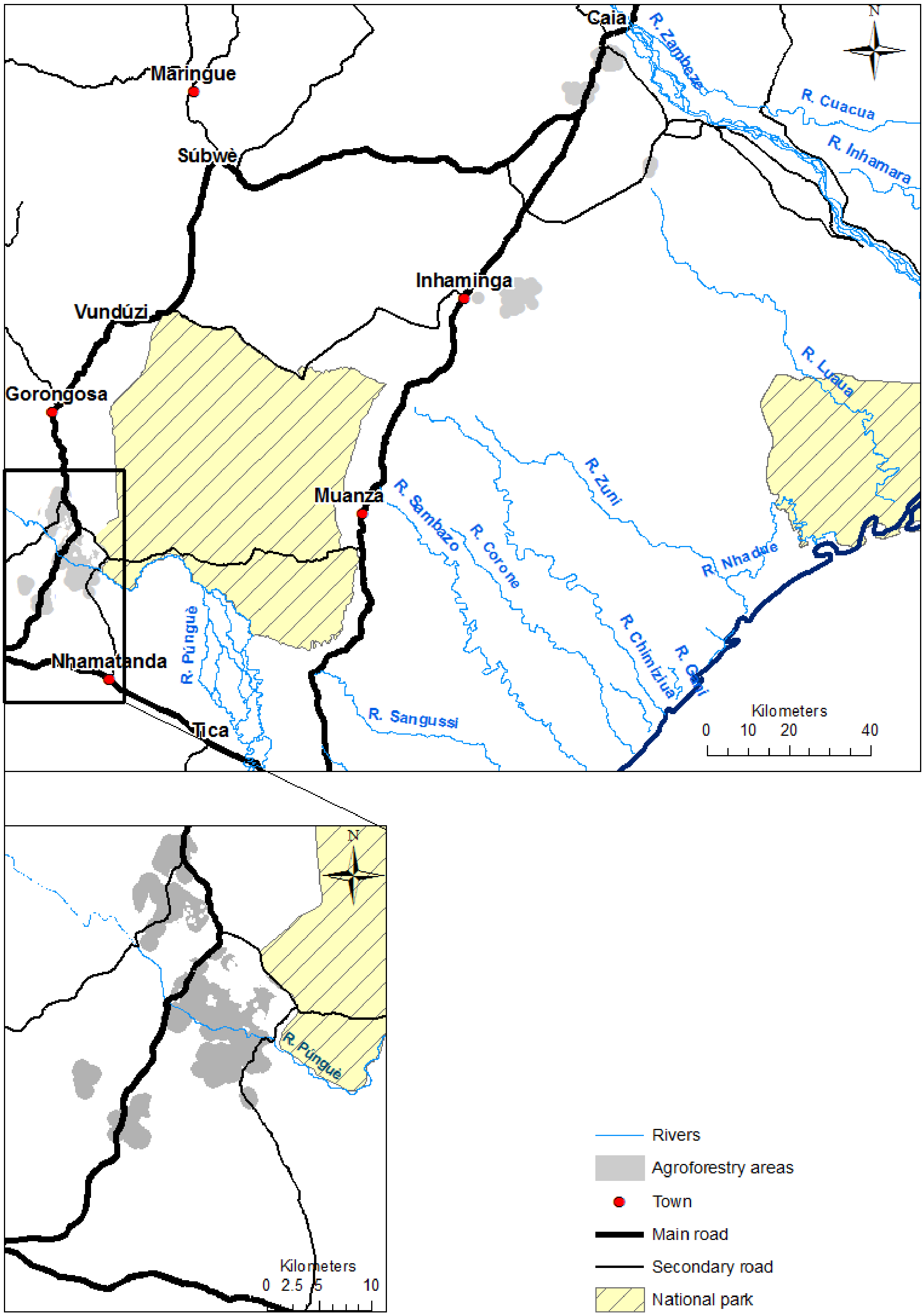
Area 1 contains the community sawmill and carpentry shop. Area 1, 2 and 3 contain bee keeping groups, guinea fowl and drip irrigation. Area 4 only contains a sesame promotion programme and sesame oil press for bringing an extra cash crop to market with value added. The bee keeping programme is now expanding into area 4.

The map on the following page contains the areas which are managed for REDD, and also the locations of households in the same Chicale *Regulado.* Currently only Chicale *Regulado (*areas 1 and 2 on map above) have REDD management.



REDD management areas, mapped with the community for conservation. Households in the Chicale *Regulado* also shown. All households in this *Regulado* receive a benefit through the trust fund to protect these areas.

The map below shows the location of *machamba*s with agro-forestry system areas in the Gorongosa and Zambezi Delta project regions.

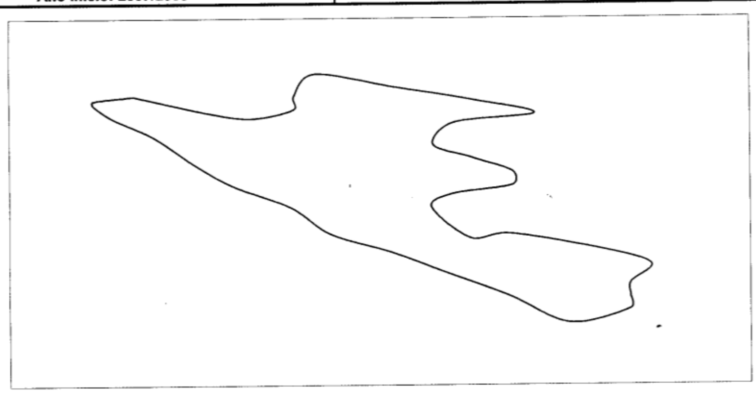


Mapping of agro-forestry areas, process.

Agro-forestry areas are mapped using a Garmin Etrex GPS by the community technicians. Each system contract has a map associated with it. As the coordinates downloaded from the GPS are in coordinate system UTM, each unit increase in coordinate represents a movement change of one metre. This relationship means the area in metres squared can be calculated from the GPS coordinates. In boundary systems perimeter is the metric which is used to calculate the carbon benefit as the metric needs to be linear rather than area. In this instance the UTM coordinates can again be used to calculate perimeter as in the example contract below:

Nome: Faraminha Rale
Comunidade: Pungue
Area: 0.30 ha (354.77 m)
Sistema: Bordadura
Ano inicio: 2007/2008

Tecnico: Manuel Francisco
Data: 28/02/08



Observacoes:

Coordenadas e calculo area

x	y	dx	dy	x*dy - y*dx	border (m)
615982.4	7902426.594				
615984.6	7902424.205	2.2443	-2.389	-19206997.90	3.2778352
615991.4	7902417.039	6.7329	-7.166	-57620377.73	9.8327767
615995.9	7902414.636	4.5035	-2.403	-37068762.36	5.1045001
616000.4	7902419.357	4.548	4.721	-33032065.32	6.5553143
616000.5	7902426.481	0.0445	7.124	4036729.23	7.124139
616002.8	7902438.339	2.3334	11.858	-11134988.61	12.085401
616011.8	7902431.159	8.9921	-7.18	-75482415.78	11.506966
616020.8	7902423.979	8.9921	-7.18	-75482415.78	11.506966
616027.5	7902416.813	6.7329	-7.166	-57620635.23	9.8327767
616018.4	7902412.12	-9.0663	-4.693	68754664.49	10.20892
616016.1	7902400.261	-2.3334	-11.859	11134125.82	12.086382
616020.6	7902393.109	4.4738	-7.152	-39759505.45	8.4359937
616025	7902385.957	4.4737	-7.152	-39758715.21	8.4359407
616025	7902378.833	-0.0445	-7.124	-4036906.27	7.124139
616018.2	7902374.127	-6.8071	-4.706	50893269.28	8.2754484
616015.9	7902367.017	-2.3037	-7.11	13824809.89	7.4738968
616020.3	7902350.367	4.4143	-16.65	-45140083.35	17.22523
616024.8	7902352.713	4.5332	2.346	-34377751.04	5.1042745
616036.1	7902343.144	11.2363	-9.569	-94687947.49	14.758733
616040.6	7902335.992	4.4738	-7.152	-39759392.78	8.4359937
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616017.9	7902331.384	-6.7032	11.915	60310761.37	13.671142
616011.2	7902343.299	-6.7032	11.915	60310761.37	13.671142
616004.5	7902352.84	-6.718	9.541	58965305.40	11.668856
616000.1	7902367.116	-4.4293	14.276	43795971.80	14.947337
615993.4	7902379.031	-6.7032	11.915	60310788.20	13.671142
615988.9	7902390.932	-4.4441	11.901	42449899.82	12.703693
615984.5	7902405.208	-4.4292	14.276	43795127.91	14.947307
615980	7902414.735	-4.459	9.527	41105309.18	10.51886
615977.8	7902421.873	-2.2146	7.138	21897553.23	7.4736535
615977.8	7902424.247	0.0148	2.374	1345375.52	2.3740461
615982.4	7902426.594	4.5332	2.347	-34377569.60	5.1047342
					354.77

[redacted]

Figure 23. Final column contains the linear difference between the UTM coordinate points which is summed to calculate the perimeter. Total area size is blanked out in this example as it is a boundary system.

G3.4. Define the project lifetime and GHG accounting period and explain and justify any differences between them. Define an implementation schedule, indicating key dates and milestones in the project's development.

Project lifetime for Sofala Community Carbon Project

The historical timeline of the Sofala Community Carbon Project can be divided in three broad phases, described in the following.

Pilot to the EU phase (2002)

Prior to official project launch, a trial phase was implemented with a group of 53 farmers and linked to a purchase of carbon by Future Forests.

Activities implemented included: Locating suitable area for pilot activities of circa 6,000 ha, finding climate data, linking to communities, linking to provincial authorities, appointing staff, securing water supply, making nursery, locating best supply of seeds and seasonality of seed production, purchasing transport, linking to other stakeholders, educating people to understand the nature of carbon sequestration, ecological services, and the benefits that can accrue to the community. Staff included local people (including women) and skilled people from outside who acted as trainers.

Research Pilot phase (August 2003 - August 2008)

The phase was characterised by a high degree of intervention and hands-on management of project outputs and operators. This phase of the project was funded from grant funding (EU), investment (Envirotrade) and the sale of carbon offsets. The project was managed by a consortium and by its completion significant measures had been taken to ensure the independence and sustainability of the micro enterprises, the community forest management programme and the community reconstruction and development activities. This phase also included the establishment of the MCLT and the signing of the monitoring contract with the University of Eduardo Mondlane. A large amount of scientific research into the carbon dynamics of the project regions was carried out and pubished in the final report to the EU in 2009.

Operational phase ***(since September 2008 - 2013)***

The second phase which commenced in 2008 saw the withdrawal of the University of Edinburgh and ECCM from the management of the project and the end of EU funding. The MCLT has a growing role to play in the dissemination of funds to participants in the project and its activities. The University of Eduardo Mondlane was contracted to monitor ongoing forest and fire management activities. Micro enterprises are functioning as independent entities with their own bank accounts and management arrangements. They rely on the project for some institutional support and access to project infrastructure. The MCLT is to become increasingly responsible for the management of the disbursement of carbon revenue. The phase is managed by ECL and their local subsidary EML.

Envirotrade's exit strategy and end of the project timeline (2013-)

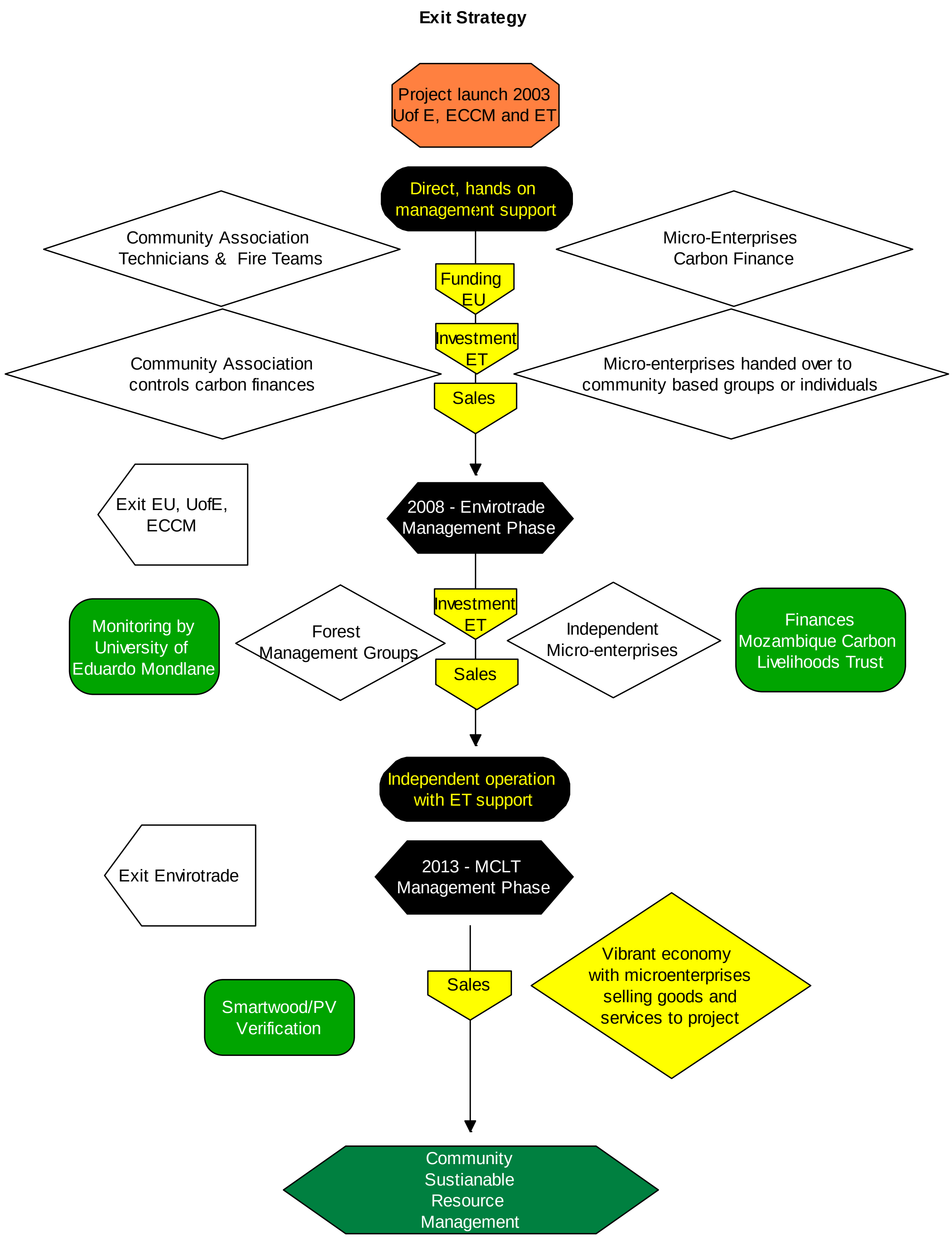

Figure 24. Timeline of exit strategy with key stakeholders. MCLT: Mozambique Carbon Livelihoods Trust, ET: Envirotrade, U of E: University of Edinburgh, ECCM: The Edinburgh Centre for Carbon Management, PV: Plan Vivo.

The final phase of the project which will begin in 2013, follows on the significant downscaling of Envirotrade's role during the final period of the second phase. During this phase the Community Association supported by the MCLT will play a central role in driving the process and ensuring that the project deliverables are forthcoming. During this phase the payments to farmers for agroforestry activities will decline as the project meets its legal requirements to pay producers for their carbon. Envirotrade is commited to paying farmers 4.46 dollars a tonne for their agroforestry contracts over 7 years in exchange for payments for ecosystem services. The payments are forward weighted so that 30% in the first year, 12% in years 2-6 and 10% in the final year. If the last contracts were signed in 2009 the last payment will be received in 2016. Envirotrade envisages that the entirety of the final phase will be funded by offsets under the management of MCLT, if all current offsets were sold at the average carbon price achieved, the project would gross 10 mil dollars.

Key Performance Indicators - monitoring and evaluation

The project management team will monitor progress in the implementation of the exit strategy within the context of delivery of overall project deliverables. The project has held management review meetings at important points in the projects development. These reviews have composed of both external parties and project stakeholders. These will continue to take place at regular intervals. Key performance indicators linked to this exit strategy include the following:

- The independent operation of all micro enterprises
- The full establishment of the MCLT
- Independent operation of community forest management units
- Hand over of the payment of forest management to the MCLT
- Annual inspections by the University of Eduardo Mondlane
- Annual board meetings of the MCLT
- Annual reports from the Community Associations
- Regular inspections by the Verifiers
- Closure of the final Agroforestry contract
- Regular visits by Carbon clients

Stakeholders

The stakeholders in the exit strategy are the communities and their elected representatives, individual producers who are contracted to the project, the Mozambique government and the departments who are operating in the target communities, the MCLT, Envirotrade, the clients who have purchased carbon from the project and the Standards to which the project has aligned itself and who are responsible for evaluation the quality and quantity of product in the programme.

Who will be responsible for the implementation?

The implementation of the exit strategy will be jointly implemented by the Community Associations, the MCLT and Envirotrade.

Who will the responsibility for delivering the programme be transferred too?

The Mozambique Carbon Livelihood Trust and the Community Associations will jointly administer the programme.

How will the activity be transferred?

Envirotrade will hand responsibility over to the MCLT for the employment of the data base capture and maintenance Community Associations.

What are the standards and institutional arrangements that need to be maintained?

The project will be reviewed and subject to external verification by the Plan Vivo Foundation and Smartwood, the CCB verifier periodically and the MCLT will need to maintain administrative links with the two Standards.

How will it be funded?

The Carbon Livelihoods programme will continue to be funded from the balance of carbon revenues held in the MCLT and from the ongoing sale of carbon from the forest management component of the project. Envirotrade has engaged in extensive financial modelling to establish what potential revenue streams to community will be throughout the life of the project that will be available to the management of the MCLT and the community to plan and structure finances.

How will the community role be supported?

The community will be able to access financial resources from the MCLT, technical support and marketing skills from Envirotrade and will be able to draw on the Plan Vivo Foundation for expert knowledge about the voluntary carbon market and standards.

What is the role of the local authorities?

Local government in Mozambique is growing in capacity and is becoming better equipped to deal with communities as resources are made available and constitutional reforms improve governance. The communities will benefit from this process.

What assets need to be retained by Envirotrade organisation and which ones will be transferred to MCLT?

The assets associated with the project will be systematically handed over to the MCLT and fall under the day to day management of the Community Association.

What are the handover processes?

The handover needs to be done formally, so that everyone is aware when it takes place and the commitments, which new people are entering into, or re-commitments by existing partners can be acknowledged. For those living in the area and those who have worked for some time in the area, the point of exit is a "Rite of Passage" and needs to be marked with celebratory events within the community.

GHG accounting period

The GHG accounting period is 100 years. Farmers who have signed contracts adopting agro-forestry systems are paid for the entire 100 years of contract benefit during the first seven years of each contract. This assumes that the agro-forestry activities, after 7 years, will be self financing and will provide sufficient incentive to continue for a further 93 years. All the trees planted as part of the project are useful, such as fruit, timber or firewood trees and there is an incentive to maintain the system beyond the payment period and replant dead trees, this significantly increases the permanence of the project. Each farmer may have several contracts (i.e. some already have six separate contracts in place). This means that actual carbon revenues are paid out over an extended period. For example, a farmer with four contracts implemented in successive years will get payments over a period of 11 years. The ownership of the project by the community as outlined in the exit strategy above will increase permanence of REDD management and agro-forestry. The trust fund will also release money for community projects beyond the payment period and beyond 2013 when Envirotrade pulls out.

G3.5. Identify likely natural and human-induced risks to climate, community and biodiversity benefits during the project lifetime and outline measures adopted to mitigate these risks.

