REFORESTATION OF DEFORESTED LAND IN MADAGASCAR THROUGH THE ESTABLISHMENT OF A TRAINING CENTRE FOR SUSTAINABLE FORESTRY DEVELOPMENT

Fondation EcoFormation
Reforestation & agroforestery
Biodiversity restoration

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Project Title	Reforestation of deforested land in Madagascar through the establishment of a training centre for sustainable forestry development	
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1 PROJECT DETAILS

1.1 Summary Description of the Project

The EcoFormation reforestation project in Madagascar will be established in the rural district of Bekoratsaka, in the northwestern part of the island (Sofia region). Due to extreme poverty, a lack of awareness and adequate resources to train an agricultural population, this region continues to be plagued by the massive destruction of its forests as a result of precious wood working and slash and burn activity. In fact, the Sofia region is one of the largest vegetation fire hearths in Madagascar. Thousands of hectares of natural forest and degraded forests are destroyed each year in this region.

These soils are devoid of chemical fertilizers or pesticides and when they are reconverted to accommodate mono-cultures, the risk of soil depletion is significant. In other cases, soils are left abandoned. The massive destruction of these primeval forests is disastrous for the biodiversity provided by balanced ecosystems.

EcoFormation has decided to reforest a depleted area and to create a Training and Sustainable Development Centre where local youths will benefit from the following:

- Awareness-building programs for natural protection and preservation of the ecosystem's balance which is a key element in maintaining the local population's livelihood.
- Professional Training (nursery gardeners, foresters, farmers, woodcutters, woodworkers) to preserve the environment and to develop local resources.
- On-site employment to implement specific campaigns aimed at reforesting, replanting endemic tree species and to re-establish primeval forests.
- Involvement in forest maintenance and management activities to protect the land from erosion and to restore natural streams.
- Training designed to create and maintain nurseries and to develop food crops on forestlands (agroforestry).

The Training Centre will provide practical knowledge and training in forestry, nursery gardening, agroforestry and agro mechanics to local youths. This is a way to give the population the power to conserve, to use durably and transform one of their natural treasures, precious wood.

The proposed project offers various key benefits relevant for development cooperation, e.g.:

- Reduction of poverty, creation of local jobs and revenues,
- Food crop farming, ensuring food security,
- Positive environmental impact, enhancing resilience and climate change mitigation,
- Strengthening of local institutions, involving local organizations.

Therefore, the Training and Sustainable Development Centre will be transferred to the locals when financial autonomy has been reached.

The total surface of the project perimeter is 12'696 ha. Thereof, 8'972 ha have been identified suitable for reforestation according VCS requirements and guidelines. Within this VCS project area, an initial management plan has been developed for the reforestation of 6'073 ha (without land requirements for site development, fire belts, etc). The species foreseen for reforestation activities are: Eucalyptus camadulensis, Khaya senegalensis, Tectona grandis, Dalbergia trichocarpa and Terminalia mentaly

In addition to the reforestation activities to be registered under the VCS standard, the project proponents will implement activities dedicated to agroforestry with food crops (rice, pineapples, onions, etc.) and improved agricultural practices to satisfy local needs and to ensure the forest integrity (end of slashing-

and-burning). Although these additional activities have the potential to further reduce greenhouse gas emissions, they are not subject of this Project Document.

A cooperative called Avotrala has been set up for this project. The members of Avotrala are local villagers and farmers and the Board of Directors of the Cooperative is composed of locals elected by the General Assembly.A right to use the land free of charge for an undetermined time has been given by the state to the Cooperative. Avotrala is responsible for the management of the structure as well as the field management (plantation, nurseries, workers,etc.). EcoFormation helps the Cooperative with the management, the training and the financing (in the starting phase of the project). It is EcoFormation who is responsible for the process to get carbon credits.

A UNFCCC CDM methodology has been used for the project implementation, the AR-ACM0003 "Afforestation and reforestation of lands except wetlands". The project intends to issue carbon credits for the voluntary market, using the VCS standard.The project lifetime is of a minimum of 60 years (rotation time for the slowest growing tree species) but it is undetermined since the project's goal is to have extended rotation with replanting in order to preserve the ecosystem linked with the replanted forest. However, the first crediting period is of 30 years and the sequestration over those years is estimated to be 2'883'562 tons of CO_2e , whereof 2'450'646 tCO_2e will be claimed by project participants in form of Verified Carbon Units (VCUs) and 432'916 tCO_2e will remain in the VCS AFOLU pooled buffer account.

Forest wardens, nursery gardeners, foresters and farmers will be employed by the Training and Sustainable Development Centre to reforest and preserve these new woodlands. They will operate in close collaboration with the instructors of the Centre.