Several risks have been identified and mitigated:-

Risk	Level of risk	Management measures
Risk of flooding: Mozambique has suffered from severe flooding in recent years, partly due to high rainfall and excessive runoff in deforested catchment areas and partly due to poor management of water resources on the Zambezi river. Neither of these factors is predictable and some level of flooding is expected in future years even if not on the scale seen recently. Flooding of the Pungue river (connected to the Zambezi by flood plains) does affect roads from Beira to the project site to the extent that these may be impassable at the highest volume of water. However the project site itself is above the level of the flood waters and has not been directly affected, even by the worst flood waters. While forestry and land management will not be affected, per se, operations management is planned taking flood risk into account.	**Low**	Ensure plenty of supplies are available to the project in the event of getting cut off from Chimoio and Beira. Install satellite internet connection to continue remote management if country and operations managers are isolated from the site. Use only off road vehicles in the project which can deal with damaged roads.
Risk of fire: Though fire constitutes part of miombo ecology, it is an important factor in forest loss and in poor regeneration. It also causes loss of forest dependant species. Fire is a risk to human life as well as infrastructure. On the 1st of September 2008, 99 homestead were destroyed and 43 people were killed in Manica and Sofala when a last bush fire swept through.	**High**	A key aim of the project is to work with communities in the buffer zones to develop techniques that reduce the need for fire in land management. In reforestation, fire should be prevented until the plants exceed the suffrutex height for moderate fires (typically 1.5 m). As such, fire protection activities must be more intensive during the first three seasons for moderately fast growing species. Tree species that can propagate vegetatively from truncheons have the advantage of jump-starting their establishment into saplings beyond the suffrutex stage, thus completely doing away with the seedling stage in the nursery. The risk of fire is actively reduced by the project, through physical means (by the use of fire breaks, training and deployment of fire management teams, using early burning, keeping fuel wood loads to a minimum and investing in fire-fighting equipment and by institutional means

Risk	Level of risk	Management measures
		education in schools and in communities and working with the community and park authorities to monitor illegal activities in the area which could lead to fire damage. More recently a new fire product MCD45A1 has become available to study fire scars in the region. This will allow the project to monitor the success of its fire regime.
Social risks: Divisions in the community can arise due to cultural, political or religious differences. Working with a project can assume more significance than just the activities involved and can be used to enforce positions and marginalize certain parts of society. The community can feel that their land tenure is threatened by outside investors which creates perverse behaviour which may threaten the climate benefits of the project. It choice is not central to the project design then people may feel they are being coerced into a project activity against their will causing social suffering.	**Medium**	These risks can be reduced through knowledge of the community to avoid possible conflict. All project staff, including senior management living in the community, have considerable experience in the community and have built up a high level of trust of the project's intentions. The project has also assisted with the creation of a community association as part of the registration of land rights in collaboration with the Mozambique NGO ORAM. The project is working with the community to develop community structures with the capacity to manage resources and finances. The project has also reduced the risk of social instability by ensuring that the community is fully involved in the design of operations. This helps ensure project objectives are correctly orientated and encourages a feeling of ownership and responsibility of the project. The unusually diverse array of land-use activities planned and undertaken in the project also ensure that a wide range of people from the community participate in the project. This reduces the number of people that feel left out.
Health risks. Aids and HIV are a large-scale problem in Mozambique. Some estimates put the figures infected as high as 30% of the population. Key figures within the community may fall victim to these infections, although currently the problem is less acute in remote rural areas than it is in urban centres.	Medium	The project will involve as many members of the community as possible to dilute the risk. The project is also directly involved in primary health delivery in the community by providing facilities, services and personnel.
Institutional capacity risks: The project may encounter difficulty when the structures in government are not available to support a complex project implementation with a relatively new commodity - carbon. For	Medium	The project works closely with a wide range of Mozambique role players and is working hard to foster links with local institutions at all levels. The project contributes directly in a range of ways to institutional capacity

Risk	Level of risk	Management measures
example in Mozambique there is no forest definition submitted to the by the Designated Operational Entity to the UNFCCC.		building through training, provision of extension support, technical advice and the exchange of research and information
Financial risk: The project has developed financial sustainability through the production of timber and other forest products in the community and through the sale of carbon offsets generated by these activities. The international market for carbon offsets is developing and much will depend on international negotiations about which there is uncertainty. There are strong indications that businesses will continue to invest in carbon offsets at some level regardless of decisions made at national level. Current trends show that companies invest partly to minimise their own risk in future and partly to improve their environmental and social credentials.	Medium	In order to maximise the opportunity for selling carbon offsets in this market, the project will seek to maximise the environmental and social benefits flowing from the project and hence capture business interest. Given the uncertainty in the carbon market, the financial sustainability of project activities is not solely based on carbon sales. Land-use activities will be promoted if they have the capacity to provide long term social and economic benefits independently of carbon sales. Carbon sales have served as a lever to accelerate change and improve the transition to sustainable livelihoods.
Institutional/political risks: Mozambique has a long history of political instability and violence. The civil war ended 15 years ago leaving much of the country's infrastructure destroyed and the economy devastated. Mozambique remains one of the poorest countries in the world and corruption is a problem in many areas. However, good progress is being made. The democratic election, after the war, was internationally recognised as fair and just, although some irregularities were reported in the subsequent election. Macroeconomic management by the government is sound. The economy is growing at 8% per year and the government is committed to reducing poverty. The UK DFID regards the prospects for effective development partnerships in Mozambique to be good and considers that 'Britain should expect to be involved long-term'.	Low	The project enjoys strong institutional support and endorsement by government at all levels. Various Cabinet Ministers, Governors and Ambassadors have visited the project and endorsed its groundbreaking efforts to address poverty using climate change related market mechanisms. It is an objective of the project to build independent institutional structures with the support of key members of the civic, legal and business societies in Sofala State to ensure that project activities are continued long after the project has finished.

G3.6. Demonstrate that the project design includes specific measures to ensure the maintenance or enhancement of the high conservation value attributes identified in G1 consistent with the precautionary approach.

The threat level to species living within the miombo woodland is insufficiently researched in order to establish threat of extinction levels[60]. As a result, the project protects the woodland so that species diversity is maintained. Specific areas REDD areas will be set aside for conservation where no cutting or disturbance will be permitted[61], these areas will predominantly be Riverine forest areas which have the highest biomass and conservation value. The exact location of the two vulnerable tree species has not been inventoried, all closed canopy woodland where they might occur has been included within the HCV assessment which will then be incorporated into the REDD management for the site in consultation with the community.

G3.7. Describe the measures that will be taken to maintain and enhance the climate, community and biodiversity benefits through and beyond the project lifetime.

The sustainable business exit strategy is defined in section 3.4. The sustainable land management activities adopted will generate additional income after carbon payments have finished through the increase in soil fertility, production of fruit and firewood. In forest management areas, NTFP exploitation and a reduction in land conversion pressure will reduce long-term incentives to deforest. The project and community are currently negotiating with the administrator to get the REDD areas Protected Status (Zonas de uso de valor historico-cultural) under article 13 of the Forest and Wildlife Law. This will mean that they will become protected by law and community consensus. There will no incentive for farmers to return to the baseline situation. The research pilot phase has already demonstrated this.

G3.8. Document and defend how communities and other stakeholders potentially affected by the project activities have been identified and have been involved in project design through effective consultation, particularly with a view to optimizing community and stakeholder benefits, respecting local customs and values and maintaining high conservation values. Project developers must document stakeholder dialogues and indicate if and how the project proposal was revised based on such input. A plan must be developed to continue communication and consultation between project managers and all community groups about the project, its impacts and potential adaptation of implementation throughout the life of the project.

Communities have been extensively involved in project design and implementation through:

1. Scoping study (January/February 2002)
2. Consultations with stakeholders (January –December 2002)
3. Stakeholder summit at Chitengo (August 2003)
4. Community briefings (08 December 2003 process launched, since then ongoing)
5. Traditional ceremony with *Régulo* (August 2003)
6. Meetings with interest groups (ongoing)
7. Meetings with government departments (ongoing).

Reliable feedback used to improve project outcomes is generated through:

1. Quarterly reports
2. Report backs to Community
3. Meetings with Management committee

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[60] Campbell, B. M. (1996). The Miombo in Transition: Woodlands and Welfare in Africa. Bogor, Indonesia, Centre for International Forestry Research.

[61] See individual forest management plans for each conservation area.

4. Visits to the project

5. Inspections by independent bodies.

Field-based knowledge can be of value to other projects. If actively disseminated, this information can accelerate the adoption of innovative practices that bring benefits both globally and locally. Relevant or applicable lessons learned have been documented through:

1. University of Edinburgh – research and publication - ongoing
2. Conference at end of the EU research and development phase
3. Producing operational manuals.

To encourage replication of successful practices, information is disseminated as follows:

1. Extension support and training
2. Demonstration plots and systems
3. Sending farmers for specialised training
4. Training seminars and workshops
5. Working visits by community leadership from other areas in the region
6. Research students using the project as a field site
7. Co-operation with University of Maputo and IAC
8. Participation in conferences and workshops
9. Publication of research papers
10. Websites
11. Schools education programme.
12. Project handbook has been drafted to replicate the project in other areas

G3.9. Describe what specific steps have been taken, and communications methods used, to publicize the CCBA public comment period to communities and other stakeholders and to facilitate their submission of comments to CCBA. Project proponents must play an active role in distributing key project documents to affected communities and stakeholders and hold widely publicized information meetings in relevant local or regional languages.

The project has already setup a functioning communication platform for different stakeholders. The community associations are actively involved in project activities from signing contracts to managing the trust fund. The project website provides access to project-specific documents and to information which is of public interest. Already it is one of the most informative websites for information on miombo management.

The project has translated a number of key documents into Portuguese to provide stakeholders that do not speak English with access to information. Furthermore, the project is documenting minutes from all stakeholder meetings which are available on site. This ensures transparency and serves as an institutional record of the development of the partnership between the community and the project.

The community traditional leaders[62] and community association discussed the CCBA process and its purpose in the week starting the 17th of August 2009 during regular meetings with the project. Provincial

[62] Minutes will be taken at meeting to show those attending. Available in the „Attach folder".

government was also informed in the same week. A summary of the PDD in Portuguese was disseminated to leaders and government in these meetings. A copy of the PDD will also appear on the project website with a Portuguese summary once the audit process is finalised.

G3.10. Formalize a clear process for handling unresolved conflicts and grievances that arise during project planning and implementation. The project design must include a process for hearing, responding to and resolving community and other stakeholder grievances within a reasonable time period. This grievance process must be publicized to communities and other stakeholders and must be managed by a third party or mediator to prevent any conflict of interest. Project management must attempt to resolve all reasonable grievances raised, and provide a written response to grievances within 30 days. Grievances and projects responses must be documented.

Three types of dispute have been defined, each being resolved in a different manner.

1. Disputes between Project staff and Envirotrade are resolved by a labour syndicate which represents workforce. Procedures where disputes relate to harassment are documented below.
2. Disputes between the Community and Envirotrade are resolved by consultation and discussion. Mediation is provided by the District Administrator, where required.
3. Disputes between Individuals and Envirotrade are resolved dependant on the concern. If an individual has broken contract with Envirotrade then there are clear guidelines in the contract[63] as to how to proceed. If there is any other dispute between Envirotrade and the individual, a combination of traditional and civil authorities will act as mediators. Community chiefs and sub-chiefs represent traditional authority and the Community Association represents the civil, elected authority[64].

The first point of contact for a producer who is unclear on his or her contract, monitoring or payment is the community technician who is based in the same community. In the instance that the technician is the source of the problem, regular visits to each ward are carried out by the agro-forestry supervisor and other managers. The producer will have the opportunity to raise an issue during these visits or during one of the regular consultations held in each community, for example any meeting prior to monitoring. Disputes are significantly reduced in the community if they are involved in the monitoring of their own fields, co-sign the monitoring form and keep their record of the trees planted and contracts. A meeting prior to monitoring is essential to prime producers about what to expect and the possible consequences. An improvement in monitoring in 2010 was to provide the community technicians with easy reference summary sheets for their farmers from the database. This meant that data could be on hand to answer any questions or queries on mortality and payment, rather than the individual contract to be sourced in the contract stores at HQ. This new system will be included in the monitoring plan.

Disputes between community employees and Envirotrade

Where informal methods fail, employees are advised to make a formal complaint to their Supervisor/Line Manager or where this is not appropriate another Team Leader/Manager or the HR Manager. Where possible, the complaint should be made in writing and state:

- The name of harasser
- The nature of the harassment

[63]Library of contracts is available onsite and scanned copies available.

[64] A list of traditional leaders is available for each community. This is continuously updated, when a leader dies he son traditionally inherits his title. The community association is an elected body and members are available on request.

- The dates and times when the harassment occurred
- The names of any witnesses to any incidents of harassment
- Any action already taken by the complainant to stop the harassment

In circumstances where the employee has not kept a record of the dates and times when the harassment occurred, they should not feel they are unable to complain. The company is committed to eliminating harassment and all complaints will be treated seriously and fairly.

When the complaint is received, action may be taken to separate the harasser from the complainant. This may involve the temporary transfer of the alleged harasser to another department, or suspension with pay in accordance with the company's disciplinary procedure until the complaint has been investigated and resolved.

The next steps to be taken will be in accordance with the company's disciplinary procedure. A thorough investigation will be carried out as quickly as possible. This would normally be conducted by the employee's Team Leader/Line Manager unless they are connected with the allegation in any way in which case a more senior manager will conduct the investigation.

During the investigation, all employees involved are expected to respect the need for confidentiality and failure to do so will be considered a disciplinary offence.

As part of the investigatory process, investigatory meetings will normally be held with the alleged harasser and complainant. They will both have the right to be accompanied by a work colleague or Trade Union official at these meetings. In preparation, the alleged harasser will be given full details of the nature of the complaint. The purpose of these meetings is to gather all the facts surrounding the complaint in order to determine what action is required. An appropriate member of staff may accompany the Team Leader/Line Manager to the meetings in order to take notes and witness proceedings.

As part of the investigatory process, any witnesses will also be interviewed to obtain further details of events.

If after a full investigation has been undertaken the Team Leader/Line Manager feels disciplinary action is required, the issue will be taken forward in accordance with the company's disciplinary procedure (reference must be made to this procedure). Disciplinary action may range from a verbal warning through to summary dismissal depending on the circumstances and severity of the incident.

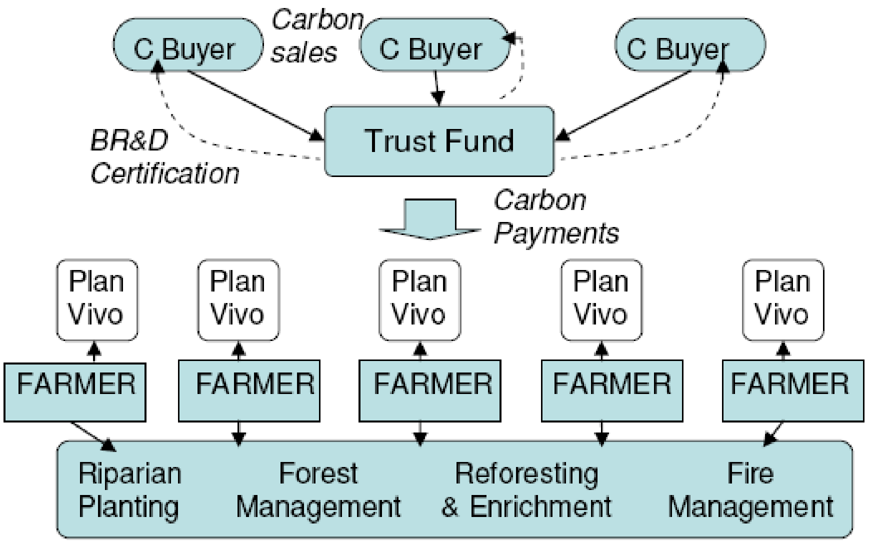
The employee who was subjected to the alleged harassment will be advised of the outcome of the investigation and disciplinary procedure (where conducted). If they are not satisfied with the way in which the complaint has been handled then they should raise a grievance in accordance with the company's grievance procedure. This will normally commence at stage 2 of the grievance procedure. This should be done within 5 days of being informed of the outcome of the investigation or disciplinary process (where conducted).

G3.11. Demonstrate that financial mechanisms adopted, including projected revenues from emissions reductions and other sources, are likely to provide an adequate flow of funds for project implementation and to achieve the anticipated climate, community and biodiversity benefits.

The project has built structures to ensure financial sustainability through forest management, improved farming techniques, the production of timber and NTFPs . The transformation of the community will also benefit from the sale of carbon offsets. This serves to accelerate rather than maintain the rate of change.

The Plan Vivo system is based on a contractual relationship between the project developer and the farmer (producer). The contract contains clauses, compliance with these clauses will ensure the release of a payment for ecosystem service from Envirotrade through MCLT.

Figure 11. Organisational structure of the project according to Plan Vivo specifications.



Mozambique Carbon Livelihoods Trust (MCLT)

An independent trust (MCLT) has been established to administer the proceeds of the sale of carbon offsets generated by project activities. It is supported in all of its activities by EML, a non-profit company under Mozambique law, sponsored by Envirotrade Group and with local stakeholders. MCLT and EML keep records of all land-use activities implemented in the target community and details of monitoring activities carried out. Monitoring of forest management areas will be carried out by Eduardo Mondlane University and is paid for by MCLT from carbon offset sales.

EML serves as a point of exchange between parties interested in purchasing carbon offsets and communities involved in land use activities and ensuring transparent accounting of carbon assets. EML, on behalf of MCLT, will use a recognised Markit Registry (previously TZ1) to track the produced and traded carbon offsets.

To carry out verification and registration activities for MCLT, EML technical and administrative personnel work on land-use planning, assessment and aggregation, as well as monitoring and administration of carbon assets.

MCLT was launched in 2007 to ensure that the community and individual farmer proceeds of carbon offset sales from Envirotrade Carbon Livelihoods projects in Mozambique were safeguarded. At least one third of the proceeds of any carbon offset sale go directly to this fund and are paid out to individual farmers over seven years for agro-forestry and other payments for REDD management and incentives.

MCLT works closely with related community associations to ensure that sustainable livelihoods are built and that far reaching land-use change takes place in target communities in and around protected areas. MCLT's position within the carbon finance custody is below.

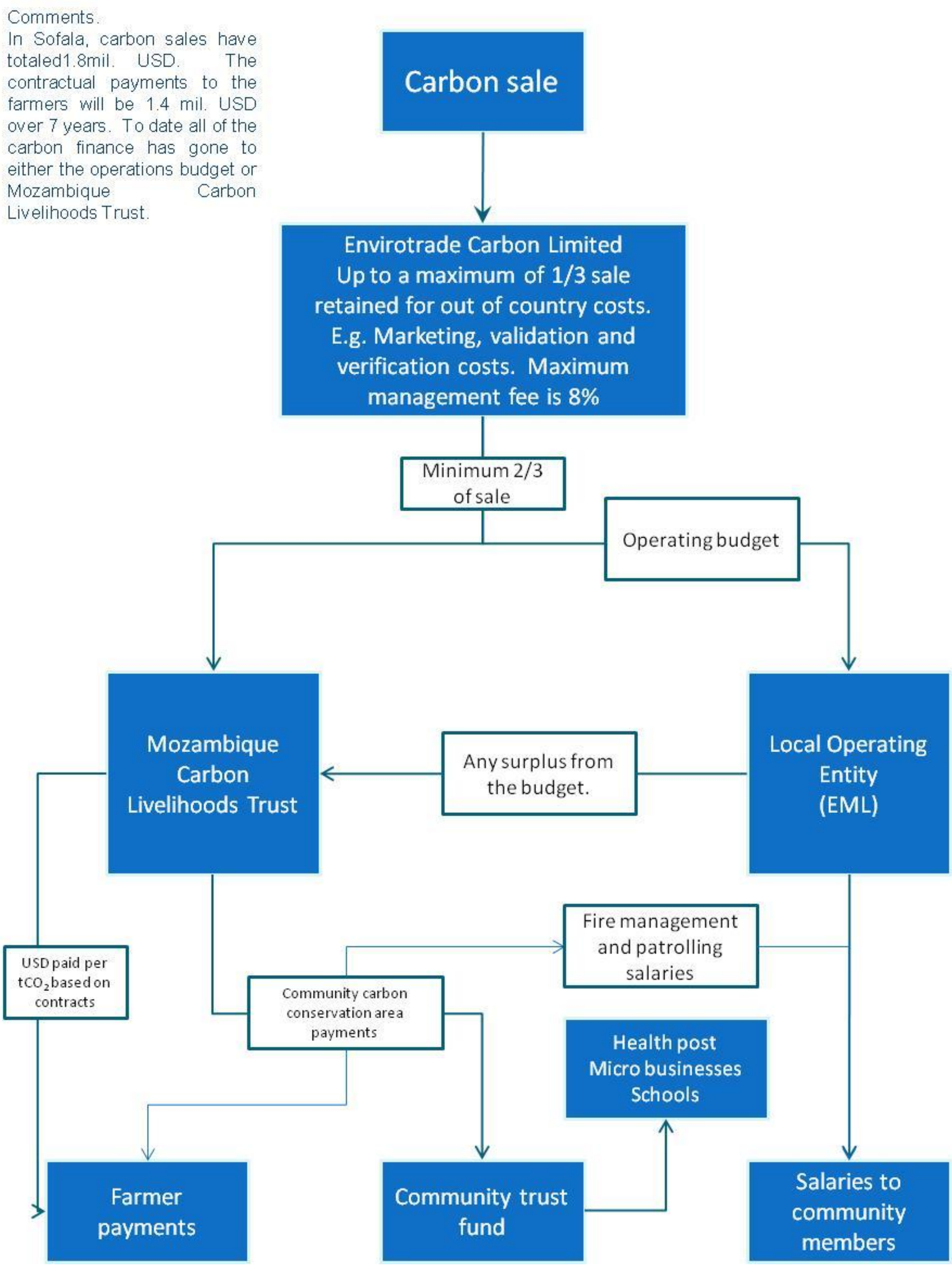


Figure 25. Benefit sharing through MCLT in relation to the other entities. USD paid to the community per agroforestry and agricultural tCO_2 is 4.46 USD. Community carbon conservation areas are under REDD management. Payments are made relative to the area size stored for REDD management as payments for fire management and patrolling. The more sales are made, the more money will be placed in MCLT, which after payments are made, will place the balance in the community trust fund.

Each farmer in the project has one or more contracts to manage his or her land according to Technical Specifications, guidelines, procedures and standards on agro-forestry planting and REDD. Adoption of the Plan by a farmer triggers payment from MCLT. Clients who buy carbon receive certificates from the Plan Vivo Foundation. Independent third party project validation and verification services are conducted by independent Plan Vivo and CCBA standard accredited companies. Carbon sales are organised through MCLT, composed of local stakeholders.

A portion of the income in MCLT goes to farmers directly based on a contractual agro-forestry payments of 4.46 dollar/tCO_2 irrespective of sale. Another proportion will be paid to the community trust fund dependant on compliance with REDD management strategies in accordance with the monitoring plan. Individuals are paid for patrolling and fire management, communities are paid for not opening machambas or setting bush fires. The more sales the more money goes into MCLT as the operations cost will remain static. This directly links the client to the farmer, after the contractual payments are made through MCLT any balance may be used by the community trust fund for community projects such as school building. So far three schools have been built in Nhambita, Mbulawa and Munhanganha.

It is important to note that while carbon credits have been calculated as an average carbon benefit per hectare over 100 years, farmers are paid the entire value of these offsets during the first seven years. The schedule of payments to farmers for tree planting runs as follows: immediately after planting, 30% of payment, then 12% per year for five years, then a final payment of 10% in the seventh year. Thereafter, the trees are established and yielding sufficient tangible benefits to dissuade the farmer from reverting to shifting cultivation. The no burning of agri-residues payment is split evenly across the 7 years and is not front weighted as there is less implementation labour required from the farmer than there is for tree planting for the first year.

Several hundred farmers are expected to participate in more than one Plan Vivo contract each and to receive payments over seven years for each contract from date of signing. For REDD, payments are made over 10 years to the community fund in the case of a publically owned parcel of land and the owner of the land in the case of a privately owned parcel of land. REDD areas may be private land where a farmer owns part of the bush which his or her family have the right to clear under traditional law. Otherwise all of the largest areas are owned communally.

At least 2/3 of sales revenue will remain in country and be reinvested in the community. As in figure 24 this 2/3 includes the operations budget of EML. Where EML covers its costs the balance is returned to MCLT for distribution to the community fund. To date all the revenue from sales has been reinvested in the community (over two thirds). MCLT performs an oversight role ensuring that the not-for-profit company acts in the best interests of MCLT and the producers.

ECL receives up to one-third of the proceeds of any carbon offset sale to cover all off-site and international administrative, research, project development and marketing costs and provide the Company a profit. This includes responsibility for validation, verification and certification. All taxes, etc are also paid from this portion of the funds from carbon offset sales. Importantly, ECL takes on the responsibility of covering any shortfalls at the MCLT by extending interest-free loans. These short-falls arise when carbon is sequestered by project activities and is not immediately sold. The maximum management fee from sales is 8%.

Based on total carbon stocks generated and average price the total revenue generated by Sofala project will be over 10 million dollars which will cover implementation costs and still provide MCLT with finance.

Building financial sustainability

The range of co-benefit activities designed to compliment the carbon management in the community focussed on livelihood creation. The micro-enterprises provided a flow of co-benefits to a wider range of community members than those contracted to provide carbon related environmental services. These included beekeeping, a saw-mill, a carpentry workshop, crafts, nurseries and vegetable production. The management consortium that administered the project for the first five years handed over management of the project to Envirotrade in 2008; this effectively marked the end of the first phase of the project and the commencement of the downscaling of direct participation in the management of the project.

G4. Management Capacity and Best Practices

G4.1. Identify a single project proponent which is responsible for the project's design and implementation. If multiple organizations or individuals are involved in the project's development and implementation the governance structure, roles and responsibilities of each of the organizations or individuals involved must also be described.

The single project proponent is Envirotrade Carbon Limited, however the project is a collaborative effort between several different organizations, which hold the following roles and responsibilities:

Envirotrade Mozambique Limitada (EML), a Mozambique not-for-profit organization, has responsibility for Project Technical Operations and full Project Administration after the Pilot Project phase. EML administers the day-to-day running of the project using staff stationed at the Headquarters in Nhambita, for the Gorongosa region, and close to Inhamitanga, for the Zambezi Delta region. EML runs the technical operations, employs local staff, and manages relations with the local communities involved.

Envirotrade Carbon Limited (ECL). ECL has replaced Envirotrade Limited as the project developer in early 2009. The voluntary liquidation of Initial Carbon Partnership Limited (formerly Envirotrade Limited) in the UK is a long-planned step in the corporate restructuring of the Envirotrade Group, and will have no negative effect on any of the Group's projects. Since early 2009, the principal company of the Group has been Envirotrade Carbon Limited, incorporated in Mauritius. The Mauritius jurisdiction was chosen for this new entity in order to establish the Group more appropriately in Africa. Envirotrade Carbon Limited has assumed all of the assets, liabilities and operating functions of the former Envirotrade Limited in the UK, and has established registered branches in both the UK and the Republic of South Africa to conduct the Group's business in those two countries., has the responsibility to market the carbon offsets generated by the projects, negotiate the sale of the carbon offsets, raise additional finance where necessary, carry out research and administration and develop new projects.

Mozambique Carbon Livelihoods Trust (MCLT) is a Mozambique trust responsible for management of the proceeds of the carbon sales. This vehicle is a safeguard to protect the interests of the farmers and the local communities. The trust fund is currently in an embryonic form and must develop in accordance with the exit strategy documented in G3.4. Board members include the Community Association, Contabil (an auditing firm) and EML. In the future, EML will pull out involvement completely and will be replaced by representatives of independent NGO's.

The University of Edinburgh (UoE), a British academic institution, was responsible for the EU-funded project supporting the research Pilot Project phase. UoE will continue to carry out general research and carbon monitoring.

The **Edinburgh Centre for Carbon Management** (ECCM), a British commercial Organization, provides Plan Vivo and related services and administers Plan Vivo activities. Database management for Plan Vivo was initially manual but an electronic database has been in use for three years. ECCM developed the Plan Vivo approved technical specifications which the community, in partnership with EML, implement.

The **Park Administration of the Gorongosa National Park** provides an additional source of revenue to the Community Association from tourist revenue. The Park Administration cooperates with the project on fire management, conservation enforcement and an environmental education program which was run by the project and WWF. The project was initially developed in 2000 in collaboration with Roberto Zolho, the then park manager who perceived the need for a human fence around the park.

Other stakeholders in the governance of the project, include:-

- Forest dwelling communities living in the buffer zone and the park;
- Mozambique Government Departments of Agriculture, Forestry, Health, Education, Energy, Tourism and Environment;
- Plan Vivo Foundation (www.planvivo.org), for inspection and certification;
- Eduardo Mondlane for research and monitoring;
- Funding from the purchase of carbon Offsets by corporations (e.g. The Creative Artists Foundation of Los Angeles, MAN Group, IIED & the Carbon Neutral Company);
- Various local and international NGOs (co-operation with GTZ, Food for the Hungry and WWF Mozambique).

Plan Vivo project participant structure			
Party	**Type of organization and legal status**	**Nationality**	**Role**
Envirotrade Carbon Livelihoods	Commercial, incorporated in Mauritius.	Mixed	Carbon credit sales, marketing and coordination of validation and verification processes.
The University of Edinburgh	Academic	British	Carbon monitoring and research
University of Eduardo Mondlane	Academic	Mozambique	Research and ongoing monitoring
Envirotrade Mozambique Limitada	Not for profit company in Mozambique	Mozambique company local subsidary of ECL	Manage project operations
Edinburgh Centre for Carbon Management	Commercial, now re-organised in to the commerical arm of Plan Vivo, BioClimate Research & Development	British	Writing technical specfications for the project developer

The Mozambique Carbon Livelihoods Trust (MCLT)	Non-profit making Trust	Mozambique	Ensure that the community and individual farmers benefit

G4.2. Document key technical skills that will be required to implement the project successfully including community engagement, biodiversity assessment and carbon measurement and monitoring skills. Document the management team's expertise and prior experience implementing land management projects at the scale of this project. If relevant experience is lacking, the proponents must demonstrate how other organizations will be partnered with to support the project or have a recruitment strategy to fill the gaps.

Key technical skills required to implement the project successfully

The core project management team members are presented below. They combine long term practical experiences in project and miombo forest management.

- Envirotrade Operations Director : Philip Powell (ECL)

  Philip has extensive experience in relations with and working in post conflict communities after 6 years of working with the KwaZulu-Natal Peace committee. He also continued to represent rural communities in his role as senator in the first post apartheid senate in South Africa. He has successfully implemented a community reforestation project in Bhutan. He has coordinated the project from 2001, and expanded it to include Zambezi Delta site. He has taken the Envirotrade model to Quirimbas national park and is supervising its expansion. He has carried out scoping studies for community carbon projects in Zambia, Sudan, Ghana, Senegal and Angola. He has been invited to carry out carbon consultancy work in Zambia and has just started a community agro-forestry project in the Democratic Republic of Congo. Philip has an MA in Strategic studies and is a Miombo committee member.

- Country Manager: Antonio Serra (EML)

  Antonio was the EML Mozambique Operations country manager until 2009 when in a long planned move Antonio was promoted to Mozambique Country Manager in recognition of his success. Prior to working for Envirotrade, Antonio has worked as a team leader for WWF in Niassa reserve on human elephant conflict, been head of the Sofala Forest and Wildlife Department, co-ordinator of the natural resource community association Mucombezi *Regulado,* head of the forest research centre in Manica Province and coordinator of Community Based Natural Resource Management Project in Moribane Forest Reserve. Antonio has an MPhil in development studies from the University of Brighton and a BSc. in Forestry.

- Project Manager Zambezi Delta region : Alastair MacCrimmon (EML)

  Alastair has over 30 years experience of forest and forest related industries in Zimbabwe, South Africa, Mozambique and other East African countries. He has coordinated extension services to rural tobacco growers in Zimbabwe to plant trees for fuel wood. He has managed multiple forestry plantations and has had a special role in achieving FSC certification in Zimbabwe. Alastair has a forestry diploma.

- Operations Manager Zambezi Delta region : Aristides Muhate (EML)

Aristides has extensive experience in the Forestry service and is well conversant with community forestry and Mozambique Forest Law. Prior to joining EML he was the Head of Provincial Department of Forest and Wildlife in Nampula Province. He has extensive computer skills and is a skilled data base manager. He has an BSc (Hons) in Forestry Engineering.

- Administrator Lee Mangochi (EML)

  Lee has experience in fulfilling similar jobs in large multinational companies working in Mozambique and is experienced in dealing with Mozambique laws and other requirements. He has a Diploma in Business Administration.

- Co-Benefits Consultant: Gary Goss (EML)

  Gary has 30 years of experience in forestry, agriculture and community resources. Gary worked in with community members in intensive conservation areas for 22 years in Zimbabwe focusing on stream bank cultivation, forest protection and water conservation. He is involved in the human capital development in the community.

- Technical support and research: Lucy Goodman (ECL)

  Lucy Goodman is Envirotrade technical expert in the carbon sequestration field and provides scientific and technical support to the projects on the ground. She has worked at the International Emission Trading Association contributing to submissions to the UNFCCC and as an analyst in EcoSecurities implementation team. She has worked on the potential of REDD in Sierra Leone and assessing climate change monitoring capacity in Ghana. Lucy has a BA in Biological Sciences and a MSc in Applied Ecology and Conservation.

- Database administrator: Alex Tendai Chipepera

  Alex is a qualified computer programmer and competent in systems analysis and designing. He is a member of the Association of Computer professionals in England.

- Miombo Committee member: Dr Richard Tipper (Ecometrica)

  Part of the original consortium during the EU research and development phase Richard is a pioneer applied researcher into carbon science and carbon credit quantification.

- Professor John Grace (UoE), research & carbon monitoring support

  Part of the original consortium during the EU research and development phase John is the Professor of the Department of Geosciences at Edinburgh University. He has published extensively on carbon dynamics.

G4.3. Include a plan to provide orientation and training for the project's employees and relevant people from the communities with an objective of building locally useful skills and knowledge to increase local participation in project implementation. These capacity building efforts should target a wide range of people in the communities, including minority and underrepresented groups. Identify how training will be passed on to new workers when there is staff turnover, so that local capacity will not be lost.

The project builds various types of institutional and human capital

The project was designed from the outset to address specific challenges in the community that undermine sustainable development objectives. Key components of this strategy are embedded in the project design and are referenced to the challenges that determine the projects success in delivering its objectives. These challenges to sustainable use of natural resources are rooted in the experiences of Mozambique and its people though the years of war and conflict that devastated the country. The process of development of capacity in key aspects has systematically engaged the project in reconstruction and development at a community level in a manner that seeks to maximise the transfer of key skills and the fostering of self sufficiency. A fractured community which had seen the dispersal and displacement of its people, the destruction of key civic and traditional structures and institutions and the complete cessation of education had to be engaged and assisted to develop the carbon product and distribute the proceeds to the sale in an equitable and transparent manner. This was a major challenge in a community that was identified from the outset as having a particularly acute deficit in all areas of social and other capital. Reconstruction and development in Sofala has come as a consequence of building capital in key areas:

1. Increased technical capacity: a key component of the project has been training. The training of thousands of farmers in agroforestry and forestry techniques, training community technicians in the use of carbon management systems, training community forest and fire management teams and training of community representatives in administration and financial management. Key to this process has been the recruitment, training and deployment of community technicians. These individuals who are recruited from amongst the farmers participating in the project are key to the long term sustainability of the project. They receive regular retraining and are responsible for both the support of farmers but also the ongoing monitoring of farmers compliance with the systems and standards. They are a key component as they are imbedded in the community and it is foreseen that they will play a central role in the transformation of their community and that their continued presence in the community as part of a resourced programme for an extended period of time will be a key factor in the long term success of the Carbon Livelihoods programme.

2. Management systems: The project has developed a participatory system for managing the sale of carbon credits and administration of the contracts and payment of the proceeds to stakeholders. This management system draws heavily on the participation of the community technicians at all times and will be eventually imbedded in a logical and user-friendly carbon database.

3. Data and technical information: The project has produced datasets and developed technical documents required for the management of carbon assets and disseminated this knowledge through training and the translation of key documents into Portuguese. The dissemination of these documents in vernacular languages is a key objective of the programme and key to long term sustainability and the transfer of skills and knowledge to farmers and the community.

4. Institutions: the project has led to the establishment of elected statutory community associations with responsibility for the management of community resources and regional institution with the responsibility of managing carbon assets from the pilot project and other areas. These structures have gained in experience and self-confidence through the projects life time and are becoming increasingly competent in the administration of the project and its activities. The community associations are involve din all meetings with the government and are increasingly able to lead these meetings.

5. Material: tree nurseries and planted seedlings, reforested areas have the potential to provide long-term social and economic benefits to the community and through tree nurseries established in the project this area may be expanded. Nursery micro-enterprises have emerged and flourished as a response the projects interventions.

6. Infrastructure: the community has invested in infrastructure such as the building of schools, a clinic and the wells. The community associations have held consultations, agreed on sites and priorities, planned, allocated resources and overseen the building activities related to the building of the schools. The process of

identifying sites, planning, budgeting and execution of the building project is now largely administered and controlled by the community leadership. This capacity will be harnessed in the future management of the community and its resources by its elected representatives.

7. Administration: The success of project income producing activities has meant that a significant proportion of the proceeds will be administered by the Mozambique Carbon Livelihoods Trust (MCLT). Part of the funds raised from the sale of carbon offsets have been invested in the Community Associations to build capacity and the Associations have worked closely with Envirotrade and the MCLT to determine how community carbon funds should best be used. The MCLT as a independent entity is central to the long term sustainability of the programme in these and other communities. The trust fund will eventually have a number of trustees on its board representing key members of the civic, legal and cultural societies as well as representatives of project management and financing bodies.

8. Sustainability at the policy level: The project has the support of officials at all levels of government. The project works closely with all stakeholders in this regard and with both provincial and national government to demonstrate how carbon offset projects can provide a range of benefits to rural populations and provide a framework through which rural development projects can register resulting carbon offsets in a way that will facilitate either the sale of such offsets if international agreements allow or for such offsets to be included in the national carbon balance once international treaties are extended to include Annex one countries.

9. Ongoing monitoring – the continued implementation of the standards and institutional arrangements that underpin the Carbon Livelihoods Programme is crucial to credibility of the product and continued sales of carbon offsets. The project through the MCLT has entered into a contractual agreement with the University of Eduardo Mondlane to conduct ongoing annual monitoring of the ongoing fire and forest management component of the programme. The parameters and guidelines for inspections need to be agreed between all stake holders up front in a contract will be between University of Eduardo Mondlane and the MCLT. An annual inspection process of two distinct programme areas will take place in September each year and inspection to be followed promptly by a written report. Corrective actions will take place in October and then a final annual report will be produced.
Monitoring plan by the University includes annual boundary inspection of fire breaks, incursions and integrity of the boundary controls and protection programme for the forest. The inspection draws on remote sensing and monitors ecological indicators, the functioning management / governance of related activities, meets with the governing committee which produces a report summarising their activities for the year and details problems encountered. The inspections monitor restoration activities, fire management programme, leakage and ensure forest resources are being used sustainable according to the management plan. (i.e. check on extraction figures supplied by the committee).

The monitoring process tracks and documents encroachment, land clearances for agriculture, unsustainable activity such as charcoal production, uncontrolled burning and illegal logging in the project area. The annual inspection ensures that a plan is in operation and that its interventions should include; protection / sustainable management of any woodland areas within the community, the implementation of agroforestry measures to provide products such as fuelwood or poles that may no longer be available from within the conserved woodland, a plan to monitor leakage on specific woodland areas outside of the woodland conservation area and the management of leakage.

The process and the monitoring programme of the University will be subject to periodic ongoing external review by Smartwood and the Plan Vivo Foundation. These verification inspections are linked to the issuance of certificates and the long term credibility of the project and its product.

Training community technicians.

Sofala has a strong training and development component that is directed at the provision of skills and other resources to our staff. This training is undertaken at the Nhambita Base Camp and the counterpart camp in Zambezi Delta closer to Inhamitanga and involves a number of elements:

- Training of Community Extension Officers is undertaken and certificates are issued on the completion of the syllabus. Training is structured around an operational manual as well as technical and other guidelines. The training also involves extensive field training as the community extension officers are based in the community and are the primary interface between Envirotrade and the community.
- Training of Forest Technicians is conducted by the University of Edinburgh and paid for by Envirotrade. Assistance is also provided from the University of Eduardo Mondlane. Technicians are provided with ongoing training and are also exposed to training by external experts and visiting scientists..
- Training of staff – Envirotrade encourages staff members to attend international conferences and publish in academic journals on subjects related to our core business. Envirotrade and the University of Edinburgh have also sponsored post graduate studies for three employees..
- The company also organises training workshops that bring together external experts to train its management.

Capacity building through the project is structured to accommodate the broader needs of the community and not only for the direct needs of the project. The development in capacity of all the community associations, involved in the project provides significant co-benefits. Additionally, school programmes have been developed that provide a basis for continuous knowledge transfer.

Capacity building is provided through (i) short courses given by experts and (ii) training on the job. Some examples[65] include:

- Running a tree nursery
- Agro-forestry techniques
- Tree planting
- Recording sample plots, inventory
- Biomass survey
- Measuring survival and growth of trees
- Planning harvesting operations
- Tree felling techniques, use of a saw mill
- Beekeeping
- Breeding guinea fowls
- Carpentry
- Use of PC soft-ware to keep records
- Business training and bookkeeping

[65] Training materials and manuals in Portuguese available on site.

The University of Edinburgh (UoE) has carried out a forestry inventory and has developed the Permanent Sample Plots. The forestry technicians are trained to monitor these in absence of supervision by the UoE.

UoE has also supplied research-level inputs in: fire impacts and fire control, carbon modelling, charcoal production (this will be achieved through postgraduate students, some of them Mozambican). Technical support for tree nurseries and agro-forestry work will come from a forestry and agro-forestry experts, employed by EML. The level of experience required for this work is high; it requires technical knowledge and leadership skills. External reviews will be regularly sought.

Through the development of Technical Specifications, the project has, in fact, generated valuable material to guide the implementation of different practices, i.e. the Technical Specification on REDD sets out how to calculate the initial carbon stocks according to different vegetation types.

G4.4. Show that people from the communities will be given an equal opportunity to fill all employment positions (including management) if the job requirements are met. Project proponents must explain how employees will be selected for positions and, where relevant, must indicate how local community members, including women and other potentially underrepresented groups, will be given a fair chance to fill positions for which they can be trained.

The Sofala Community Carbon Project already provides the majority of permanent jobs for local people living in and around Chicale and Mucombezi *Regulado*. In Zambezi Delta site 18 people are employed in the main camp. The project hires local people as forestry and agro-forestry technicians and for a wide range of project duties.

People are recruited in consultation with the Community Associations in different areas which is an independent democratically elected group. In this way Envirotrade does not bias selection towards one particularly group. In an independent review from the Africa Forum[66], it was found that Envirotrade had an equal mix of employment of the two political party members in the area.

The community nurseries, operating as independent private enterprises, also employ a number of women. There were originally two female community technicians in Gorongosa site and one in Zambezi Delta, all have since left Envirotrade but in the future the project is open to hiring female technicians again.

The project has minimised the risk of social instability by ensuring that the community is fully involved in the design and implementation of day-to-day operations. This helps to ensure that people are focussed on project objectives and encourages a feeling of ownership.

The project involves as many members of the community as is possible in the expectation that reliance on a small number of individuals may be a high risk strategy due to the high HIV infection rate.

A socio-economic study of the project has shown that participation in the pilot project is not a function of literacy [67] and that even the poorest and most illiterate people have signed agro-forestry and forestry contracts. Furthermore, 43% of contracts, in the Gorongosa project region, are held by women and 22% are held by women in the Zambezi Delta region. It is hoped that, as the Zambezi project becomes more established, there will be an increase in female participation.

G4.5. Submit a list of all relevant laws and regulations covering worker's rights in the host country. Describe how the project will inform workers about their rights. Provide assurance that the project

[66] Africa Forum 2008. Report on the Nhambita community carbon project.

[67] Rohit Jindal. Page 369 Final Report.

meets or exceeds all applicable laws and/or regulations covering worker rights and, where relevant, demonstrate how compliance is achieved.

In the project regions, there is an active worker syndicate[68] which is involved in any disciplinary issues and has an infrastructure of meetings, etc. The syndicate works closely with the Community Association. As the project is community driven (fundamental to the Plan Vivo process), emphasis on the rights of the community, workers and individuals is central to the project's ethic. EML works very closely with the workers syndicate, representatives of the syndicate regularly assist at project meetings. Envirotrade and the Community Associations also assist the Syndicate officials in their task of representing the workers and meeting with them, educating them and interacting with them.

The project also employs a Projects Administrator who assists in interfacing with the syndicate and the community on labour and administrative issues. He is works closely with the Labour Department and other relevant government departments. His responsibility is to ensure that the project and all of its activities comply with all labour legislation. The project and its activities is overseen via regular inspection by the Labour Department.

The applicable law is the Labour law 1998 accepted on the 30th April[69].

G4.6. Comprehensively assess situations and occupations that pose a substantial risk to worker safety. A plan must be in place to inform workers of risks and to explain how to minimize such risks. Where worker safety cannot be guaranteed, project proponents must show how the risks will be minimized using best work practices.

Risks to Envirotrade workers includes but is not limited to vehicle accidents, health complications from rural isolation, recurrence of war in a post conflict society and wild animal attack. Envirotrade ensures that its employees have sufficient safety equipment (helmets for motorbike operatives), medical assistance from the health post and employment of a nurse on site and avoid putting workers in undue risk of wild animal attack during inventories by ensuring technicians do not visit field sites alone or in small groups.

Project vehicles are regularly used when a Envirotrade worker or community member need urgent hospital attention.

Micro-businesses such as the saw mill, bee keepers and carpentry shop have been independent of Envirotrade since the beginning of 2009 as part of the sustainability programme. Nonetheless during the training stage and handover safety equipment and advice was provided.