The planting of the trees produced in the nurseries took place on February 18th, 2011.

1.2 Sectoral Scope and Project Type

Sectoral scope: AFOLU
Project category: ARR
This project is not a grouped project.

1.3 Project Proponent

Entity	Description	Function
EcoFormation Philippe DUBOIS President Avenue des Alpes 61 1844 La Tour-de-Peilz Switzerland Tel & Fax +4121 943 14 34 Cell +41 79 301 02 89 phdubois@ecoformation.org www.ecoformation.org	Founded by Prof. Dr. Balz Gfeller (Forest Engineer) and Philippe Dubois (Agricultural Engineer), EcoFormation is a non-profit making foundation recognized as being in the public interest and offers pragmatic solutions in close collaboration with local populations. Based on their expertise, EcoFormation's partners believe that: • Training the local population must precede action. • Local populations can help contain destruction of forestlands. • Agroforestry is one of the solutions for developing food crops and favouring the production of marketable agricultural products. • Native populations will protect the forest if they recognize it as a source of revenue and food.	Project proponent

1.4 Other Entities Involved in the Project

Entity	Description	Function
Coopérative Avotrala Miarinjara Jacob Amédée President Mandrosoarivo School Sofia Region Madagascar	Cooperative constituted of farmers from the following villages: Mandrosoarivo Andrafiakely Miarinarivo Àntanandava Antanambao I Ambodirnadiro II	Land owner
Savaivo s.a.r.l Andriamparany RAKOTOMAVO Director B.P. : 8186 Bâtiment DRFP – FOFIFA Antananarivo 101 Madagascar Office tel. 033 11 693 47 andri.savaivo@blueline.mg http://www.savaivo.org	Office responsible for the land-use analysis (incl. analysis of satellite images), ecological survey, delineation of project area, species selection and management plan.	Project participant
HELVETAS Swiss Intercooperation Oliver GARDI Advisor Environment and Climate Change Maulbeerstrasse 10 3001 Bern Switzerland Tel. +41 79 460 51 26 oliver.gardi@gmail.com http://www.helvetas.org	Technical support for calculation of emission reductions and methodological revision of the PD that was initially written by Antonia Jaquet of Carbon Credit Consulting Sàrl. Supervision of the validation process. Consultancy financed through the Swiss Agency for Development and Cooperation (SDC)	Consultant

1.5 Project Start Date

The project activity directly leading to the sequestration of CO2 started on 18th February 2011 with the plantation of the first trees grown in the nurseries.

1.6 Project Crediting Period

The project crediting period will be of 30 years starting on 1st March 2011 and ending on 1st March 2041. The crediting period is renewable (maximum two times in order not to exceed the maximum period of 100 years).

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project	X
Mega-project	

Estimated GHG removals for the project crediting period, incl. VCS buffer. The calculation of the emission reductions follows the VCS AFOLU Requirements v3.3 for ARR projects with harvesting and the AFOLU Guidance "Example for Calculating the Long-Term Average Carbon Stock for ARR Projects with Harvesting", with a long-term average GHG benefit of 2'883'562 tCO2e.

Years	Estimated GHG emission reductions or removals (tCO2e)
2012	2983
2013	23695
2014	27401
2015	60648
2016	106816
2017	152978
2018	157486
2019	194128
2020	191977
2021	204107
2022	214411
2023	238328
2024	273364
2025	226870
2026	264027
2027	289393
2028	254951
2029	0
...	0
2041	0
Total estimated ERs	2883562
Total number of crediting years	30
Average annual ERs	94452

1.8 Description of the Project Activity

Introduction

Inspired by their reforestation and agro forestry experiences in Africa, Asia and Latin America, Pr. Dr. Balz Gfeller (Forest Engineer) and Philippe Dubois (Agronomist Engineer) founded the EcoFormation Foundation. It is a non-profit organization, recognized as a public utility and registered under Swiss and Malagasy law. Its aim is to offer pragmatic solutions in close collaboration with local populations.

The missions of EcoFormation are:

- Reforest former primary forests with slow and fast growing endemic species
- Train locals to grow nurseries and implement sustainable forest and agro forest management practices
- Develop forest and agricultural products to ensure locals' and the site's independence
- Bring the concept to other sites as the income from carbon sequestration finances initial investments

The founders, Balz Gfeller and Philippe Dubois, have decided to set their first project in Madagascar, in the rural district of Bekoratsaka in the Sofia region.