G4.7. Document the financial health of the implementing organization(s) to demonstrate that financial resources budgeted will be adequate to implement the project.

All implementing partners are subjected to annual audits by independent auditing companies. All organisations are subject to inspections. Project has been running independently of EC grant finance for a year. When all carbon credits are sold, current losses will be covered[70].

G5. Legal Status and Property Rights

[68] List of members available

[69] Mozlegal, L. (1998). Law nr 8/98. Assembly of the Republic.

[70] See Envirotrade Group Budget Summary 2009.

G5.1. Submit a list of all relevant national and local laws and regulations in the host country and all applicable international treaties and agreements. Provide assurance that the project will comply with these and, where relevant, demonstrate how compliance is achieved.

This project is consistent with:

- The **1995 National Environment Policy**; this specifically has, as its aims:
  - To ensure that environmental and natural resource management takes place in such a way that ecosystems maintain their functional and productive capacity for the present and future generations;
  - To promote the ecosystems and the fundamental ecological processes; and
  - To integrate global and regional efforts in the search for solutions to environmental problems.
- The **Agrarian Policy**; one of the main objectives is:
  - The involvement of the local communities in the management of natural resources to promote the sustainable use of natural resources.
- The **Land Policy**; the Land Policy stresses the recognition of the local community's rights, as well as their methods and approaches to the agrarian management of land.[71]
- The **1997 National Policy and Strategy of the Department of Forestry and Wildlife (DNFFB)** seeks to realise the potential of forest and wildlife resources through the sustainable use and conservation of biodiversity.

The Mozambique Government has also committed itself to the following international treaties and protocols

- Convention on Biological Diversity (CBD), the Montreal protocol, the United Nations Convention to Combat Desertification (UNCCD), the United Nations Framework Convention for Climate Change (UNFCCC), UNFCCC Kyoto Protocol, the Convention on International Trade in Endangered Species and the Ramsar Convention on Wetlands.

The project is complimentary with these conventions.

G5.2. Document that the project has approval from the appropriate authorities, including the established formal and/or traditional authorities customarily required by the communities.

The project works closely with formal authorities through government departments at a state and national level, these include the Department of Agriculture and Forestry, of Tourism (Wildlife), of Energy (Bio-fuels), of Environment, of Health (Primary Health Care), of Education (building and upgrading schools and Environmental Education) and the University of Eduardo Mondlane in Maputo. An annual report is delivered to formal stakeholders in Portuguese.

The project has applied for and successfully being granted an Environmental License[72] to operate in terms of the NEP by MICOA. The project is registered with all relevant government departments for purposes of tax and administration. The project also has a legal status as a not-for-profit company registered according to Mozambique Law.

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[71] This is expressed through the community DUATs.

[72] Available as a scanned copy

The project enjoys strong institutional support and endorsement by government at all levels. Various Cabinet Ministers, Governors and Ambassadors have visited the project and endorsed its groundbreaking efforts to address poverty using climate-change-related market mechanisms[73].

Traditional authorities are invited regularly to the community meetings and consultations. *Régulos, Sapandas* and *Fumos* (see section G1) are traditional spokespersons for the community. The land tenure boundaries of the community are verbally outlined by the *Regulo* as part of the DUAT (see section G1) system. As such the *Regulo* much be consulted to allow the presence of the project.

G5.3. Demonstrate with documented consultations and agreements that the project will not encroach uninvited on private property, community property, or government property and has obtained the free, prior, informed consent of those whose rights will be affected by the project.

The Project has worked closely with ORAM (a Mozambique registered NGO) and the Chicale community to register the community's land tenure in terms of Mozambique land law. Further, the project has also tried to assist those *Régulados* in Zambezi Delta without DUAT's to acquire them. The project has contributed significantly to entrenching and formalizing community control over land use in the project area. This is a pre-requisite for any legal contract between the project and the community according to Plan Vivo specifications and as such the project could not proceed without this issue being resolved.

All project transactions and activities are underpinned by legal contracts[74] with the individual producer, signed and witnessed and enforceable through Mozambique law. The producer of carbon is the farmer, and he or she is paid for this product by Envirotrade while the producer still owns the land. A core philosophy of Envirotrade is not to own land in Africa as a outside organisation as this is likely to lead to conflict. As the farmer is required to be present during mapping of land, signing of the contract and monitoring he or she is central to the process which could not be carried out without his or her free, prior, informed consent.

G5.4. Demonstrate that the project does not require the involuntary relocation of people or of the activities important for the livelihoods and culture of the communities. If any relocation of habitation or activities is undertaken within the terms of an agreement, the project proponents must demonstrate that the agreement was made with the free, prior, informed consent of those concerned and includes provisions for just and fair compensation.

The project and its activities do not involve the relocation of any people. Allocation of land and settlement of people is administered by the traditional authority (*Régulo*) and the elected community authority. Involvement in the project, in any capacity, is entirely voluntary.

G5.5. Identify any illegal activities that could affect the project's climate, community or biodiversity impacts (e.g., logging) taking place in the project zone and describe how the project will help to reduce these activities so that project benefits are not derived from illegal activities.

The primary illegal activities that may affect the project's outcomes are logging and charcoaling. However, local communities are extensively involved in project activities (see sections G3 and G4). and fully appreciate the new and better livelihood opportunities that the project provides thereby providing an incentive to minimise illegal activities. This will mitigate the risk to non-permanence from illegal activities.

G5.6. Demonstrate that the project proponents have clear, uncontested title to the carbon rights, or provide legal documentation demonstrating that the project is undertaken on behalf of the carbon owners with their full consent. Where local or national conditions preclude clear title to the carbon

[73] Extensive quarterly reports listing who visited the project and when available.

[74] Paper copies of these contracts exist on site.

rights at the time of validation against the Standards, the project proponents must provide evidence that their ownership of carbon rights is likely to be established before they enter into any transactions concerning the project's carbon assets.

Members are entitled to sell the products arising from their use of the land. This is entrenched in law in Mozambique. The community have taken management of the land under contract from the government and as such are selling a "product" of their labour.

In the special case of land use, the government extends so-called DUATs, which is a licence to trade products of the land. The Chicale and Mucombezi and Matondo communities have DUATs (see G1.6). Communities in the Zambezi Delta site (apart from Matondo) are currently applying with WWF and Oxfam for their DUAT and forming community associations. The DUAT covers the overall aspect of land use but do not specify any special activities. Since the carbon revenues are a result of improved land use these aspects are covered by the DUAT. In general terms, there is no specific regulation on carbon ownership in Mozambique at national DNA level. Nevertheless, the project has liaised with the DNA since 2002, and will apply to the DNA as this evolves.

Envirotrade has sought a legal opinion from a Mozambique lawyer on the tenure of the community over their carbon services[75].

One of the pre-requisites for being able to participate in the REDD management within the project, is the community obtains a DUAT from the government to allow them to manage the land and be able to sell the products, i.e. giving them the right to sell the carbon credits generated.

The Project has applied for an Environmental License from the government, which was granted on a detailed project motivation and description for the Sofala Community Carbon Project, followed by an Environmental Impact Assessment.

The legal title of the VERs will be transferred from the land use rights holder after the additional carbon was sequestered to the buyer upon delivery of certification documentation and signing of an Emission Reductions Purchase Agreement.

[75] Legal position regarding property and land-use rights and traditional communities in Sofala Province, Mozambique with specific reference to the communities participating in the Sofala Carbon Livelihoods Project in the province of Sofala.

IV CLIMATE SECTION

CL1. Net Positive Climate Impacts

CL1.1. Estimate the net change in carbon stocks due to the project activities using the methods of calculation, formulae and default values of the IPCC 2006 GL for AFOLU or using a more robust and detailed methodology. The net change is equal to carbon stock changes *with* the project minus carbon stock changes *without* the project (the latter having been estimated in G2). This estimate must be based on clearly defined and defendable assumptions about how project activities will alter GHG emissions or carbon stocks over the duration of the project or the project GHG accounting period.

The project uses Plan Vivo technical specifications (methodologies) written by ECCM and approved by Plan Vivo. The latest versions currently in use are summarised below:

Title of technical specification	**Baseline carbon uptake / emissions (t CO_2e / ha)[76]**	**Long-term carbon uptake with management**	**Expected losses from leakage (t CO_2e / ha)[77]**	**Net carbon benefit (t CO_2e / ha)**
1. Boundary Planting (ver. 2)	0.0	47.2	0.0	47.2
2. Dispersed interplanting with *Gliricidia*	0.0	36.7	0.0	36.7
3. Dispersed interplanting with *Faidherbia* (ver. 2)	0.0	117.1	0.0	117.1
4. Fruit Orchard, Cashew	10.3	147.4	0.0	137.1
5. Fruit Orchard, Mango	10.3	124.7	0.0	114.4
6. Homestead planting	0.0	154.2	0.0	154.2
7. Woodlot	41.5	224.8	0.0	183.3
8. No burning calculation	35.2	60.9	0.0	25.7
9.Avoided deforestation	10.3	93.2	0.0	82.9

Figure 63. Summary of baseline and project carbon uptake or avoided emissions per hectare calculated by Plan Vivo Technical specifications. Sequestration potential is modelled in CO2FIX as the average carbon uptake per hectare over a hundred years. Modelling parameters are found in the technical speification documents themselves, found online at www.planvivo.org.

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[76] See section G2 for justification and explanation.

[77] See section CL2 for justification

[78] 11.8 tCO_2e per 100m. Perimeter is used to calculate carbon in the ECCM calculator.

Previous versions of technical specifications used by the project and future developments

The 2004/2005 season preceded the Plan Vivo System requirement for technical specifications. It was acceptable by the Plan Vivo that a calculator (Boundary version 1) researched and created by ECCM could be used. The figure used in the calculator was 45 $tCha^{-1}$ with a 10% risk buffer deducted, this was conservative relative to Boundary version 2 which is 47.2 $tCha^{-1}$ [79]. The *Faidherbia* technical specification (Faidherbia version 2) was updated and accepted in 2009 to include new data which was carried out in Malawi. The previous technical specification was 58.0 $tCha^{-1}$, the cancellation of the balance of credits between the old and new specifications will be made public on the Markit registry[80] once the modalities are created by the Plan Vivo technical panel.

Community technicians have been trained to carry out biomass surveys under the supervision of researchers and field technicians from EML on 15 permanent sample plots in natural vegetation. Biomass surveys are carried out to quantify the standing carbon stock and the rate of carbon accumulation in different vegetation covers. Annual inventories measured above and below ground biomass, timber, foliage, roots and soil carbon. The survey design considered all carbon pools that have been expected to change (Ryan 2009). The results of 3 years of these surveys in permanent sample plots will inform the new generation of technical specifications where the CO2FIX model will be reparameterised. These technical specifications will include a reassessment of whether the risk buffers currently in use are appropriate. Based on assessment of growth rates in agro-forestry systems, *ex post* calculations will be used to inform and check previous *ex ante* calculations. Current technical specifications do not link monitoring results to carbon quantification if correction actions by the farmer are carried out i.e. replanting dead trees. A simple calculation will be considered in the new technical specifications to link *ex post* monitoring results to *ex ante* carbon calculations.

Methodological approach for calculating the carbon sequestration potential - agro-forestry

The net carbon stock changes due to the adoption of described project activities follow the Plan Vivo system. Average net increase of carbon storage in biomass and forest products over a 100 year period are calculated relative to the baseline. The net carbon stock change was estimated using the following two-stage approach.

- In stage 1, carbon uptake of each species was calculated using the CO2FIX-V3 model (Mohren et al. 2004), taking into account the accumulation of carbon in various carbon pools in tree growth (timber, foliage and roots) and the effect on these pools of management practices (thinning, harvesting, timber utilisation etc.). Details of parameters used (basic wood carbon content; timber production; total tree increment relative to timber production; turnover rate; product allocation for thinning and expected lifetime of products) are given in the respective Technical Specification[81].
- In a second step these model outputs were then used to calculate default carbon uptake values for each land use system based on species specific characteristics and the rotation length. The average net carbon storage in biomass (i.e. the living parts of the tree including the main stem, canopy and roots) and forest products (i.e. poles, timber used for furniture and construction etc.) were considered.

Methodological approach for calculating the carbon sequestration potential - agricultural soil carbon

No burning of agri-residues is expected to increase inputs to soil organic carbon at a conservative rate of 1 $tCha^{-1}yr^{-1}$.

In granitic sandy soils, such as those in Sofala Province, the main factor influencing SOC stabilization is carbon input (Chivenge et al., 2006). After an area of woodland is cleared for agriculture, we can assume that the soil

[79] On the assumption that 400m of linear boundary planting surrounds a hectare of land (100m x 100m)

[80] http://www.markitenvironmental.com/registryview.php

[81] Available online, www.miombo.org.uk

organic carbon (SOC) is going to decline by 40% (Walker and Desanker 2004). This decline is due to exposure of soil organic matter to microbial activity through tillage, erosion and reduced annual carbon input. Under conventional farming practices (i.e. burning all residues), (Zingore et al. 2005) found that an equilibrium of 9.6 $tCha^{-1}$ was reached after 10 years, compared with 22.8 $tCha^{-1}$ under indigenous miombo woodland. Indigenous woodland in Chicare has a very heterogeneous SOC content but the average is 41.7±4.8 $tCha^{-1}$ at 0-20cm (Ryan in submission). In Chicare Regulado SOC would reach 25.0 $tCha^{-1}$ under conventional agriculture at equilibrium after 40% of the carbon was lost, the difference between indigenous woodland and agricultural land therefore being 16.7$tCha^{-1}$.

To stabilise this SOC loss on agricultural land, inputs must be maintained. Soil organic carbon at equilibrium increases quickly as a function of annual carbon input and reaches a plateau at around 3-4 $tCha^{-1}yr^{-1}$: it is conservative to assume that an annual input of 1 $tCha^{-1}yr^{-1}$ reduces the decline in SOC (from its value under natural vegetation to the value under farming) by half compared with burning i.e. no carbon input at all (Stewart et al. 2007). In the project zones this means not burning would correspond to an additional **6.6 (from Zigore et al 2005) and 8.3 $tCha^{-1}$ (from Ryan in submission) at equilibrium.**

Nome do campones:	Example Of Calculator		
Nome do povoado:	Bue Maria		
Primeiro ano de plantio:	2009		
Volume de dioxido de carbono			
Referencia	***Sistema de uso de terra***	***Variações***	***dioxido de carbono / hectar acima da linha base***
MOZ-TS-NHA-DIP var gliricidia	Consociação	Gliricidia	37
MOZ-TS-NHA-DIP var faidherbia	Consociação	Faidherbia	117
MOZ-TS-NHA-FO-Cashew	Pomar fruteiras (caju)	Cajueiro	137
MOZ-TS-NHA-FO-Mango	Pomar fruteiras (manga)	Mangueira	114
MOZ-TS-NHA-HP	Quintal		154
MOZ-TS-NHA-WL	Plantação florestal	Especies madeireiras	183
RT provisional	Machamba sem queimada		26
			T CO2 por 100 m
MOZ-TS-NHA-BP	Bordadura		12
Land use system		***Area total plantada***	
Consociação var gliricidia		1	
Consociação var faidherbia		1	
Pomar fruteiras (caju)		1	
Pomar fruteiras (manga)		1	
Quintal		1	
Plantação florestal		1	
Machamba sem queimada		1	
		Metros plantados	***Area de Bordadura***
Bordadura		400	1
Land use system		***para vender (tCO_2)***	***Margem (tCO_2)***
Consociação var gliricidia		31	5
Consociação var faidherbia		100	18
Pomar fruteiras (caju)		117	21
Pomar fruteiras (manga)		97	17
Quintal		131	23
Plantação florestal		156	27
Machamba sem queimada		22	4
Bordadura		40	7
Total		693	122
Pagamento			
Preço ao produtor / tCO_2 (Mtn)	111.5	Mtn	$ (approximate)
Ano	2010	23,194	$927.75
	2011	9,278	$371.10
	2012	9,278	$371.10
	2013	9,278	$371.10
	2014	9,278	$371.10
	2015	9,278	$371.10
	2016	7,731	$309.25
Total a receber		77,313	$3,092.51
Variables			
Farmer payment $ / tCO2	4.46		
Exchange rate Mts / $	25		
Farmer payment Mts / tCO2	111.5		

The incentive payment to farmers to stop burning of agri-residues will last 7 years, this is the expected time it would take to alter land use change and overcome the initial loss of nutrients from the burning of a machamba. If the inputs of 1 $tCha^{-1}$ last for 7 years, you can expect the soil to equilibrate at 7 $tCha^{-1}$ more than its original SOC. The carbon dioxide equivalent or carbon credits due to the farmer is therefore 7 x 3.67 or 26 tCO_2ha^{-1}.

The carbon calculator is the summarised output of all the agro-forestry and agricultural soil carbon technical specifications and is used to determine the number of carbon credits generated based on the land use system, area planted and baseline. Area planted is determined by mapping process in G3.3 carried out by community technicians and then entered into the carbon calculator, an example is in figure 27.

By summing the total carbon in each contract with the farmers, it is possible to get a project wide summary of carbon produced and available for sale. Each contract has a carbon calculator attached derived from the technical specification in use at that time.

The project holds two databases, one for Gorongosa site and one for Zambezi Delta, as an internal registry of calculators.

Figure 64. ECCM Carbon calculator.

Calculation of total agro-forestry and agricultural soil carbon stock changes with project activities

The following table contains the *ex-ante* carbon calculations summed from the carbon calculators attached to each contract. The table differentiates between the different versions of the technical specifications. The accounting period for the underlying carbon modelling in CO2fix[82] is 100 years.

Plan Vivo Technical Specification	Total tCO_2e produced with baseline deducted	tCO_2 risk buffer	Net tCO_2e	Area (ha) under system	Number of contracts	Number of farmers under system
Cashew	9,044	1,357	7,687	64	95	89
Gliricidia	1,978	297	1,681	54	65	60
Homestead	8,719	1,308	7,411	57	330	323
Mango	6,268	940	5,328	55	57	55
Woodlot	18,981	2,847	16,134	103	103	99
Boundary Version 1	11,352	1,135	10,217	74	51	48
Boundary Version 2	73,994	11,099	62,895	1,547	1,377	1,232
Faidherbia Version 1	196,507	29,476	167,031	923	821	727
No burning of agri-residues	43,749	6,562	37,187	1,688	1,674	1,258
Total from calculators	370,592	55,021	315,571	4,565	4,573	3,891

Risk buffer agro-forestry

The Plan Vivo system requires that a risk buffer is held back from sale against accidental carbon stock loss. The modalities for this are currently under review by the Plan Vivo technical board, however on completion cancellations will be made from the projects wide risk buffers on the Markit registry alongside total project sales. The risk buffer is 15% for all agro-forestry technical specifications apart from boundary version 1, which was 10%. The risk buffers were estimated using the expert judgement of ECCM.

Methodological approach for calculating the carbon sequestration potential - REDD

Currently there is only REDD activities in Chicale *Regulado*, Gorongosa site. Zambezi Delta site activities are planned for which a new technical specification will be developed. The Gorongosa project region is a mosaic of vegetation types which differ in their carbon stocks. Five vegetation covers were distinguished in an initial inventory carried out in 2004[83]. Eighty seven tree inventories of between 0.21 and 1.00 hectares were used to determine the carbon stocks of the five vegetation covers in the Nhambita area. Only the carbon stocks in above

[82] See individual technical specifications for details.

[83] Mushove, P. (2004). Preliminary inventory of Nhambita Community Forest, Gorongosa District, Mozambique., ICRAF-Mozambique

and below ground biomass are included within the crediting system derived from this survey, i.e. soil carbon is excluded from the analysis at present as in G2.3.

The above ground biomass was determined within the land classes through an allometric derived from the Chicale *Regulado*:

$$\log(B_s) = 2.601\log(D) - 3.629$$

Where B_s = dry biomass of stem (kg C) and D is diameter at breast height (DBH) (cm). Log is natural log.

Figure 65. 1 Estimated carbon stocks in above ground biomass of woodland areas in Sofala province (Ryan 2009). The ± figure measures the spread of the data (the Standard Deviation). It can be used to estimate 95 % confidence intervals when *n* samples have been made from a new area in the region. All stems above 5 cm DBH and all root biomass above 2 cm diameter were included. The density, moisture content and weight of the biomass was recorded from the destructively harvested trees.

Height of tree is subject to large bias during measurement and was only found to increase accuracy of biomass calculation by 2% and was thus excluded as a parameter to the allometric. The expected biomass of five different

Vegetation category	Description	Carbon stock (tC ha^{-1})	N
Miombo woodland	Tropical woodland including, but not limited to that dominated by miombo species. Dominant tree species: *Brachystegia boehmii, Diplorhynchus condylocarpon, Pterocarpus rotundifolius, Burkea africana, and Brachystegia spiciformis.*	27 ± 13	26
Savanna	Characterised by relatively sparce woodland composed of a few large trees in the genera Combretum and Acacia, with open, grassy spaces between trees. Dominant tree species: Combretum adenogonium, Combretum apiculatum, Combretum hereroense, Commiphora mossambicensis, and Pterocarpus rotundifolius.	14 ± 10	10
Riverine forest	Dense, high woodland adjacent to watercourses. Dominant tree species: Sclerocarya birrea, Khaya anthotheca, Cleistochlamys kirkii, Acacia nigrescens, and Pterocarpus rotundifolius.	47 ± 18	6
Secondary Woodland	Abandoned machambas and degraded woodland. Dominant tree species: *Brachystegia boehmii, Julbernardia globiflora, Brachystegia spiciformis, Diplorhynchus condylocarpon,* and *Burkea africana.*	13 ± 9	45
Machambas	Agricultural plots. Tree species sometimes found: *Sclerocarya birrea, Diplorhynchus condylocarpon, Pterocarpus angolensis, Burkea Africana, and Pseudolachnostylis maprouneifolia.*	2.77 ± 0.61	32

vegetative covers found in miombo woodland in the project region are given in figure below.

The Root : Stem ratio 0.42±0.01 was also derived from 23 trees and was used to derive the below ground biomass from the above ground biomass.

The allometric, carbon densities of vegetation covers and root:stem ratios are all found in the REDD technical specification which was submitted for peer review in September. They were derived by Casey Ryan and recorded in his PhD thesis (2009), papers from which will be published in 2010.

The carbon in soil organic matter is not included because of the high costs associated with monitoring changes in soil carbon over time. The carbon stock of Chicale *Regulado* woodland is dominated by soil carbon, 76.3±9.9 tC ha^{-1} (Ryan 2009). Given that upon conversion to agricultural land, miombo woodland lose around 47% of its soil C (to 1.5 m depth) (Walker and Desanker 2004), this implies 36 tC ha^{-1} is lost from the soil when land is deforested. Not including soil carbon makes the carbon quantification extremely conservative, as typically more carbon is lost from the soil than biomass during deforestation in the region. The carbon stored in leaf-litter and dead wood is also likely to increase as a result of conservation measures but does not constitute a large proportion of the total carbon pool and is excluded. A new study started in 2009 will determine the amount of dead wood in a miombo woodland and seek to explain soil carbon variability (pers. comm. Emily Woolen, PhD candidate, Edinburgh University) which will further increase the understanding of carbon cycling and storage in the Nhambita area.

Assumptions		
Project effectiveness	75.00%	
Risk buffer	10.00%	
Price per tCO_2e	n/a	
Payment period	10	years

Carbon stocks		
Miombo woodland	38	tC/ha
Savannah	20	tC/ha
Riverine forest	67	tC/ha
Secondary woodland	18	tC/ha
Machambas	3	tC/ha

Carbon calculations	STEPS 1-3	STEP 4	STEP 5		STEP 6	STEP 7	
	Initial area of ACEU woodland in project area	Initial C stock of ACEU woodland in project area	Carbon stock under deforestation scenario	Change in carbon stock under deforestation scenario	Carbon benefit of project	Carbon benefits eligible for crediting	
	(ha)	(tC)	(tC)	(tC)	(tC)	(tC)	(tCO_2e)
Miombo woodland	10	383	28	-356	267	240	881
Savannah	10	199	28	-171	128	115	424
Riverine forest	10	667	28	-640	480	432	1,585
Secondary woodland	10	185	28	-157	118	106	389
Total	40	1,434	111	-1,323	993	893	3,278

Figure 66. REDD carbon calculator developed by ECCM. This is derived from 4 years of research carried out in Sofala on carbon stocks and densities. Steps 1 to 3 are to be followed by the project developer to stratify the vegetation types (see text). ACEU stands for Accessible, Cultivatable, Extractable and Unprotected. All areas included within the calculator should be ACEU. In this calculator, the carbon stocks of *machambas* (agricultural land) is deducted from the net carbon available for sale, agricultural land is the baseline (see G2.1). Project effectiveness is the expected compliance rate and risk buffer is the amount of carbon which is held back from sale against unforeseen losses of carbon from the REDD areas.

Stratification of REDD areas

All REDD areas must be stratified using the methodology derived by the University of Edinburgh detailed in the REDD technical specification submitted to the Plan Vivo (steps 1-3 of the carbon calculator figure 29). Ground transects are used to stratify different vegetation types by the project developer using a field guide developed by the University. During the EU research and development stage, optical satellite imagery was found to be poor at differentiating different carbon densities and vegetation types in the miombo landscape[84] [85] [86]. The project with the University of Edinburgh has recently acquired ALOS PALSAR, an L-band radar satellite imagery of the REDD areas, which will assist both in checking stratification and monitoring (see CL3.2).

The boundaries of the REDD areas are mapped below superimposed against the preliminary ALOS PALSAR imagery.

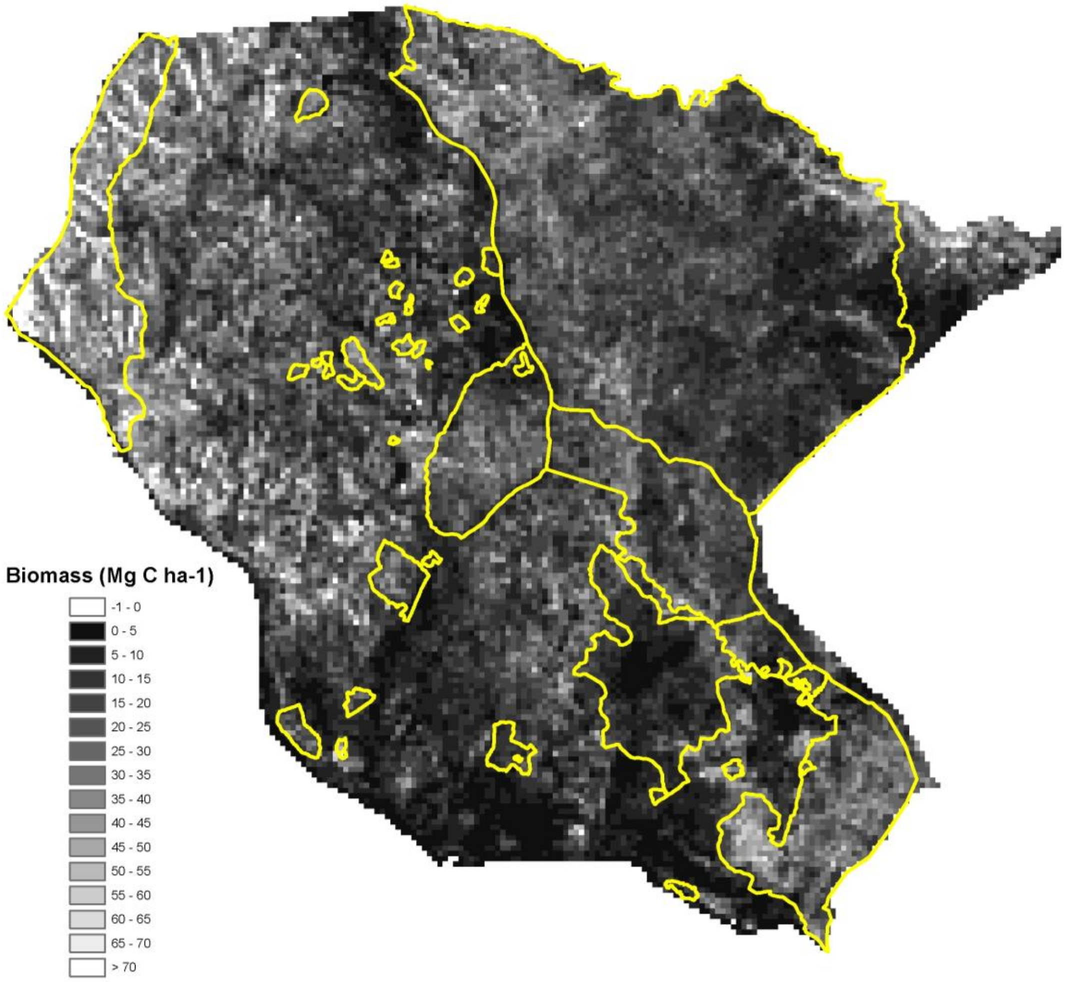

Figure 67. This image shows a map of aboveground biomass (Mg C ha-1) in the Chicale *Regulado* at a 100 m (i.e. 1 hectare per pixel) resolution. This data is derived from data from the ALOS PALSAR satellite in July 2007, converted to biomass using a locally-derived regression equation from the 53 biomass field plots collected from 2004-2007 by the Sofala Carbon Community Project and Edinburgh University (data provided by Dr Casey Ryan). The remote sensing analysis was performed by Edward Mitchard.

REDD technical specification assumptions about how project activities will alter GHG emissions or carbon stocks

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[84] Spadavecchia, L., M. Williams, et al. (2004). Synthesis of Remote Sensing Products and a GIS Database to Estimate Land use Change: an Analysis of the Nhambita Community Forest, Mozambique. Edinburgh.

[85] Wallentin, G. (2006). Carbon change rate and assessment of its drivers in Nhambita, Mozambique, University of Edinburgh.

[86] Flaherty, S. (2008). Analysis of Land Use Change using SPOT images. Edinburgh, Institute of Geography, School of GeoSciences, University of Edinburgh.

For the REDD technical specification, since it is unlikely that project activities will completely prevent all deforestation, the calculated emission reductions are based on a 75% reduction in deforestation relative to the baseline scenario or 75% compliance with the activity. The 25% of credits held back against non compliance are defined as the "non compliance risk buffer" in figure 32. A 10% risk buffer is held back against carbon stock loss such as by bush fire and wind throw. Use of the risk buffer must be done in consultation with Plan Vivo and the carbon loss displayed on the Markit Registry for transparency.

Some areas which have been set aside for REDD as community conservation areas contain recently abandoned *machambas* - the amount of land is summarized in Figure 29. Communities are expected to enrichment plant these *machambas* with trees from the community nurseries. Neither the existing carbon stocks on newly abandoned *machambas* nor the enrichment planting activities are included within the carbon stock estimates for these areas. This is extremely conservative as there will be natural regeneration as well as enrichment planting.

Each REDD area has a carbon calculator[87]. Variables that have to be entered into the calculator by the project developer are area size and vegetation cover in hectares. These carbon calculators can be summed to get the total REDD carbon stocks available for sale. The summary is below:

Total REDD area (ha)	9,599
Degraded Miombo (ha)	254
Machamba (ha)	79
Miombo (ha)	7,033
Riverine (ha)	618
Savannah (ha)	1,615
Average tCO2/ha	123
Total tCO2e over 100 years	1,179,266
Risk buffer tCO2e	117,927
Non-compliance risk buffer tCO2e	265,335
Net tCO2e over 100 years	796,005

Summary of carbon stocks from REDD activities and total vegetation types in REDD areas.

[87] A summary if each calculator is submitted in the Plan Vivo annual report which triggers the release of credits to the buyer and can be found online at www.planvivo.org

Both the REDD carbon stocks and agro-forestry carbon stocks can be summarised in the following table, where the total baseline for the different systems of carbon enrichment from agro-forestry and REDD activities is subtracted from the total with project carbon estimated to be sequestered over 100 years.

	-1	-2	(3) = (1) – (2)
	carbon stock changes *with* the project	**carbon stock *without* the project**	**net change in carbon stocks due to the project activities**
REDD	893,589	97,585	796,005
Agro-forestry and Agriculture	380,566	64,995	315,571
Total	1,274,156	162,580	1,111,576

Figure 68. Summary of carbon produced for sale in the tCO_2e.

CL1.2. Estimate the net change in the emissions of non-CO_2 GHG emissions such as CH_4 and N_2O in the *with* and *without* project scenarios if those gases are likely to account for more than 5% (in terms of CO_2-eq.) of the project's overall GHG emissions reductions or removals over each monitoring period.

A number of studies demonstrated that deforestation mainly leads to CO_2 emissions and only a small amount of CH_4 and N_2O are emitted[88]. CH_4 and N_2O emissions from the adoption of agro-forestry and forest management activities are even smaller. They are estimated to account for less than 5 % and will not be monitored. Future research on this topic in Miombo ecosystems will be considered. In case that respective CH_4 and N_2O project emissions are likely to account for more than 5% of the overall GHG emissions they will be monitored.

CL1.3. Estimate any other GHG emissions resulting from project activities. Emissions sources include, but are not limited to, emissions from biomass burning during site preparation; emissions from fossil fuel combustion; direct emissions from the use of synthetic fertilizers; and emissions from the decomposition of N-fixing species.

The greatest sources of project emissions are estimated to be from electricity generation, vehicle use and flights by the three international staff. The total emissions in 2008 were estimated to be less than 0.1% of total project carbon benefits. They can therefore be conservatively ignored.

The project does plant pigeon pea and other N-fixing trees. The N_2O emissions from N-fixing species are expected to be low, the biggest potential source being the release of N_2O during burning. Leaf litter is incorporated into the soil for enrichment and the only likely part of the plant to be burned is the stem or branches. The highest concentration of nitrogen is in the leaves[89]. In the case of pigeon pea the majority of nitrogen is transported to the grain as the plant senesces[90], the grain is a foodstuff and cash crop.

CL1.4. Demonstrate that the net climate impact of the project is positive. The net climate impact of the project is the net change in carbon stocks plus net change in non-CO_2 GHGs where appropriate minus any other GHG emissions resulting from project activities minus any likely project-related unmitigated negative offsite climate impacts (see CL2.3).

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[88] Houghton, R. A. and J. L. Hackler (2006). "Emissions of carbon from land use change in sub-Saharan Africa." Journal of Geophysical Research - Atmospheres **111**(G02003).

[89] Högberg, P. (2009). "Tansley Review No. 95. 15N Natural Abundance in Soil-Plant Systems " New Phytologist **137**(2): 179-203

[90] Ranganathan, R., Y. S. Chauhan, et al. (2001). "Predicting growth and development of pigeon pea: leaf area development."

The net climate impact is 1,111,576 tCO_2e based on contracts signed by April 2009. The emissions as a result of project implementation and offsite negative impacts on the climate are not considered significant and are not deducted. Non CO_2 GHG gases are not emitted as a result of the project.

CL1.5. Specify how double counting of GHG emissions reductions or removals will be avoided, particularly for offsets sold on the voluntary market and generated in a country with an emissions cap.

There are two agro-forestry databases for the two project sites which record the producer name, community, *machamba* location, system size, system type, net carbon produced, buffer carbon produced, monitoring results and GPS coordinates. The information in the database reflects that in the contracts and in the carbon calculator. Interrogation of the database and plotting of the GPS coordinates is a check on double counting, which is regularly carried out. REDD management area boundaries are defined by GPS and kept in a project wide GIS database.

During annual reporting to the Plan Vivo foundation, individual contracts (with associated carbon stocks) from the database must be linked to sales to individual buyers. The Plan Vivo foundation does not issue credits to the buyer until the submission is made. Once approved the retired credits are loaded onto the Markit Registry[91] in the public domain.

The project is recognised as a sub-national pilot project. When Mozambique is implementing a national GHG inventory, the baseline and carbon monitoring data from the project regions will be shared with respective government agencies to ensure that double accounting in potential future national REDD programmes is prevented. Emission reduction activities are mapped to check for geographical overlap.

CL2. Offsite Climate Impacts ("Leakage")

CL2.1. Determine the types of leakage that are expected and estimate potential offsite increases in GHGs (increases in emissions or decreases in sequestration) due to project activities. Where relevant, define and justify where leakage is most likely to take place.

Probable types of leakage are:

- Displacement of agricultural development
- Displacement of charcoal making
- Displacement of wood fuel collection

Potential sources of leakage:

- Many of the traditional practices such as shifting cultivation, charcoal making, burning of *Machambas* to clear the fields for new crops and felling trees to set up new *Machambas* are potential sources of leakage and need to be addressed. The project is designed to incentivise people to move from shifting cultivation to sedentary farming and not to open new *machambas*.
- There is a perception that there are abundant forest resources in the area and, therefore, people may be interested in protecting trees only on their *Machambas* and not the ones on common lands. People are incentivised to conserve forest through REDD management. The project has worked with WWF on an environmental education programme in Chicale *Regulado.*
- The project incentivises no burning of agri-residues on the field, it's theoretically possible the farmers lift agri-residues from one field and burn them in another. Part of the extension provided by the community

[91] http://www.markitenvironmental.com/registryview.php

technicians is that the agri-residues should be incorporated into the field to enrich the soil, it is also logistically difficult to move agri-residue without draft animals (absent from the project area due to tsetse fly).

In the management plan defining community management activities, all potential sources of leakage are mitigated in the project design. Therefore, the leakage is expected to be negligible. The detailed mitigation strategies are presented in the chapter below.

CL2.2. Document how any leakage will be mitigated and estimate the extent to which such impacts will be reduced by these mitigation activities.

Leakage Risks	Management measures to minimise the risk of leakage
Displacement of agricultural development	Adoption of sustainable land management will increase soil fertility and therefore reduce the pressure to continue slash and burn or other practices expanding agricultural activities outside the project boundary.
Displacement of charcoal making	Sustainable charcoal making industry based on woodlots, obviate need for displacing charcoal production to areas outside project. Alternative livelihoods for a cash income are also created through the project activities, either directly through employment or by the now independent micro-businesses which the project started.
Woodland conservation could displace fuel wood collection to other woodland areas outside the project boundary	Protection / sustainable management of any woodland areas within the community. Implementation of agro-forestry measures to provide products such as fuel wood or poles for building that may no longer be available from within the conserved woodland.

CL2.3. Subtract any likely project-related unmitigated negative offsite climate impacts from the climate benefits being claimed by the project and demonstrate that this has been included in the evaluation of net climate impact of the project (as calculated in CL1.4).

As the project design is based around minimising leakage, no project leakage is expected. The remote sensing component of the REDD technical specification will allow this assumption to be monitored.

In the case of leakage being detected a discount of carbon stocks will be carried out. Guidance and modalities will first be required from the Plan Vivo technical panel.

CL2.4. Non-CO_2 gases must be included if they are likely to account for more than a 5% increase or decrease (in terms of CO_2-equivalent) of the net change calculations (above) of the project's overall off-site GHG emissions reductions or removals over each monitoring period.

Non-CO_2 gases are not likely to account for more than 5% of recorded GHG stock changes and therefore will not be monitored.

CL3. Climate Impact Monitoring

CL3.1. Develop an initial plan for selecting carbon pools and non-CO_2 GHGs to be monitored, and determine the frequency of monitoring. Potential pools include aboveground biomass, litter, dead wood, belowground biomass, wood products, soil carbon and peat. Pools to monitor must include any pools expected to decrease as a result of project activities, including those in the region outside the project boundaries resulting from all types of leakage identified in CL2. A plan must be in place to continue leakage monitoring for at least five years after all activity displacement or other leakage causing activity has taken place. Individual GHG sources may be considered "insignificant" and do not have to be accounted for if *together* such omitted decreases in carbon pools and increases in GHG emissions amount to less than 5% of the total CO_2-eq benefits generated by the project. Non-CO_2 gases must be included if they are likely to account for more than 5% (in terms of CO_2-equivalent) of the project's overall GHG impact over each monitoring period. Direct field measurements using scientifically robust sampling must be used to measure more significant elements of the project's carbon stocks. Other data must be suitable to the project site and specific forest type.

The long term monitoring plan is embedded into the constitution and TOR of the Mozambique Carbon Livelihoods Trust (MCLT) supported by Envirotrade as part of the long term management plan for land use change. The monitoring will be ultimately carried out by MCLT after 2013 when the Envirotrade phase is over (see section G3.4). MCLT has already signed a monitoring agreement with Eduardo Mondlane University to monitor the REDD areas.

Until 2013 monitoring has and will be carried out by EML and reported on annually to the Plan Vivo foundation. The annual report triggers issuance of credits to the buyer.

The Plan Vivo system requires that the monitoring should be simple and robust so it can be carried out by the community and is transparent for the farmer. All carbon modelling for the technical specifications is *ex-ante*. Above ground biomass is used as a monitoring indicator for all systems apart from agri-residues where the presence/absence of the residues themselves is monitored as is the presence of ash.

Annually monitoring of simple indicators is used to determine whether the agro-forestry systems are being implemented successfully. Monitoring is carried out twice a year on each agro-forestry contract, indicators are selected to test that the *ex-ante* modelling assumptions are correct. A farmer will have contact with his or her community technician at least twice a year which serves the purpose of not only monitoring but also extension. Spot checks on community technicians monitoring results are carried out by supervisors and management.

Annual monitoring indicators assessed by the technician are as follows:

- Number of trees by species alive in first monitoring - prior to the rains, this monitoring shows whether the farmer planted the tree or not.
- Number of trees by species alive in second monitoring - after the rains, has the tree survived and put out new shoots.
- Is the farmer planting at the correct spacing defined by the technical specification
- Is the farmer burning his or her agri-residues

Extension is carried out at the same time and recommendations are made to the farmer who must be present at the time of monitoring and co-sign the monitoring form with the technician. Technicians must check whether the farmer is making basins around the tree, disposing of the bags from the seedlings correctly, protecting the tree at the base, intercropping pigeon pea and making fire breaks around the *machamba*.

From year five of the tree's growth, the project will assess the diameter of breast height of a sub-set of trees to ensure the assumptions in the CO2fix model (see CL1.1) are being met.

At least every five years, a comparison will be made between biomass and soil carbon in the *machambas* in Plan Vivo and outside Plan Vivo will be carried out and published in peer review. In 2009 the impact of the project activities on soil carbon was assessed and the results will be published in 2010[92].

REDD areas are monitored through a combination of satellite imagery analysis, patrolling by community teams on the ground and ongoing forest inventories for which a memorandum of understanding has been signed with Eduardo Mondlane University. Above ground biomass will be the focus of these inventories.

Monitoring of leakage

It is a requirement of the Plan Vivo Standards that the potential for project activity to cause displacement of emission generating activities to other woodland areas in the vicinity of the project area should be considered, and that project activities should be planned and structured to minimise any such leakage risk. These actions should include:

- Incorporation into the project of as many communities and woodland areas in the region as possible.
- Implementation of agro-forestry and improved crop management measures to increase crop yields and reduce encroachment into surrounding woodland areas for agricultural land.
- Establishment of sustainable woodlots to provide products such as fuelwood or poles that may no longer be available from within the conserved woodland.
- Monitoring leakage in woodland areas outside the project area.

Where communities have a satisfactory plan for managing leakage risk it should be assumed that there is no leakage. However, during annual inspection of REDD areas using freely available satellite imagery by Eduardo Mondlane it will be investigated whether there has been a sharp increase in deforestation in Sofala province outside of the REDD management areas, which might indicate possible leakage.

Monitoring of project off and on site emissions

The three greatest sources of emissions from the project activities are considered to be power generation on site, vechile use, flights by international staff and the possible burning of nitrogen rich legumes which will release N_2O (see CL1.3). Once every 2 years these emssions will be derived from the record of the amount of diesel consumed by the project in electricity generation and vechile use and the number of flights taken by staff. The burning of residues from legumes will be closely monitored by field staff.

CL3.2. Commit to developing a full monitoring plan within six months of the project start date or within twelve months of validation against the Standards and to disseminate this plan and the results of monitoring, ensuring that they are made publicly available on the internet and are communicated to the communities and other stakeholders. .