This project's goal is to reforest 6'073 hectares of deforested lands (surface of the initial management plan) within the VCS eligible project area of 8'972 hectares.
The project activity's lifetime is undetermined since the goal is to reforest the land on a long term basis with rotational exploitation of the forest resources. Since there is a mix a species with various growth rates and lifetime, the sustainable harvesting activities will spread over time.
However, the Management Plan has been done fore a period of 60 years which will cover the first rotation of harvesting and replanting activities.
More details about the technical aspect of forest management can be found in section 1.8 of this document.

Organizational structure

To ensure the longevity of the project, EcoFormation has set up association and a cooperative in collaboration with the villagers and local authorities.
The goal of the project is to do reforestation (as well as biodiversity restoration and agriculture but not under the VCS) on a long term basis.
In order to achieve these goals, EcoFormation had to make sure that the project was accepted and supported by the local communities.
Therefore two type of entities have been created.
There is of course EcoFormation which initiated and manages the project, then there is the Avotrala Cooperative, which owns the land and manages the fieldwork and finally there are associations.
There are as many associations as Fokontany (malagasy villages) members of the Cooperative. The associations represent the interests of the following Fokontany in the Cooperative:

- Mandrosoarivo
- Ambodimadiro II
- Antanandava
- Andrafiakely
- Antanambao
- Miarinarivo

Each of the six participating Fokontany has created an association. Three persons of the Fokontany (the Chief of the Fokontany, the wise man (Raya aman-dreni) and a young person of the village (Tanora)) have each a voting right.
All other people of the village interested in becoming a member (and get a voting right) can do so by paying 300 Ariary (about 10 cents of Euro) which represents a reasonable amount for the villagers who can also earn this right by working for Avotrala.

The Avotrala Cooperative groups all the Fokontany associations. The General Assembly votes for a Board of Directors composed of a President, a Vice-President, a Treasurer, a Technical Coordinator and a Secretary.
Avotrala is responsible for the day to day and field management of the project.
The funds come from EcoFormation until the project becomes profitable.
The duties of Avotrala are to provide quarterly financial and management information to EcoFormation. And EcoFormation has to sell the carbon credits coming from the project and redistributes 60% of the revenue to the Cooperative. 30% of this revenue is used to cover the operating costs (machine, fuel, manpower, etc.) and the other 30% is redistributed to the members (the General Assembly votes to determine the mode of retribution). The 40% left go to the EcoFormation Foundation which reinvest the money in similar project in Madagascar or other countries.

Below is the organization chart of the structure.

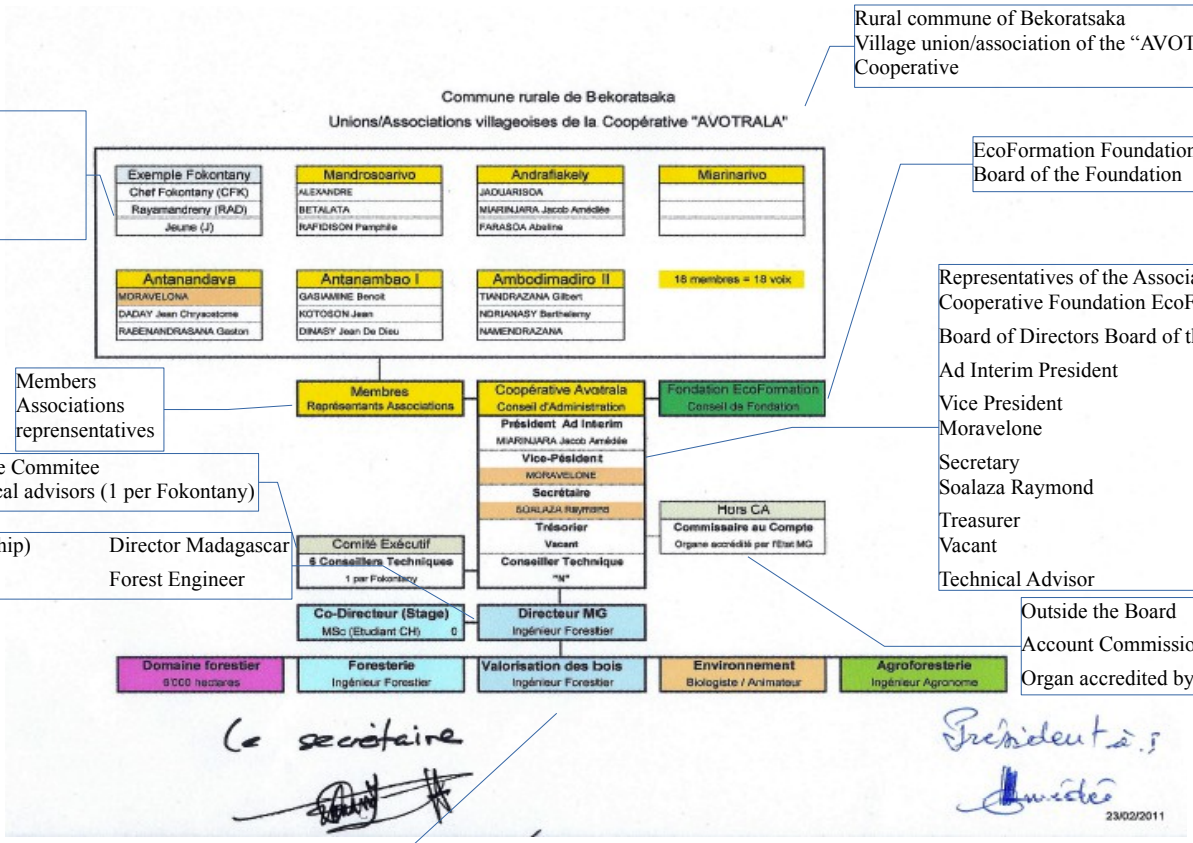


Illustration 1: Avotrala organization chart

Forest area	Forestry	Timber promotion	Environment	Agroforestery
6.000 hectares	Forest Engineer	Forest Engineer	Biologist/Organizer	Agronomy Engineer

Several legals documents have been made (in French and Malagasy). The list of these document is below and those documents can be found in the annex part of this document.

- Agreement between EcoFormation and Avotrala, see annexe 2.
- Additional clause to the Agreement between EcoFormation and Avotrala, see annexe 3
- Agreement between Avotrala and the village Associations (one agreement per association), an example of this agreement can be found in annexe 4.
- Additional clause to the Agreement between Avotrala and the village Associations, see annexe 5
- Internal rules of the Avotrala Cooperative can be found in annexe 6.
- Statutes of the Associations can be found in annexe 7.

Note that all those rules and agreements have been made in order to prevent any conflict which could occur over work places, membership and money.

Any Fokontany situated on the project area can become a Member of the Cooperative at any time. The same goes for the local villagers who would want to join the Cooperative afterwards. A democratic process has been set up in case a member doesn't respect the rules (see internal rules of Avotrala for more details).

The hiring of manpower is proportional in each Fokontany and it is allowed to ask outsiders only in case of lack of manpower.

The total number of workers is determined by the Avotrala Cooperative according to the planting planning and this need in manpower is divided equally by the number of participating Fokontany (at this day 6, but this number could be subject to change as the Cooperative is open at any time for new comers). Each Fokontany is represented by it's three members representing the village association at the Avotrala Cooperative. Those three members are the President of the association, the wise man of the village and a designated member of the association.
Those three persons are in charge of distributing the labour among the villagers. This way of distributing the labour ensures that the local traditions are respected and the fact that three people are in charge of this mission also ensures a equality treatment to all members of the community.
The payment fees and rules have been addressed in the internal rules of the Avotrala Cooperative that can be found in annex 6 pages 9 to 12.

Project site conditions

Many analyzes have been conducted by the technical partner of EcoFormation, Savaivo, which has prepared the pre-project analysis (incl. analysis of satellite images), conducted the delineation of the project area, developed the Management Plan and the Environmental Impact Study.