The project is currently in the process of developing a monitoring plan. This is available in draft format and will be commented on by management in a meeting at the end of April 2010. The summary of the monitoring plan is below.

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[92] [92] Ghee 2010. Nitrogen and carbon dynamics in Mozambican smallholder agroforestry systems. In submission *Agroforestry Systems*.

REDD monitoring

The monitoring plan concerning REDD lists the activities and indicators to be used to monitor the achievements of project activities. The results will be published on the project website in the annual report to the Plan Vivo. The plan contains details of the following activities and items:

- *Annual boundary inspection*. A technician shall patrol the boundary of the community reserve no less than once per year to inspect fire breaks, incursions and integrity of the boundary controls.
- *Patrolling*. A contract is signed annually to patrol between a local team of community members and the Chicale community association. Any incursions into the REDD areas should be reported to the association.
- *Annual visual inspection satellite imagery.* MODIS NDVI (Normalized Difference Vegetation Index) may be used for the project zone and surrounding landscape, to assess the integrity of woodland in the REDD management areas, and identify any possible leakage of forest degradation to areas outside the project zone. This should be carried out in the late dry season when the grass has died back so that there is maximum contrast between woodland and non-woodland areas. MODIS products such as MCD45A1 can be used to monitor fire management success. The project has access to radar imagery through a partnership with the University of Edinburgh which can be used to monitor vegetation type change.
- *Annual monitoring of carbon stocks* in project zone by ground based inventories which will be carried out by the University of Eduardo Mondlane.
- *Monitoring the presence of key indicator species.* This will be carried out by the University of Eduardo Mondlane.
- *Annual assessment of governance structures*. The governing committee should produce a report summarising their activities for the year, any problems encountered, and corrective actions required.

Ground based inventories makes it possible to determine whether the vegetation carbon stocks are in line with the default values expected in line with CL1.1.

Payment adjustments and management responses to be applied in the case of different levels of deforestation are described in the table below.

Deforestation indicator	**Likely contributing factors**		**Payment response/ adjustment**
Deforestation <25% of baseline rate	Governance working effectively	Protection activities implemented effectively	Payment continues as per schedule
Deforestation 25-75% of baseline rate	Significant breakdown in governance	Protection activities not properly implemented	Payment reduces by 50% until next annual monitoring and enforcement of corrective actions
Deforestation >75% of baseline rate	Governance not functioning	No effective protection activities	Payment suspended until next annual monitoring and enforcement of corrective actions

Table 2. Deforestation indicators and responses.

Payments are made to the community fund on communal land, and to individuals on individual land. There are 7 communal areas totalling 8,716 ha. There are 34 individual areas which total 883 ha.

The patrolling and fire management teams are paid only if they carry out their respective duties. The patrolling team's duties are to check for activities which contravene REDD management, the opening of *machambas*, logging and charcoaling. They are also to sensitise the community as to the rules in the REDD area so as such they are part of the consultation process. The fire management team make fire breaks and carry out early burning which are monitored soon after they have been carried out.

Agri-residue monitoring

Burning in a field is possible to detect during biannual monitoring by the forestry technician. This is recorded on the agro-forestry monitoring form. If burning of a *machamba* is accidental from bush fires coming into the field, this is still recorded as the farmer has a contract to make a fire break around his or her field. Burning of a field and agri-residues leads to non payment of the farmer's no burning contract that year.

Agro-forestry monitoring

Agro-forestry monitoring is carried out twice a year before and after the rains. A summary of the activities is recorded in CL3.1. The monitoring is carried out by community technicians (one per hundred farmers) who are spot checked by supervisors on mapping, extension and monitoring notes. Each community technician lives in the community that he or she checks.

When there was a limitation in the numbers of trees that could be provided to the farmer from the nurseries at the beginning of the project, there was a monitoring linked to gradual establishment. Now each community has ample access to enough seedlings due to the increase in the number of community run nurseries, establishment is no longer the focus of monitoring. Instead mortality is the focus of monitoring derived from comparison of the number of trees delivered to the number of trees alive after the rainy season. Mortality is a simple monitoring indicator linked to above ground and below ground biomass. The farmer's payment is linked to mortality. Growth rates will be measured independently by the project once the tree is 5 years old, however this is to check the assumptions of the CO2fix model and will not be linked to payment as growth and diameter at breast height will be determined to a great extent by natural variation in soil type and environmental factors beyond the farmer's control. A representative sample of contracts will be selected to monitor growth through the diameter at breast height in the 5th year of their growth.

A 15% natural mortality is considered acceptable and the project will not penalise the farmer for this but will replace the trees from the nurseries at the project's cost. Between 15-60% mortality the farmer will have 4 meticals per tree deducted from their payment to cover the cost of the tree's replacement. If there is mortality of 60-80% the farmer will not receive a payment, but will receive replacement trees. If mortality is below 15% the following year then the farmer will receive the previous year's payment minus the costs of the replacement trees and the new year's payment. Above 80% of mortality the farmer has failed to establish the system and his calculator will be removed from the database. Discussion with the technicians and supervisors may lead to the farmer to signing a new contract for another year and trying again. The technician should address any extension gaps before the farmer is provided with more trees.

For transparency and clarity, an example of a hypothetical farmer is given.

A farmer may have a boundary system of 416m, the total number of carbon credits owed to him or her is 42 tCO_2 (defined by the technical specification, not inclusive of the risk buffer). The farmer will receive 104 trees (4 metre spacing along boundary defined by the technical specification). The payment in the first year (30% of the money he or she expects to receive) is 1,400 meticals. If mortality is below 15% the farmer will receive 1,400 meticals. If mortality is between 15% and 60% the replacement trees come at the cost to the farmer of 4 meticals deducted from his or her payment. If for example 30 trees die (29%) a deduction from the payment of 120 meticals is made. If between 63 and 83 trees (60-80%) die the payment is suspended until the following year and released on successful replanting plus the expected payment from the second year (560 meticals) and minus the cost of the replacement trees. If greater than 83 trees die the contract may be cancelled and resigned the following year with special attention to extension.

V COMMUNITY SECTION

CM1. Net Positive Community Impacts

CM1.1. Use appropriate methodologies to estimate the impacts on communities, including all constituent socio-economic or cultural groups such as indigenous peoples (defined in G1) resulting from planned project activities. A credible estimate of impacts must include changes in community well-being due to project activities and an evaluation of the impacts by the affected groups. This estimate must be based on clearly defined and defendable assumptions about how project activities will alter social and economic well-being, including potential impacts of changes in natural resources and ecosystem services identified as important by the communities (including water and soil resources), over the duration of the project. The "with project" scenario must then be compared with the 'without project' scenario of social and economic well-being in the absence of the project (completed in G2). The difference (i.e., the community benefit) must be positive for all community groups.

Methodological approach

Within the Nhambita Livelihood Assessment Study, conducted in 2004, a baseline was established to monitor the project impact on the community livelihood. Using a set of indicators, the impact will be monitored over the duration of the project.

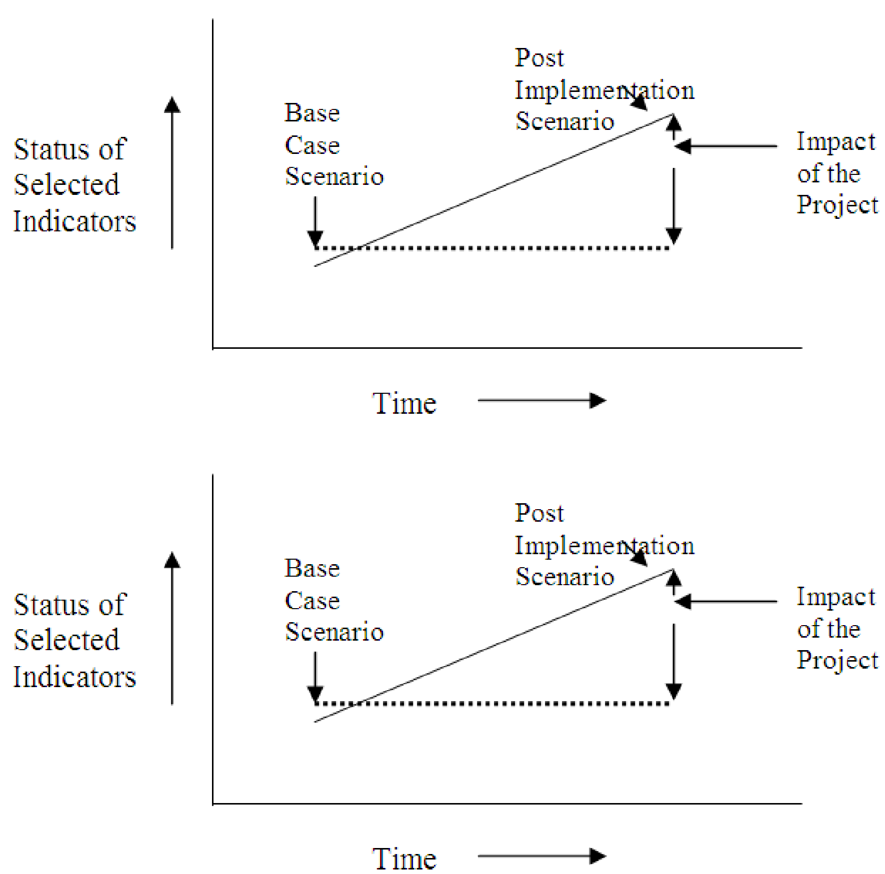


Figure 69. Concept of measuring the impact of a project.

To differentiate between the project impact and macroeconomic changes or wider policies, project participants and a control group outside the project was monitored (Nachmias and Nachmias, 1996). This entails measuring changes in two groups on the same variables; one being the target group and the other the control group.

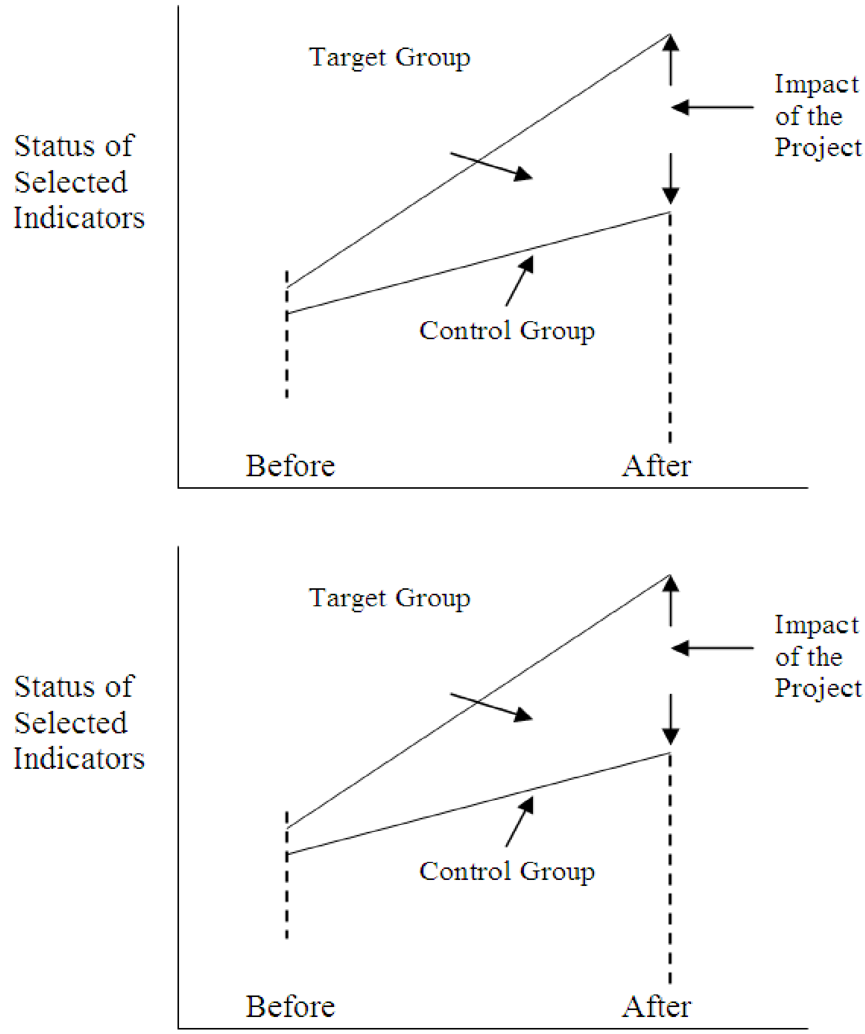


Figure 70. Using Control Group to measure the impact of a project.

The Sustainable Rural Livelihoods (SRL) approach was used as a monitoring framework to analyse the specific impact of the project on the local community over time. The SRL provides an analytic basis for livelihood analysis, especially in context of rural communities. SRL was developed by the UK's Department for International Development (DFID) in the late 1990s as an analytical framework to understand poverty and for identifying entry points for poverty reduction initiatives (DFID, 1998). The framework is based on a detailed analysis of five different types of assets upon which individuals draw to build their livelihoods:

- Natural Assets: The natural resource stocks from which resource flows useful for livelihoods are derived (e.g. land, water, forests, environmental resources, etc.).
- Social assets: The social resources (networks, membership of groups, relationships of trust, access to wider institutions of society) upon which people draw in pursuits of livelihoods.
- Human assets: The skills, knowledge, ability to labour and good health important to the ability to pursue different livelihood strategies.

- Physical assets: The basic infrastructure (transport, shelter, water, energy, and communications) and the production equipment and means which enable people to pursue their livelihoods.
- Financial assets: The financial resources which are available to people (whether savings, supplies of credit, or regular remittances or pensions) and which provide them with different livelihood options.

Following the above methodological approach, relevant developmental indicators were selected and will be tracked during the life of the project. The following table presents the list of indicators used in the project (see CM3.).

Table 3. Indicators used for measuring community impacts.

Type of Asset	Relevant Indicators
Social Asset	- Land tenure and property rights - Status of traditional institutions - Presence/absence of local leadership
Physical Asset	- Status of infrastructure - Sources of energy - Access to drinking water
Human Asset	- Literacy levels - Access to health facilities - Land use practices - Awareness on key agriculture / forestry practices - Gender division of labour
Natural Asset	- Average productivity of land - Access to irrigation - Benefits derived from forests
Financial Asset	- Sources of income - Extent of cultivation of commercial crops - Livestock ownership - Ownership of durable items such as bicycle, radio etc.

Major Assumptions

The primary assumption is that, except for the Sofala Community Carbon Project, there will be no other sources of outside investment in the regions. Therefore, in absence of the project, there would have been no other major development. However, there may still be government programmes that have a socio-economic impact in the area which cannot be analysed by tracking changes between the project and the control communities.

Within the frame of the above, one main assumption of how project activities will impact communities is that, through carbon payments and the generation of commercial activities, the income of the households will increase which reflects a higher socio-economic well being of a household (represented through a higher number of durable items and animals). Another assumption of how project activities will impact communities is that through the introduction of sustainable agricultural practices, local food security, as well as agricultural productivity will be increased.

Estimate of the impacts on communities resulting from project activities

Based on these assumptions, the impacts on the community through the project are estimated in the following:

Indicators	Socio-economic impacts in the "with project" scenario
Sources of income	Local incomes will rise substantially, in the short term, as a result of income from carbon sales and commercial activities from micro-industries. In the long term, commercial activities are likely to grow and significantly increase incomes. The project will pay between USD433 and USD808/ha, over a period of seven years[93], for the amount of carbon sequestered by various land-use activities. One hectare is the average family land holding. The carbon cash flow will vary from 30% in the first year to 12% in year 5, and a final payment of 10% in the seventh year. The majority of farmers have more than one contract, signed over a number of years, so that the direct payments last beyond seven years. Average annual payments are USD116 /household. This is a significant increase in cash income for most households when compared with an average income, in absence of the project, of USD50. This also addresses an important local need to have a regular cash income until the adopted project activities yield annual cash revenues. The project also encourages other income generating activities such as bee-keeping, sustainable timber logging, processing of NTFPs etc. This will not only increase the available income but will reduce the impact of crop failure through a reduction in reliance solely on subsistence agriculture..
Local food production / Average productivity of land / Awareness of land-use practices	The introduction of agro-forestry systems will significantly improve fruit and crop production which, in turn, will improve the nutrition of children. The introduction of improved seed types will further enhance overall food security in the region.
Natural resource utilization / Awareness on forestry practices	Existing natural resource utilisation was dominated by slash and burn activities and long fallow periods to restore *machamba* soil fertility. However, in order to support an increasing population, better resource utilisation is essential. The introduction of agro-forestry systems provides a substantial improvement in land utilisation. Introduction of agro-forestry systems raises awareness of alternative land-use practices that can provide improved productivity, increased annual income from the same land and a wide range of associated benefits.

[93] Rohit Jindal thesis

Gender	Women have received specific training in agro-forestry, forestry and working in the nurseries and vegetable gardens. Their income has already significantly increased since the project was launched. Women also benefit from community farming extension activities and sign and receive carbon payments from activities on their *machamba*s.

Comparison between "with project" and "without project" scenario

Table 4. Summary table for community benefit due to the project activities.

Socio-economic impact		
Without project scenario	**With project scenario**	**Difference (community benefit)**
Low and irregular local income	Significantly increased and regular income.	Positive
Few commercial activities	Rise of forest and non-forest commercial activities thus providing for income generation	Positive
Lack of employment opportunities (incl. women)	Generation of more and more varied employment opportunities (incl. women)	Positive
Low agricultural productivity, slash and burn prevails	Higher agricultural productivity through the introduction of agro-forestry activities	Positive
Insecure food security	Assuring food security	Positive
Natural resources to diminish	Natural resources will be managed sustainably	Positive

CM1.2. Demonstrate that no High Conservation Values identified in G1.8.4-6 will be negatively affected by the project.

HCV 4: Forests that provide basic services of nature in critical situations (e.g. acting as fire breaks, to prevent erosion or to protect water catchments)

HCV 5: Forests fundamental to meeting basic needs of local communities

HCV 6: Forests critical to local communities' traditional cultural identities

HCV4 The project seeks to protect these critical forests as part of REDD management. The project also carries out enrichment planting on river banks where there has been deforestation.

HCV5 Woodland has significant value to the community through collection of medicines, edible caterpillars, bee keeping and poles for building. Sustainable woodland use, which does not deforest the land is allowed in the REDD areas protected by the community through the project.

HCV6 The REDD management areas strengthen the protection of the communities traditionally important zones but do not prevent the ongoing use of them. Guasha is under high pressure for conversion to farmland but is of intense traditional importance to local communities. Payment of patrolling teams strengthens protection of these area against clearance.

CM2. Offsite Stakeholder Impacts

CM2.1. Identify any potential negative offsite stakeholder impacts that the project activities are likely to cause.

It is not expected that the project will result in any negative offsite stakeholder impacts based on the results of the social and environmental impact assessment which was conducted at the onset of the project. Ongoing monitoring through socio-economic surveys will enable the analysis of this.

CM2.2. Describe how the project plans to mitigate these negative offsite social and economic impacts.

Not required see above

CM2.3. Demonstrate that the project is not likely to result in net negative impacts on the well-being of other stakeholder groups.

Not required see above

CM3. Community Impact Monitoring

CM3.1. Develop an initial plan for selecting community variables to be monitored and the frequency of monitoring and reporting to ensure that monitoring variables are directly linked to the project's community development objectives and to anticipated impacts (positive and negative).

Based on the Livelihood Assessment Study conducted in 2004, a detailed follow up study was implemented in 2008 (see Rohit 2008) in Gorongosa. Key impact monitoring parameters and the method to measure the impact are presented below. The next detailed monitoring will be conducted by 2012.

Methods of measurement of expected socio-economic impacts	
Area of impact	**Method of measurement**
Local incomes	Periodic survey using a standard questionnaire and based on the initial (baseline) survey by Jindal (2004).
Local food production	Survey, by the project team, of quantity and diversity of crops produced and notes on any external sales at the Gorongosa market. Baseline records are available from the *Escola de Machamba* (training school for farmers where food is produced and sold).
Gender	Periodic survey using a standard questionnaire and based on the initial (baseline) survey by Jindal (2004).
Literacy levels	Periodic survey using a standard questionnaire and based on the initial (baseline) survey by Jindal (2004).
Access to alternative livelihoods to	Periodic survey using a standard questionnaire and based on the initial (baseline) survey by Jindal (2004).

subsistence farming	

In Zambezi Delta Envirotrade is currently in the process of recruiting a masters student to carry out a baseline socio-economic survey.

CM3.2. Develop an initial plan for how they will assess the effectiveness of measures used to maintain or enhance High Conservation Values related to community well-being (G1.8.4-6) present in the project zone.

In the Plan Vivo annual report progress on protection and maintenance of HCV zones will be documented. The conservation of HCV woodland outside of the national park protected areas occurs as a result of community consensus which is strengthened by REDD activities. The success of REDD activities as monitored as described in CL3.2 will in part document success or otherwise of preservation of HCV zones.

In future, to maintain identified HCV areas, community consultation about REDD area selection will be focused on these areas. The Mucombezi community is currently in discussions about preserving the lion mountains through REDD (see section G1.8). In the future the project plans to provide extra incentives for those communities who protect their riverine forest, as opposed to the less biodiverse areas, either through extra payment or the provision of free bee keeping equipment.

There is enrichment planting in the REDD areas, with particular focus on river banks and steep slopes. The growth of these trees will be monitored by the REDD patrolling teams to address HCV4.

CM3.3. Commit to developing a full monitoring plan within six months of the project start date or within twelve months of validation against the Standards and to disseminate this plan and the results of monitoring, ensuring that they are made publicly available on the internet and are communicated to the communities and other stakeholders.

A full monitoring plan was developed during the project research phase and the impact, in the Gorongosa region, analysed after 4 years (see section CM1 above). The project is one of the very few carbon mitigation projects that can demonstrate a positive socio-economic impact. The results of 4 years of research and findings are presented in the final report to the EU published in 2008 on www.miombo.org.uk. Respective research reports are available on the project website. Baseline socio-economic data is now being collected in the Zambezi Delta region using the Gorongosa socio-economic survey as a model.