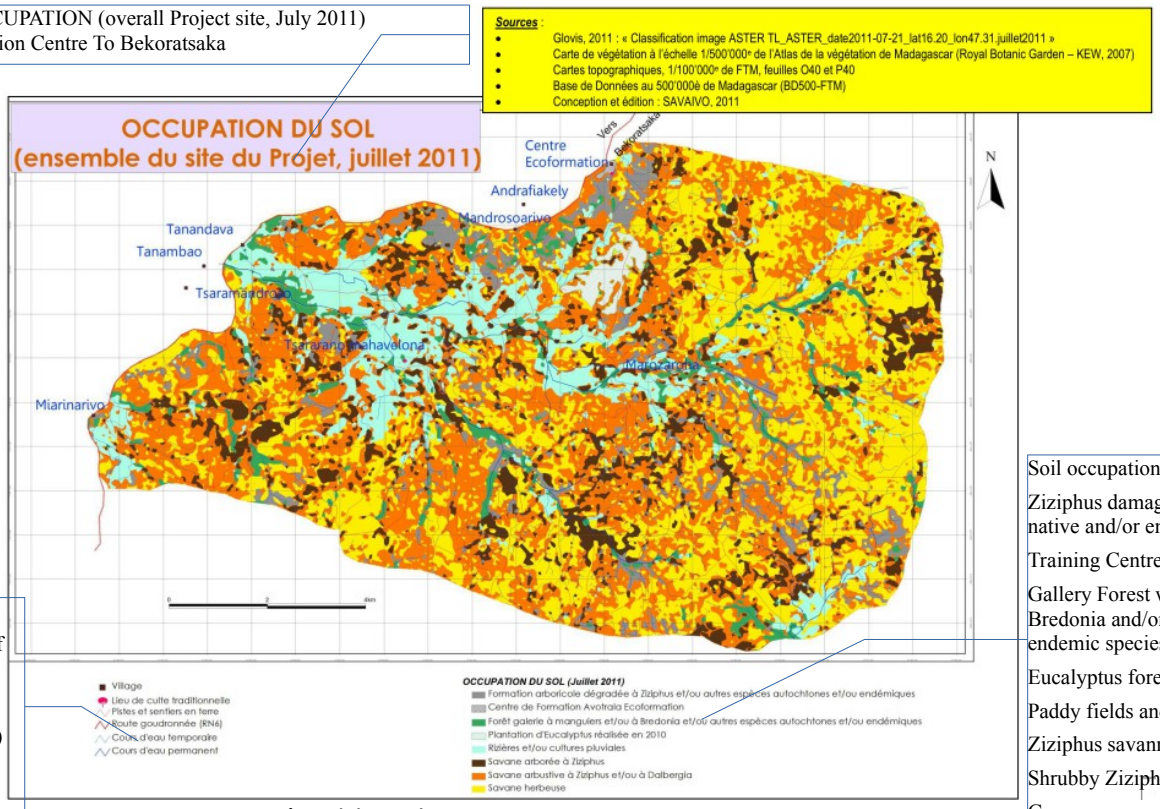
Below are maps[1] showing the site conditions of the complete project perimeter (12'696 ha) regarding:

- initial conditions of the vegetation cover of the site
- hydrogeology
- topography (with a map showing the inclination levels and another one stating the altitudes)
- soils

The map on next page shows the soil occupation in july 2011.

1 All the maps are taken form the Management Plan done by the Savaivo office and presented in Annex 13
Please also note that any illustration, map or table which source isn't clearly stated means that is comes from the Management Plan.

SOIL OCCUPATION (overall Project site, July 2011)
Ecoformation Centre To Bekoratsaka

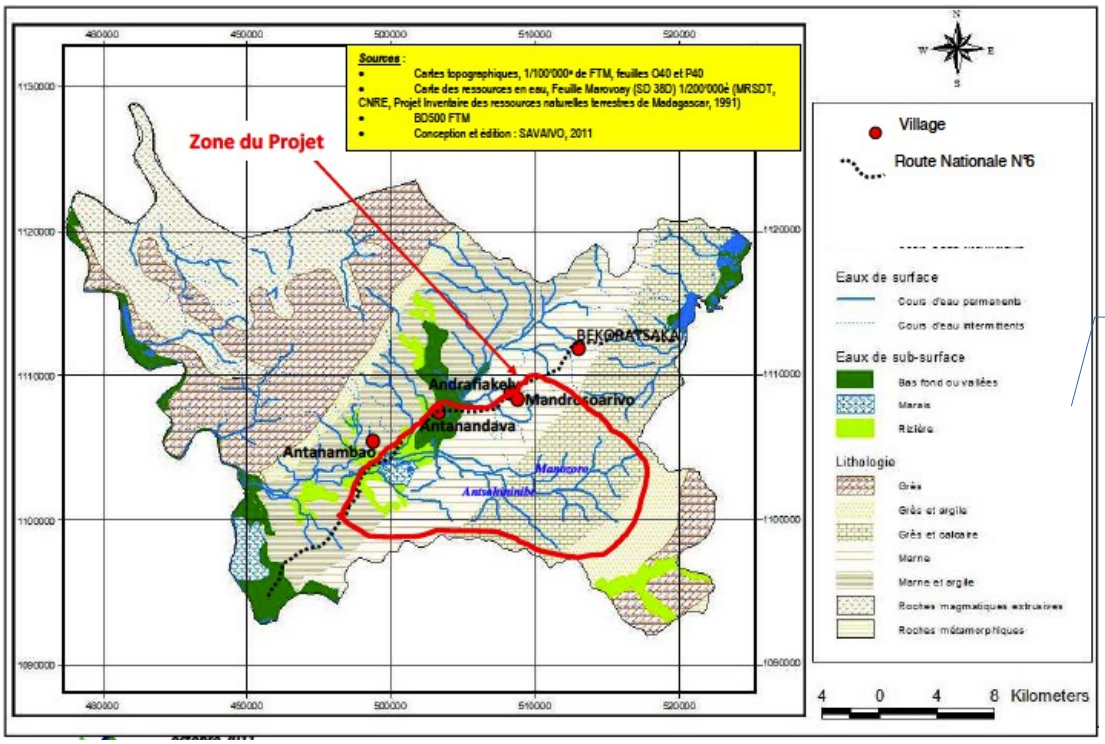


Village
Traditional places of worship
Earth trails
Tarmac roads (RN6)
Temporary rivers
Permanent rivers