Monitoring of the social impacts of the project, participation in micro-businesses, increase in income and results of community consultation is a requirement of the Plan Vivo annual reporting system. The Plan Vivo will not release certificates unless they are satisfied both with the level of reporting of socio-economic values and the results.

VI BIODIVERSITY SECTION

B1. Net Positive Biodiversity Impacts

B1.1. Use appropriate methodologies to estimate changes in biodiversity as a result of the project in the project zone and in the project lifetime. This estimate must be based on clearly defined and defendable assumptions. The "with project" scenario should then be compared with the baseline "without project" biodiversity scenario completed in G2. The difference (i.e., the net biodiversity benefit) must be positive.

Assumptions of how project activities will alter biodiversity

The land-use systems reduce pressure to deforest the national parks and forest reserves by increasing food security and protecting the buffer zone from deforestation which contributes to biodiversity conservation. Satellite imagery can be used to monitor this impact to assess whether there is encroachment on the parks where they border the project. Biodiversity is also being enhanced through the planting of indigenous trees in and around the agricultural areas.

Estimate of the impacts on biodiversity resulting from project activities

REDD

Anthropogenic land-use change is a major driver of species loss in the tropics[94]. Preserving forest through REDD from land-use change directly tackles this threat. GNP and Marromeu buffalo reserve protects threatened and enigmatic species such as elephant and lion. By managing the buffer zone as a conservation area, wildlife/human conflict will be reduced. Incentivising farmers through payments to ecosystem services

Surveys carried out in the project zones show that, after areas are converted to agriculture, regrowth has a different floristic composition lacking the definitive miombo species, namely *Brachystegia* and *Julbernardia*[95]. This suggests that conservation will protect the unique floristic composition that defines miombo.

The project is increasing the area under conservation in order to reduce fragmentation of woodland from charcoaling and machambas in order to increase landscape connectivity.

Agro-forestry

Tree planting within *machamba*s using intercropping systems is expected to increase connectivity between conservation areas and increase viability of population size and biodiversity[96]. Matrix management has been shown to be critical for biodiversity around protected areas, thus, introduction of indigenous trees using boundary planting and woodlots is expected to have a positive impact on biodiversity.

Based on these assumptions, the impacts on biodiversity through the project are estimated in the following:

[94] Jetz, W., D. S. Wilcove, et al. (2007). "Projected Impacts of Climate and Land-Use Change on the Global Diversity of Birds." PLoS Biology **5**(6): e157.

[95] Williams, M., C. M. Ryan, et al. (2008). "Carbon sequestration and biodiversity of re-growing miombo woodlands in Mozambique." Forest Ecology And Management **254**(2): 145-155.

[96] Hambler, C. (2004). Conservation (Studies in Biology). Cambridge, UK., Cambridge University Press.

Indicators	**Impacts on biodiversity in the "with project" scenario**
threatened species	Hunting will be reduced and awareness will be raised about the value of these species. As a result, these species will receive better protection in the with-project scenario. Guinea fowl husbandry is presented as an alternative to bush meat.
species abundance	High biodiversity value species will be protected thereby increasing the abundance.
population size	Decreasing fragmentation of forest through reduction in charcoaling and new *machamba*s opening in the buffer zone will maintain a habitat large enough to maintain a larger and more viable population of woodland dwelling species.
species diversity	Species diversity is expected to increase in *machamba*s through the planting of indigenous trees species through boundary planting and woodlot. An increase in tree diversity is expected to be reflected in the wildlife.
habitat area, availability, quality and diversity	Without protection, miombo woodland would decrease due to charcoaling and shifting agriculture. Agro-forestry systems are expected to increase habitat quality and area for arboreal species in *machamba*s.
landscape connectivity	Conservation areas will reduce fragmentation and increase connectivity between populations which will contribute to diversity.
forest fragmentation	The project encourages as much land as possible to be incorporated within the Plan Vivo system. This will increase the amount of remaining forest relative to the baseline and thus reduce fragmentation.

Assessment of the impact of the activities carried out through the technical specifications as required by the Plan Vivo:

Title of technical specification	**Biodiversity impacts**	**Water availability impacts**	**Soil conservation impacts**	**Air quality impacts**
1. Boundary Planting	Planting of indigenous trees directly increases floristic diversity in agricultural land. Also may improve matrix around wooded land.	Uses water, but may also create a favourable micro-climate for cereals through shading	Improves soil	No atmospheric pollution
2. Dispersed interplanting with *Gliricidia*	May take some pressure off GNP through nitrogen fixation	Uses water	Improves soil	No atmospheric pollution
3. Dispersed interplanting with *Faidherbia*	May take some pressure off GNP through nitrogen fixation	Uses water	Improves soil	No atmospheric pollution
4. Fruit Orchard, Cashew	Reduces shifting agiculture as there is a move to cash crop.	Uses water	nil	No atmospheric pollution
5. Fruit Orchard, Mango	Reduces shifting agiculture as there is a move to cash crop.	Uses water	nil	No atmospheric pollution
6. Homestead planting	Low impact but may improve matrix for woodland speices.	Uses water	nil	No atmospheric pollution
7. Woodlot	Will take pressure off fuel wood offtake from woodland and can be used for sustainable charcoaling	nil	Improves soil	No increased atmospheric pollution
8. No burning of agri-residues	Reduction in bush fires is good for wildlife.	Nil	Improves soil	Improvement in air quality
9. REDD	Conservation of woodland and habitat.	nil	Reduces erosion	Improvement in air quality

Comparison of the "with project" scenario with the "without project" scenario

Summary table for biodiversity benefit due to the project activities.

Biodiversity impact		
Without project scenario	**With project scenario**	**Difference (biodiversity benefit)**
Deforestation continues at 2.4% a year, very little wooded habitat remains outside of GNP	Deforestation reduced and community conservation areas are protected through REDD.	Positive
National parks and forest reserves a under high pressure from farmers opening new *machamba*s and charcoaling.	Pressure taken from parks and reserves through the replacement of unsustainable shifting agriculture with sustainable agriculture with no burning. Sustainable charcoaling from woodlots reduces pressure on protected areas for charcoal.	Positive
Available protected habitat for flagship species living in the park including elephants, buffalo, lion and Nile crocodiles will decrease. Increased wildlife/human conflict is expected.	Payments for ecosystem services increase value of conservation areas for communities in the buffer zone of the park which will reduce wildlife/human conflict.	Positive

B1.2. Demonstrate that no High Conservation Values identified in G1.8.1-3 will be negatively affected by the project.

HCV 1: Globally, regionally or nationally significant concentrations of biodiversity values (subcategorised into protected areas, rare or threatened species or endemic species).

HCV 2: Globally, regionally or nationally significant large landscape level forests

HCV 3: Forests that contain rare, threatened or endangered ecosystems

The project is designed to protect woodland at a landscape level through conservation, improvement of food security to reduce the need for shifting cultivation and providing alternatives to charcoal.

Those areas which contain significant biodiversity (HCV1), riverine and tropical dry forest, also contain higher amounts of carbon (see REDD carbon calculator CL1.1). Miombo woodland which is threatened on a landscape level (HCV2) has a high carbon density relative to savannah and degraded woodland. Threatened animal species, such as hippo and Nile crocodile, are found along the riverine areas which as above have higher carbon density (HCV3). Threatened tree species, such as *Cola mossambicensis* and *Sterculia appendiculata* occur in dry tropical forest which have high carbon stocks (HCV 3).

Those areas identified by the project as HCV 1-3 will therefore be of particular desirability for REDD areas selected with the community. It is expected the project will have a positive rather than negative effect on HCV.

B1.3. Identify all species to be used by the project and show that no known invasive species will be introduced into any area affected by the project and that the population of any invasive species will not increase as a result of the project.

No known invasive species are introduced by the project. *Gliricidia sepium* has not shown to be invasive in the field, but concerns about it being an exotic as well as its intensive management requirement have led to it being phased out as a technical specification. The last *Gliricidia* trees were planted in 2007. Intercropping of *Faidherbia albida* is encouraged as an alternative system to replace *Gliricidia*, the *Faidherbia albida* seeds are sourced from Malawi.

Tree species used in the project for boundary planting, homestead planting, intercropping and woodlot are indigenous or naturalised with the exception of *Gliricidia sepium*. Fruit orchards of cashew and mango are not invasive in Mozambique. Pigeon pea (*Cajanus cajan*), which is used to improve soil fertility in the *machamba* is naturalised and sourced from Manica province in Mozambique.

B1.4. Describe possible adverse effects of non-native species used by the project on the region's environment, including impacts on native species and disease introduction or facilitation. Project proponents must justify any use of non-native species over native species.

Though the project has been advised by ICRAF to use *Leucaena leucocephala* and *Gliricidia sepium* at the onset of the project, both native species to Central America (used for fodder, fuelwood, green manure and pulpwood in the case of *Leucaena*, and to shade cocoa, coffee, vanilla and tea; as green manure, for fodder (mainly for cattle), honey production, fuelwood, live fences, ornamental and furniture in the case of *Gliricidia*), the project has never planted *Leucaena* and no longer plants *Gliricidia*. The emphasis in the intercropping has been shifted to the native species *Faidherbia.*

The project only uses one non-native species Pigeon Pea (*Cajanus cajan*). Pigeon Pea is a shrub and a food crop that is naturalised and is grown throughout the project area as a boundary plant in fields. It is of Indian origin and is believed to have travelled from India to Malaysia, then to East Africa and from there up the Nile Valley to West Africa. Historians believe that the crop then travelled to the New World from Zaire or Angola prior to the main slave trade[97].

The use of pigeon pea, a non-native species is justified as it is a valuable species for the following reasons:

- Nitrogen fixing[98].
- Grows under poor soil conditions 68 and is tolerant of dry weather.
- Has a long tap root. Water and nutrients, can be reached from deep in the soil. Plants can be used along contour barriers for erosion control.
- Nutritious, high-protein, pulse crop. Leaves can be used for animal feed. Woody parts can be used for firewood.
- Plants are perennial for up to 3 years. and are fast-growing. They make good shade for other crops, i.e. vegetables, herbs, vanilla.

In summary, *Cajanus cajan* is a naturalised species which, to the best of our knowledge, does not pose any documented threat in the project area. However, our research partners will pay close attention to any potential threat that may arise.

B1.5. Guarantee that no GMOs will be used to generate GHG emissions reductions or removals.

No genetically modified organisms will be used in the project.

[97] http://www.cgiar.org/impact/research/pigeonpea.html

[98] Claire Ghee, 2010.

B2. Offsite Biodiversity Impacts

B2.1. Identify potential negative offsite biodiversity impacts that the project is likely to cause.

It is not expected the project will cause negative offsite biodiversity impacts.

B2.2. Document how the project plans to mitigate these negative offsite biodiversity impacts.

Not applicable

B2.3. Evaluate likely unmitigated negative offsite biodiversity impacts against the biodiversity benefits of the project within the project boundaries. Justify and demonstrate that the net effect of the project on biodiversity is positive.

The Project is predicted to have a positive impact on biodiversity as no negative impacts have been identified.

B3. Biodiversity Impact Monitoring

B3.1. Develop an initial plan for selecting biodiversity variables to be monitored and the frequency of monitoring and reporting to ensure that monitoring variables are directly linked to the project's biodiversity objectives and to anticipated impacts (positive and negative).

The project is committed to developing a biodiversity monitoring plan within 6 months of validation which focuses on tree species. A program of botanical training of community technicians has started and will continue to be developed. Annual monitoring of the REDD areas will include an assessment of species diversity in plots (see CL3.2). Results of annual monitoring of REDD areas must be included in the Plan Vivo annual report which is put online on the Plan Vivo website. The assess the impact of agro-forestry systems on agricultural land diversity and species composition of birds will be analysed.

The project already has three inventories of woodland (one in 2004 and two in 2007) in Chicale *Regulado* which can be used to assess baseline biodiversity of trees. Two non quantitative transects were also carried out in the Zambezi Delta site (2009) producing a list of present of tree species on which to base future surveys. These inventories and transects have been used to compile a valuable vernacular dictionary of botanical names in collaboration with Meg Coates-Palgrave. The dictionary can be used in annual monitoring of REDD areas.

The monitoring plan will include a methodology to assess bird taxa using distance sampling in the agro-forestry areas, to assess the impact of tree planting activities on the agricultural land. Plan Vivo farms will be compared to non Plan Vivo farms annually. A simple biodiversity indice will be used to compare the difference between the sites. Bird species composition in the longest term can be analyzed to infer information about success of reducing fire and increasing wooded land.

B3.2. Develop an initial plan for assessing the effectiveness of measures used to maintain or enhance High Conservation Values related to globally, regionally or nationally significant biodiversity (G1.8.1-3) present in the project zone.

Methods of monitoring HCV	
Impacts	**Methods and thresholds**
HCV within the REDD areas. (HCV1-6)	Currently REDD is only carried out in Chicale *Regulado.* As REDD activities are expanded to the rest of the project, they will be annual checked against identified HCV wooded areas to ensure that REDD management is occurring in the most valuable HCV wooded land.
Biodiversity of flora and fauna (HCV1-3)	It is assumed that biodiversity resides primarily in the miombo and closed canopy (riverine and tropical dry forest) wooded areas. These areas of high biodiversity value will be monitored annually in the REDD areas with this vegetation cover. The success of agro-forestry activities will be analysed using the biodiversity and species composition of bird taxa.
Water availability and soil erosion (HCV4)	Rainfall is being measured; records of water levels in the irrigation wells will be recorded; records of failure of trees in the nursery and on the *Machambas* are being obtained. Successful maintenance of HCV4 will be recorded annually during REDD monitoring and the stabilisation of river banks will also be monitored by the community technicians.

B3.3. Commit to developing a full monitoring plan within six months of the project start date or within twelve months of validation against the Standards and to disseminate this plan and the results of monitoring, ensuring that they are made publicly available on the internet and are communicated to the communities and other stakeholders.

The project will commit to developing a full monitoring plan within 6 months of validation and will include this within the annual report submitted to the Plan Vivo foundation. This report is displayed on their website and is also linked to the delivery of Plan Vivo certificates (carbon credits) to the buyer. The monitoring results will be translated into Portuguese and distributed in the annual report sent to government other stakeholders by the Country manager.

Methods of monitoring environmental impacts of proposed activities to be annually submitted to the Plan Vivo	
Impacts	**Methods and thresholds**
Biodiversity impacts	Annual monitoring of REDD areas will assist in investigating the fragmentation of the landscape and possible degredation through the analysis of satellite imagery. Annaul monitoring of REDD areas by the University of Eduardo Mondlane will assit in monitoring of floristic composition and status of vegetation types. Thresholds of reporting are indicated for REDD areas in CL3. A bird distance sampling survey in Plan Vivo and non Plan Vivo *machambas* will allow the assessment of success or otherwise of the agro-forestry and fire regime systems. A highier biodiversity indice for Plan Vivo areas will indicate successful implmentation.
Water availability impacts	Rainfall will be measured; records of water levels in the irrigation wells will be recorded; records of failure of trees in the nursery and on

	the machambas will be obtained. More than a 15% mortality rate is considered a highlighting for concern.
Soil conservation impacts	Soil carbon and nitrogen concentrations will be compared with baseline data collected by Joao Fernando in 2005. One study assessing carbon and nitrogen concentrations carried out in 2009 by Claire Ghee will be published in 2010 and will compare data with Joao.
Air quality impacts	It is not foreseen that the project will have an impact on air quality.

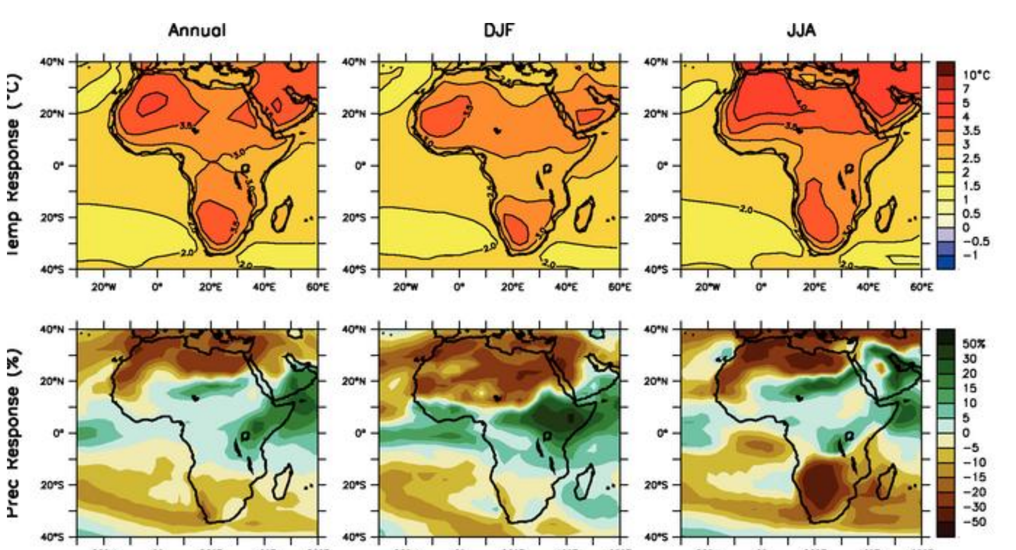
VII Gold Level Section

GL1. Climate Change Adaptation Benefits

GL1.1. Identify likely regional climate change and climate variability scenarios and impacts, using available studies, and identify potential changes in the local land-use scenario due to these climate change scenarios in the absence of the project.

While it is to be expected that anthropogenic climate change will have an effect on the climate of Sofala later this century, predicting the direction and magnitude of any changes, and their likely effects on species distributions and ecosystem services, suffers from the very high uncertainty of models. In general Global Climate Models (GCMs), though improving, are not thought to be accurate at a regional scale because of their very coarse resolution (significantly larger than many processes they are modelling), very simple underlying vegetation models (for example in this area the landcover possibilities would be generic farmland, tropical forest or grassland: there is no savanna tree coded into current models, and limited capacity for multiple land-cover types to exist within one pixel), limited feedbacks between vegetation cover and climate variables, and little ability to predict extreme weather events or cloud-cover, which are very important for local conditions. Beyond this, however, precipitation in this region of Mozambique is especially poorly modelled, for example the widely-respected UK Meteorological Office Hadley Centre's climate model significantly overestimates rainfall in this area for the present-day, and underestimates the number of extreme weather events by an order of magnitude[99].

When trying to apply GCMs, the most reliable approach is to combine as many as possible and look at the average results. This figure below is from the IPCC's Fouth Assessment Report[100], showing the average prediction from 21 GCMs for Africa as to the change in temperature and precipitation between 1980-99 and 2080-99 for the whole year, December/January/February (DJF), and June/July/August (JJA).



[99] Williams, C.J.R., Kniveton, D.R. & Layberry, R. 2010. Assessment of a climate model to reproduce rainfall variability and extremes over Southern Africa. *Theor Appl Climatol* **99**: 9-27.

[100] IPCC Fourth Assessment Report, Climate Change 2007, WG1, Chapter 11, Fig 11.2

For the Sofala area the prediction is for an increase in temperature of 2 degrees centigrade, and a decrease in precipitation of around 10%, concentrated in the southern-hemisphere winter. However the uncertainty in these models is high, as stated above, and in fact 6 of the 21 models predict an increase in precipitation for the area. The results are also very dependent on the emissions scenario chosen – these are presented here for the IPCC A1B scenario, which is a 'mid-range' scenario predicting high economic growth but with increasing uptake of alternatives to fossil fuels. Though this is thought to be one of the more likely scenarios, such predictions suffer from the impossibility or really being able to predict population growth, socio-economic conditions and scientific developments in the future.

Given the caveats above, the question remains as to what effect these changes would have on on the Sofala Community Carbon Project. The tree species of the region are highly drought and temperature resistant, and could withstand even more extreme increases in temperature or reductions in rainfall over a prolonged period of time; these changes in temperature and rainfall are not thought likely to result in a significant reduction in the range or density of any species within the project by 2100. In all likelihood the rate of growth of the trees would slow a little, impacting the ability of local people to collect firewood, and the balance of species within communities would gradually change. Also the size of riverine forests could reduce, as flow down the many seasonal rivers, and the major Pungue and Zambezi rivers, is moderately likely to reduce. Any reduction in the flow of these rivers could also have a significant negative effect on local communities, by reducing their access to fresh-water and reducing the success and scale of agriculture. However in all these cases the impact of the changing climate on the vegetation cover is likely to be much smaller than management decisions: the frequency of burning, cutting, and intensity of agriculture has a much greater impact on woody cover in African savannas than rainfall or temperature[101].

These predictions suggest it is moderately likely that the region could be more susceptible to intense droughts as a result of climate change, though this is far from certain as climate models are much worse at predicting extreme than average conditions. However if this were to occur this would have a major impact on the people and the ecosystem, with a major drought having the potential to cause extreme fires, resulting in a loss of biomass, failure of crops and the potential loss of fresh drinking-water supply.

GL1.2. Identify any risks to the project's climate, community and biodiversity benefits resulting from likely climate change and climate variability impacts and explain how these risks are being mitigated.

As in GL1.1 the climate change impacts on Sofala province are uncertain, but extreme drought is possible and mitigation strategies must be identified.

[101] Sankaran, M., Hanan, N.P., Scholes, R.J., Ratnam, J., Augustine, D.J., Cade, B.S., Gignoux, J., Higgins, S.I., le Roux, X. , Ludwig, F., Ardo, J., Banyikwa, F., Bronn, A., Bicini, G., Caylor, K.K., Coughenour, M.B., Diouf, A., Ekaya, W., Feral, C.J., February, E.C., Frost, P.G.H., Hiernaux, P., Hrabar, H., Metzger, K.L., Prins, H.H.T., Ringrose, S., Sea, W., Tews, J., Worden, J., and Zambatis, N. 2005. Determinants of woody cover in African savannas, *Nature*, **438**: 846-849.

Risk	Mitigation strategy
Death of tree seedlings planted as part of project activities	Planting a wide range of species increases the likelihood of overall survival of trees as they have different levels of environmental resistance. Local independant community nurseries which have been set up can replace dead trees. Selection of indigenous trees with deep tap roots which are resistant to drought.
Crop failure due to drought leading to extreme hunger and even starvation in the community	Diversificiation of crops will reduce impact of any environmental variation. Monocropping exposes the community to a high risk of failure. Drought resistant strains of maize could be introduced to the community. Cash crops like pigeon pea, mango and cashew as well as carbon finance gives the community the ability to buy food if their subsitence crops fail. In this way the one of the core aims of the project - poverty alleviation - is in itself a mitigation strategy against environmental disasters including drought. Agro-forestry such as the interplanting of *Faidherbia* can create an improved microclimate under which to grow cereal crops such as maize. More water is retained in the soil as a result of shading as well as increased soil organic carbon inputs. This is expected to decrease the impact of *Faidherbia*. The project already encourages no burning of agri-residues and mulching improve soil moisture content and has introduced cover crops such as pigeon pea.
Bush fires, reducing biomass in natural woodland, burning planted trees, homesteds and *machambas*.	The project already has a fire management programme underway. This is three fold, first the creation of fire breaks around *machambas,* second the fire breaks and early burning in the REDD areas and third the no burning of *machambas.* This will leave the community less susceptible to bush fires.
Community rivers dry up	The community funds from carbon finance can be used to create wells in the extreme event that the seasonal rivers in the project regions cease to flow. Drip irrigation (G3.2) will maintain productivity in absence of a reliable water supply.

GL1.3. Demonstrate that current or anticipated climate changes are having or are likely to have an impact on the well-being of communities *and/or* the conservation status of biodiversity in the project zone and surrounding regions.

Past environmental disasters can give an insight into the likely impacts of climate changes in the future in Sofala province, as in GL1.1 it is not certain these can be directly attributed to climate change:

Climate-related natural disasters in Mozambique since 1980 (IRI, 2008).

Year	Event	Areas affected	Number of people affected
2002–06	Drought	43 districts affected in South and Central provinces	800,000 affected
2001	Floods	Zambezi river	500,000 affected; 115 deaths
2000	Floods	Limpopo, Maputo, Umbeluzi, Incomati, Buzi, and Save river basins, caused by record rainfall and 3 cyclones	More than 2 million people affected; 700 deaths
1999	Floods	Sofala and Inhambane provinces; highest rainfall level in 37 years; EN1 (major road) shut for 2 weeks	70,000 people affected; 100 deaths
1997	Floods	Buzi, Pungue and Zambezi rivers; no road traffic to Zimbabwe for 2 weeks	300,000 people affected; 78 deaths
1996	Floods	All southern rivers of the country	200,000 people affected
1994–95	Drought	South and Central parts	1.5 million people affected; cholera epidemic
1991–92	Drought	Whole country affected	1.32 million people severely affected; major crop failure
1987	Drought	Inhambane province	8000 people affected
1985	Floods	9 rivers in the southern provinces; worst flooding in 50 years followed by 4 years of drought	500,000 people affected
1983–84	Drought	Most of the country affected	Many deaths from drought and war; cholera epidemic
1981–83	Drought	South and Central provinces	2.46 million people affected
1981	Floods	Limpopo river	500,000 people affected
1980	Drought	Southern and Central provinces	No data available

On the 1st of September 2008, 99 homesteads were destroyed and 43 people were killed in Manica and Sofala when a large bush fire swept through. In the project region, only one person was killed and the Chicale *Regulado* was presented with a fire management award in 2010 to recognise its achievements. It is possible therefore that the mitigation strategies against bush fires above (GL1.2) are already having an impact.

Drought related to climate change and ensuing failed crop harvest are a large threat to the community. The community is still dependant on subsistence rain fed agriculture (Rohit 2008) even if the long term goal of the project is to lift them out of poverty. Therefore they are highly vulnerable to any change in the climate, in particular rainfall and water availability. The community is post conflict, environmental stress and competition for limited resources may stimulate climate related conflict in the absence of mitigation measures outlined above.

The IUCN rates climate change as one of the top five threats to biodiversity. One consequence is habitats changing before organisms can move away or adapt, this is especially relevant for large, slowly reproducing organisms such as elephants and hippos found in the project regions. A lack of connectivity in the landscape will further reduce the ability of organisms to reach other reserves and maintain viable breeding populations, this is particularly relevant for vulnerable species with low populations such as the African wild dog found both in Gorongosa and Zambezi Delta site. The project will increase connectivity in the landscape by preserving woodland in the buffer zones around the parks and reserves in the project regions, increasing the ability of large animals to adapt.

GL1.4. Demonstrate that the project activities will assist communities *and/or* biodiversity to adapt to the probable impacts of climate change.

Any environmental variation inclusive of that caused by climate change will have an impact on rain fed subsistence agriculture. In early 2010 there was a mid season drought which negatively affected crops and tree survivability. Project activities such as sustainable land-use practices, agro-forestry, diversification of agricultural products including carbon and alleviation of poverty all contribute a communities ability to adapt to environmental variation. Crop failures as a result of the 2010 drought were compensated for in part by carbon payments which were made in April.

Bush fires are likely to become more frequent in the event of drought, a probable consequence of climate change. Fire management activities instigated as part of the project will reduce death, crop loss and property destruction. Reduction in bush fires also will directly affect the stability of flora and fauna biodiversity.

Fragmentation of habitats and loss of connectivity in the landscape reduces animals ability to migrate in reaction to a changing climate. The REDD management activities of the project and conservation of woodland around national parks and forest reserves improve adaption ability of organisms.

Stabilisation of riverbanks through tree planting is a project activity will reduce impacts of flash flooding in the project region, which are a possible consequence of climate change. This will impact both on the communities and biodiversity. For communities it will reduce soil erosion on agricultural land and biodiversity it will reduce siltation and turbidity of water downstream.

The bore hole built by the project may be used in the worst scenario that the wells dry out and it will also be used to water trees in the nearby nursery. Water use and its impacts on the community's health and well being were recently assessed and the results of this survey will be used to inform decisions related to this issue[102].

GL2. Exceptional Community Benefits

GL2.1. Demonstrate that the project zone is in a low human development country OR in an administrative area of a medium or high human development country in which at least 50% of the population of that area is below the national poverty line.

Mozambique was ranked as the poorest country in the world in 1992 and, although the country has witnessed a steady decline in poverty rates to 2003, more than 54% of the population still lived below the poverty line. In 2003, UNICEF estimated that 63% of rural children in Mozambique lived in absolute poverty (defined as "…a condition characterized by severe deprivation of basic human needs" at the World Summit for Social Development).

Sofala Province is ranked second highest among all of Mozambique's provinces for absolute poverty of children, with 59% of the children in the province living in absolute poverty, and fourth highest for severe health deprivation, with 17% of the children in Sofala suffering from severe health deprivation. Clearly, the people of Sofala province are in need of improved access to health care as a basic first step to improving their quality of life.

A summary from the - UNDP _MSF-CIS/DDM report 2000 on Sofala Province - Gorongosa District confirms this:

"Gorongosa district is very underdeveloped and it was also severely affected by the war. Access is difficult since much of the road network is impassable to traffic. Moreover, many areas are still mined, despite the mine

102 Jelena Barbir, Masters candidate. Universidad Autonoma de Barcelona

clearance work that has already been carried out, and the daily lives of the population in these areas continues to be affected.

Economic activity is virtually stagnant and the absence of any financial market hampers development. Agricultural production is normally below local requirements and the expansion of farming is blocked by, on the one hand, the lack of financial resources on the part of the peasants, and on the other, natural phenomena such as pests and drought.

Nevertheless, the district has some potential, mainly in its forestry and wildlife resources. It possesses a wealth of commercially valuable native hardwoods which, if exploited sustainably, could become a focus for local economic development. Another focus is the Gorongosa National Park. The Park's infrastructure was almost completely destroyed in the war but the wildlife remains and, despite indiscriminate slaughter, no species has become extinct.

The supply of clean, safe water for the population is another problem affecting the district. The only boreholes are those in the area of the district capital. The population in the rural areas obtain their water from rivers.

The health and education sectors are likewise beset by problems, notably shortages of infrastructure and qualified staff. The situation in the education sector is particularly serious. Many classes are held in the open air while a large number of schools were destroyed during the war and those that do exist are severely short of equipment and materials."

GL2.2. Demonstrate that at least 50% of households within the lowest category of well-being (e.g. poorest quartile) of the community are likely to benefit substantially from the project.

An extensive social study was conducted by Rohit (2008) in context of the Sofala project including more than 200 household interviews. The study reveals that project participation is unrelated to economic status of a household. The study used the Sustainable Rural Livelihoods (SRL) approach that considers both economic and non-economic impacts of a project on local community.

Results of the study are presented below. The following factors have a significant impact on the participation in the project: gender of the head of the household, household size, total area of different *machambas* owned by a family, year when the family migrated into the Chicale *Regulado*, and employment with any micro-enterprise promoted by the Sofala project. Results and signs of coefficients obtained from OLS (column 2) and from logistic regression (column 3) are fairly consistent.

Male headed households (coefficient = -0.09) had a nine percent lower probability of enrolling for agro-forestry contracts than female headed households. One possible explanation is that due to extensive polygamy in the area (Jindal, 2004), there are several female headed households that find agro-forestry contracts an attractive opportunity to earn some cash income. By contrast, male headed households have other sources of income, such as selling NTFPs from the local forest (Hegde and Bull, 2008).

Although off-farm income in the form of employment outside the village was returned insignificant (column 1), the most strong determinant of participation in the project was employment with a micro-enterprise (coefficient = 0.21, column 2) promoted by the Sofala project. Indeed, almost all employees covered in the survey have agro-forestry contracts. This could be due to their easy access to project staff that administers agro-forestry contracts as well as peer pressure from others who have already enrolled for such contracts. Similar to previous studies on adoption of agro-forestry, household size (0.04) and *machamba* area (0.06) were also both positive and significant. Presence of an additional household member helps in taking care of initial labor requirements when new land use is being adopted. Similarly, larger farm area increases the chances of participating in the project because it enables the household to take some land out of crop production and devote it to additional activities such as growing new trees. Finally, recent migrants to the community had a lower probability of participating than older residents (coefficient = -0.004). This could be due to their lack of familiarity with local community association which often suggests names for inclusion in the project. Group discussion with new migrants confirmed this result when they said that many of them would like to participate in the project but they are lower down on the waiting list.

So what do these results imply regarding participation of the poor in the Sofala project? Female headed households tend to be poorer than male headed households. Since they constitute a sizeable proportion of all households in the local community (table 1), it appears that poorer households are more likely to participate in the project. On the other hand, however, households with more resource endowments in terms of farm area and employment in micro-enterprises, also have a higher probability of picking up agro-forestry contracts. Therefore, better off households may also be well placed to access the project.

The project itself pays for most transaction costs including monitoring and supervision of carbon contracts. Similarly, almost all households possess *machambas* only one household was encountered (recent migrant) that did not have land to farm. It is also important to note that the project has already been extended to about 70 percent of all households in the community. As more than 85 percent of rural households in Sofala province were below the poverty line during the last decade (Simler *et al.*, 2004), this implies that around 60% of poor households have participated in and reaped benefits from the project. In summary, poor households in the community receive a good chance to participate in the Sofala project.

Figure 71. Table 38 Results of multiple regression explaining factors that determine a household's decision to enroll for agro-forestry contracts under the Sofala project (n=205)

	(1) coefficient estimates by OLS	(2) OLS estimates after excluding non-significant variables	(3) coefficient estimates by Logistic regression model
Male headed household	-0.09 (1.47)	-0.09 (1.55)	-0.47 (1.14)
Age of the household head	-0.00 (0.63)	(dropped)	(dropped)
Household size	0.04 (2.40)**	0.04 (3.28) ***	0.29 (3.01)***
Number of literates in the household	0.02 (1.02)	(dropped)	(dropped)
Number of *machambas*	-0.00 (0.11)	(dropped)	(dropped)
Total *machamba* area	0.07 (3.29) ***	0.06 (3.83) ***	0.49 (3.36)***
Year of migration into the community	-0.003(1.37)	-0.004 (1.42)	-0.03 (1.11)
Employment within Sofalaproject	0.19 (3.03)***	0.21 (3.20) ***	1.65 (2.82)***
Employment outside the village	-0.05 (0.55)	(dropped)	(dropped)
Constant	7.85 (1.45)	7.93 (1.49)	53.01 (1.08)

	(1) coefficient estimates by OLS	(2) OLS estimates after excluding non-significant variables	(3) coefficient estimates by Logistic regression model
	Prob > F = 0.00	Prob > F = 0.00	Prob > chi2 = 0.00
	R-sq = 0.236	R-sq = 0.229	Pseudo R-sq = 0.240

Notes: Figures in parentheses for columns (1) and (2) are absolute values of t-statistics. For column (3), figures in parentheses report absolute value of z-statistics. Based on 2008 survey among the local households.

** Significant at 5%, *** significant at 1%.

Source: Rohit Jindal's survey in 2008.

GL2.3. Demonstrate that any barriers or risks that might prevent benefits going to poorer households have been identified and have been addressed in order to increase the probable flow of benefits to poorer households.

A shortage of draft power due to tsetse fly infestation restricts the amount of land that each family can use; 29% of households cultivate less than 1 ha and yields are in general far below potential. The alternatives available to subsistence farmers are limited in these communities. The Miombo woodland contains a number of commercial timber species and licenses can be obtained to harvest timber. However most land concessions have been given to large, outside investors. The 1997 Mozambique land law allows smallholders to register their land right. However, few communities have taken advantage of this opportunity largely due to a lack of accessible information and support.

The project has enabled the community and its members to harness the miombo woodland resource in a sustainable manner and to obtain a concession to harvest and process timber. This process allows unemployed people, with no relevant skills, to receive training and resources to establish a community-driven enterprise that contributes directly and indirectly to the development of the community and its infrastructure.

The rural economy and social infrastructure of the Chicale *Régulado* was severely disrupted during the protracted civil war. Sofala province and the Gorongosa region was at the epicentre of the war and fighting in the *Régulado* and the activities of various armed forces and groups forced the majority of people from their land and into refugee camps along the Beira corridor. The Sofala Project identified activities that would contribute to national and regional government objectives that were not being realized due to a lack of resources. These include:

- Provide rural communities with access to alternative means of income generation
- Diversify smallholder production systems
- Support communities in registering their lands with relevant authorities
- Provide appropriate technical information and support to farmers to help them improve the productivity and sustainability of agriculture
- Provide data related to Miombo forests as carbon sinks and greenhouse gas mitigation resources

The project has promoted sustainable resource use and income generation in the target communities. The profits from timber extraction and utilisation have been invested in the community association and used by the community to fund community level projects. The profits from a wide range of activities linked to project activities including vegetable production, manufacture of furniture, honey production, sale of crafts and tourism support have all contributed to a community fund.

These have been defined in participation with the community and have included investments into schools, infrastructure and health services (health posts).

The Community Association has invested revenues from the sale of VER's and other project related activities in the building of a new school and a health post.

Individual community members have benefited from employment in the community forestry operations including nursery work, harvesting operations and carpentry. In addition to forest management and timber utilisation, income has been generated by community members through the promotion of bee keeping and improved honey marketing. In this way the spread of benefits through the community has been facilitated by involving a range of individuals in project activities and ensuring that profits are invested in activities that will benefit the community as a whole. Income generation within the community is recorded and tracked as part of the project.

Community members are provided with training for all activities. A key part of assessing activities for carbon offset potential is the production of management plans by community members. These plans are used by the management of ECL to assess land use activities. Community members are given training in the production of simple management plans in the form of annotated maps. These plans serve to help community members plan their time and monitor their own results as well as facilitate carbon verification. Certain key community technicians have been given further training in monitoring methods for carbon verification in conjunction with the trust fund technical team.

The project includes monitoring systems as an intrinsic part of their design. Monitoring is carried out by community technicians with support from the ECL technical team. Carbon verification requires an assessment of tree growth, soil fertility and deforestation. Part of the research component has generated simple-to-measure indicators of these attributes that are recorded by community technicians and project technical staff. Monitoring indicators are also being developed to assess the social impacts of project activities in the community.

This covers:

- Experiences with land use activities
- Skills and experiences
- Income generation
- Organisation and communication

Key indicators of project impact are based around:

- The number of community members involved in the project
- The area of various land use activities implemented
- The income generated by various activities
- Activities funded by project income
- GHG emissions avoided

- Carbon asset value realised

ECL in conjunction with the Edinburgh Centre for Carbon Management has developed the capacity to assess land use activities for carbon offset potential. This includes the management of the Carbon Livelihoods Trust Fund and the use of Plan Vivo administrative systems.

The project is explicitly designed to provide the possibility of replication of activities. Research carried out has regional significance, the results of which may be applied to land-use projects throughout the Miombo ecosystem. Technical specifications specify the carbon offset potential for land use systems with the potential to generate local benefits. These specifications may be used for any land use project in the region to assess the offset potential of community land management.

The capacity building at the provincial level provides the necessary institutional structures and technical capacity to replicate the activities in the pilot project area in other communities. The choice of the Nhambita community as the target for pilot project activities reflected not only the suitability of conditions in the community to implement sustainable land use practises but its representation of many communities in the area.

GL2.4. Demonstrate that measures have been taken to identify any poorer and more vulnerable households and individuals whose well-being or poverty may be negatively affected by the project and that the project design includes measures to avoid any such impacts. Where negative impacts are unavoidable, demonstrate that they will be effectively mitigated.

As described above the project is equally accessible to both poor and relatively better-off households. The project itself pays considerable attention to reduce inequity. By covering most transaction costs including monitoring and supervision of carbon contracts it provides poor households the same opportunity to participate. As a result the project has already been extended to about 70 percent of all households in the community.

GL2.5. Demonstrate that community impact monitoring will be able to identify positive and negative impacts on poorer and more vulnerable groups. The social impact monitoring must take a differentiated approach that can identify positive and negative impacts on poorer households and individuals and other disadvantaged groups including women.

The study from Rohit in 2004 and 2008 forms the baseline for subsequent investigations. A further study will be carried out in Zambezi Delta site by a masters student from Eduardo Mondlane to monitor the impact on the community.

GL3. Exceptional Biodiversity Benefits

Project proponents must demonstrate that the project zone includes a site of high biodiversity conservation priority by meeting either the vulnerability *or* irreplaceability criteria defined below:

GL3.1. Vulnerability

Regular occurrence of a globally threatened species (according to the IUCN Red List) at the site:

1.1. Critically Endangered (CR) and Endangered (EN) species - presence of at least a single individual; or

1.2. Vulnerable species (VU) - presence of at least 30 individuals or 10 pairs.

- *Hippopotamus amphibius* (vulnerable)
- *Lycaon pictus* (Endangered) - 3,000–5,500 individuals left in the wild[103]
- *Panthera leo* (Vulnerable)
- *Trigonoceps occipitalis* (Vulnerable) - 2,600-4,700 pairs left (birdlife international), declining in Mozambique.
- *Cola mossambicensis* (Vulnerable)
- *Sterculia appendiculata* (Vulnerable)

Or,

GL3.2. Irreplaceability

A minimum proportion of a species' global population present at the site at any stage of the species' lifecycle according to the following thresholds:

2.1. Restricted-range species - species with a global range less than 50,000 km2 *and* 5% of global population at the site; or

2.2. Species with large but clumped distributions - 5% of the global population at the site; or

2.3. Globally significant congregations - 1% of the global population seasonally at the site; or

2.4. Globally significant source populations - 1% of the global population at the site.

Studies carried out in and around the Gorongosa National Park before the commencement of the project and using information that was available to the project developers highlighted a link between the management of natural resources in the neighboring communities and the survival of the biodiversity of the park. The project was designed, in consultation with the management of the park, to preserve and protect the bio-diversity in the protected area by creating a human fence rather than using guns and fences[104].

Community use of resource areas can be divided into two broad classes; land transformation and multiple use. Land transformation comprised the conversion of woodland areas into cultivated fields or riverine gardens. This was clearly the most destructive process and would directly and negatively impact biodiversity and hence

[103] McNutt, J.W., Mills, M.G.L., McCreery, K., Rasmussen, G., Robbins, R. & Woodroffe, R. 2008. Lycaon pictus. In: IUCN 2009. IUCN Red List of Threatened Species. Version 2009.1. www.iucnredlist.org.

104 The concept of the "human fence" and protection of the high biodiversity value GNP is discussed extensively in "Envirotrade, Communities and Forest Conservation in Africa"

conservation objectives. Multiple use of given landscape units by the community could, however, under certain management conditions, remain compatible with conservation objectives. The expansion of human populations in and adjacent to the park will inevitably result in greater demands from people for agricultural land and for the resources that the park seeks to conserve. It would thus seem inevitable that conflict between the park and people whose livelihoods depend on park resources will intensify. Further conflict is likely to arise through the build-up of wildlife populations, such as elephants and large predators. One possible solution for the park management is to identify key ecosystem units, such as forest communities, and put in place fully enforced regulations governing the clearance of these areas for cultivation. Development of land-use zones in collaboration with the affected local communities would be one way of achieving this. Once these areas of both high conservation and high local resource value have been identified and their use regulated through zoning, co-management structures and institutions could be developed to provide sustainable multiple-use opportunities to those communities with a high dependency and capacity to manage these resource units. Secondly, the park management will need to develop and maintain functional relationships with these communities (i.e. relationships with low levels of conflict and high levels of co-operation) which will require significant management inputs. The maintenance of communities within the park will incur additional costs, including both direct costs such as the costs of maintaining ranger's posts in the areas in which the communities are, as well as indirect costs such as increased fire incidence. For some areas or ecosystem units, these costs may be warranted but, for other areas, these costs may not be warranted. In these instances GNP management may be better off seeking incentives to persuade communities to voluntarily relocate. The coupling of park ecosystems to ecosystems outside of the park (particularly hydrological couplings with Gorongosa Mountain), and, hence, outside of GNP management control, means that, for GNP to survive ecologically, park management must also seek to develop fully functional co-management relationships with the local communities responsible for managing these external ecosystem elements.[105]"

[105] Lynam, T., Cunliffe, R., Mapaure, I. and Bwerinofa, I. 2003. Assessment of the value of woodland landscape function to local communities in Gorongosa and Muanza Districts, Sofala Province, Mozambique. CIFOR work report.

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