Soil occupation (July 2011)
Ziziphus damaged tree formation and/or other native and/or endemic species
Training Centre Avotrola Ecoformation
Gallery Forest with mango trees and/or Bredonia and/or other autochthonous and/or endemic species
Eucalyptus forest planted in 2010
Paddy fields and/or rain crops
Ziziphus savannah
Shrubby Ziziphus and/or Dalbergia savannah
Grassy savannah

Map 1: Pre-project land-use map

Map 2 shows the hydro-gelogical conditions of the project area (in red the project site boundaries).



Village
National road number 6

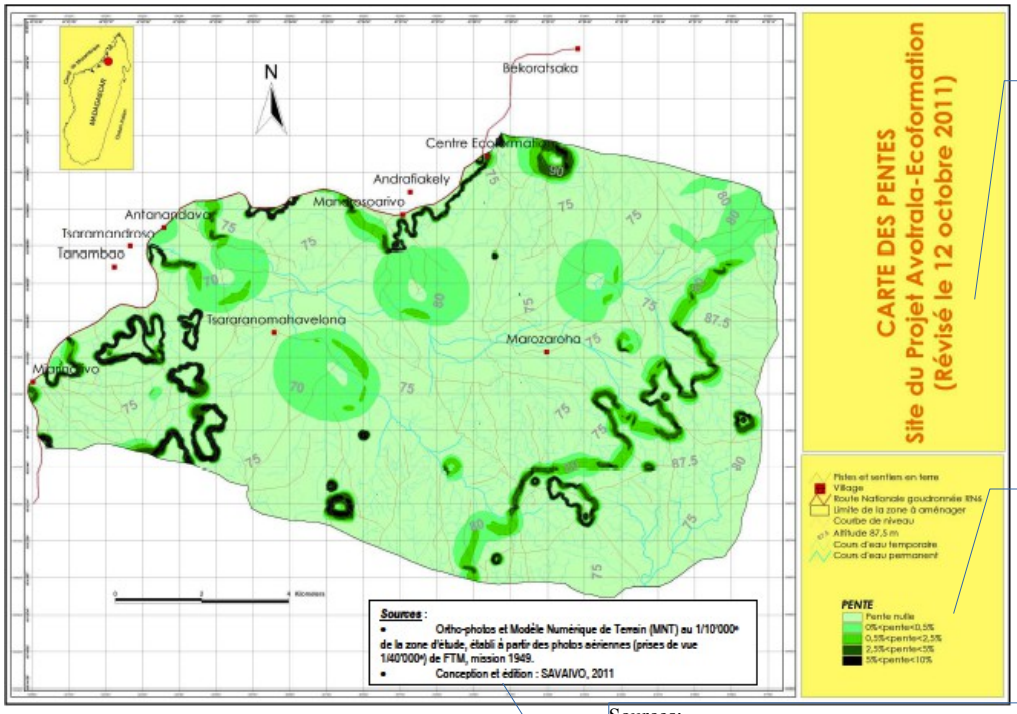
Surface waters
Permanent rivers
Intermittent rivers

Sub-surface waters
Shallow waters or valleys
Swamps
Paddy fields

Lithology
Sandstone
Sandstone and clay
Sandstone and limestone
Sandy loam
Sandy loam and clay
Igneous rock
Metamorphic rock

Map 2: Hydro-geological map

The project site is very flat with only a few slopes as stated in the map below.



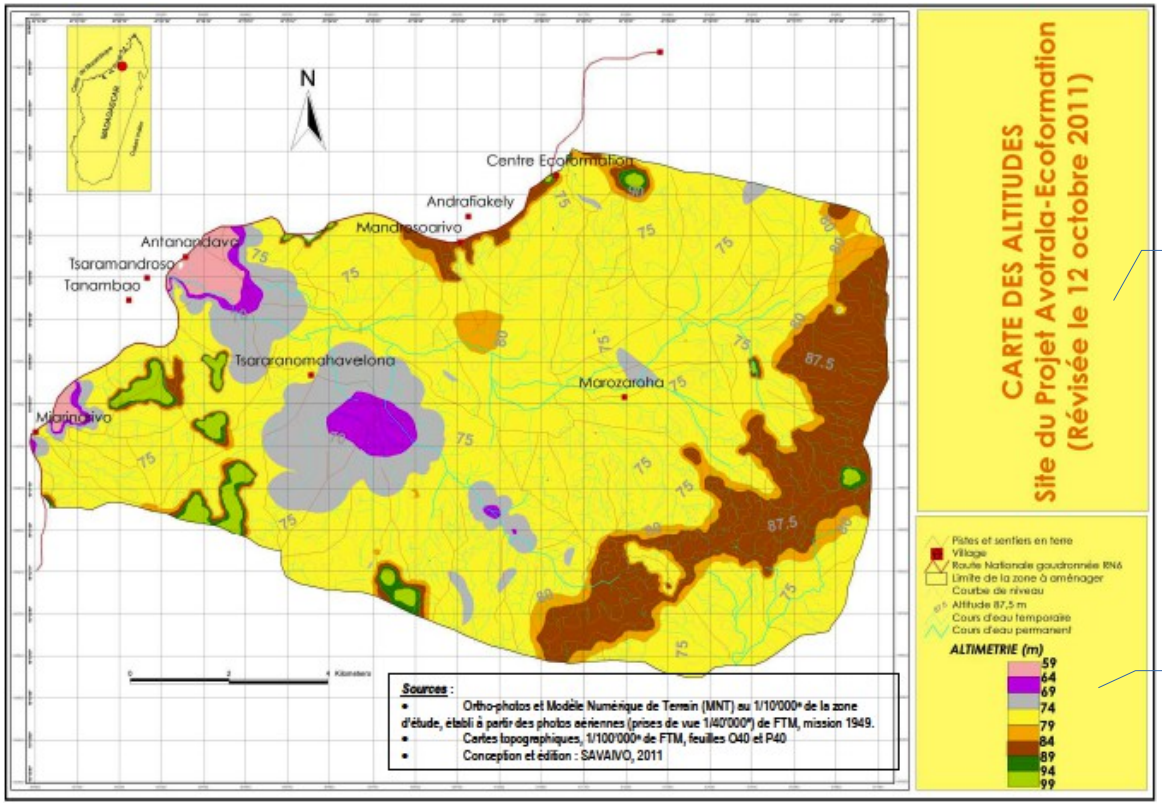
Slope map
Avotrola-Ecoformation
Project site
(Revised on October 12, 2011)

Earth trails
Village
Tarmac national road (RN6)
Unit of the area to be developed
Contour line
Altitude 87.5 m
Temporary river
Permanent river
Slope
No slope
0%<slope>0.5%
Etc.

Map 3: Project site slopes map

Sources:
Orthophotos and digital field model at 1/10 000 of the studied area, established on the basis of aerial photos (shooting 1/40 000) from FTM, mission 1949.
Design and edition: SAVAIVO, 2011

Below are the associated altitudes to the site's topography.



Altitude map
Avotrola-Ecoformation
Project site
(Revised on October 12, 2011)

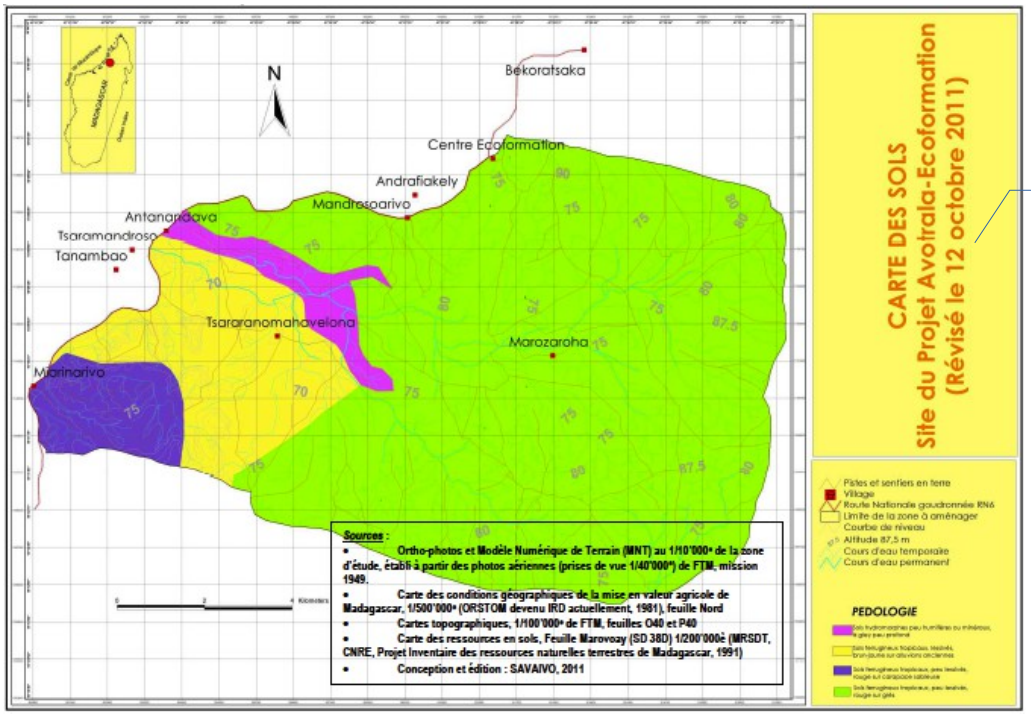
Earth trails
Village
Tarmac national road (RN6)
Unit of the area to be developed
Contour line
Altitude 87.5 m
Temporary river
Permanent river

Altimetry (m)
59
64
Etc.

Map 4: Project site altitude map

Sources:
Orthophotos and digital field model at 1/10 000 of the studied area, established on the basis of aerial photos (shooting 1/40 000) from FTM, mission 1949.
Design and edition: SAVAIVO, 2011

The soils have been analyzed and mapped as showed in the map below.



Soil Map
Avotrola-Ecoformation Project site
(Revised on October 12, 2011)

Map 5: Project site soil map

The soil analyses have been conducted by an independent laboratory, FOFIFA, and the results of these analyzes can be found in annexe 8.

Site preparation, planting techniques and technologies

Since the site is mainly covered by grassy areas, no vegetation has to be slashed or burned or removed from the site during the preparation phase.

There is no specific site preparation work to be done since the earth is plowed mechanically just before the planting activities.

Two John Deer tractors of 70 CV are used to plow the land. Furrows of about 20 cm deep are dug mechanically following the contour line of the land. The lumps of earth are overturned in the direction of the inferior part of the slope in order to mitigate the hill of the slope as well as the soil erosion.

Once these operations done, workers plant manually the young plants. Those plants are brought on-site by cart pulled by zebus when all the engines are busy and by car or tractor when they are free.

The planting rate is of about 200 trees per day for every workers. The planting period is of 3 months and

Picture 1: Planted furrows done by the tractor

Picture 2: Tractor and plow

200 workers are hired to work on the project site for the planting period (January to March).

Nursery practice

Nurseries have been set up with the collaboration of the locals (members of the Cooperative). They have been trained to set up and manage a nursery by technician of the Savaivo office.

The seeds for the nurseries are coming from the national seeds silo[2].

Preparatory work such as seed preparation and pre-germination are done by villagers trained for nursery work. Then the seeds are poted and taken care of in the nurseries.

As shown in the picture below, nurseries have been set up in Mondrosoarivo, beside the Training Center and some farmers have been hired to set small nurseries.

Picture 3: Nursery managed by a local farmer

Picture 4: Mondrosoarivo nursery

Picture 5: Project site nursery

2 Silo national des graines forestières, Antananarivo

The planning below has been set up in order to have the young plants ready for on-site plantation.

PREPARATION DES PLANTS ET PLANTATION	J	F	M	A	M	J	J	A	S	O	N	D
Confection des plate-bandes							1,2,3,4,5,6					
Rebouchage des pots							1,2,3,4,5,6					
Traitement des graines						6		1				
Semis direct en pot							2,3	1		4		
Semis en germoir									1,4	5		
Collecte et repiquage de sauvageons en pot									1,4			
Repiquage via germoir										1,4	5	
Démarriage en pot								2,3	1			
Arrosage des pépinières												
Labour des terrains de plantation												
Plantation sur *tanety*												
Regarnissage												
Confection des pare-feux												

LEGENDE
1 *Acacia a.*
2 *Khaya s.*
3 *Terminalia m.*
4 *Dalbergia t.*
5 *Eucalyptus c.*
6 *Tectona g.*

Table 1: Nursery and planting planning

The performances of the nurseries are recorded (seedling growth, seed germination rate and seed quality) in order to implement a continuous improvement process.

SEEDLING AND PLANTATION PREPARATION

Flower bed preparation
Pots filling
Seeds processing
Pot direct seedlings
Propagator seedlings
Collecting and pricking out of pot wild stock
Pricking out via propagator
Pot demarriage
Nursery watering
Plantation field ploughing
Tanety plantation
Re-filling
Cease-fire making

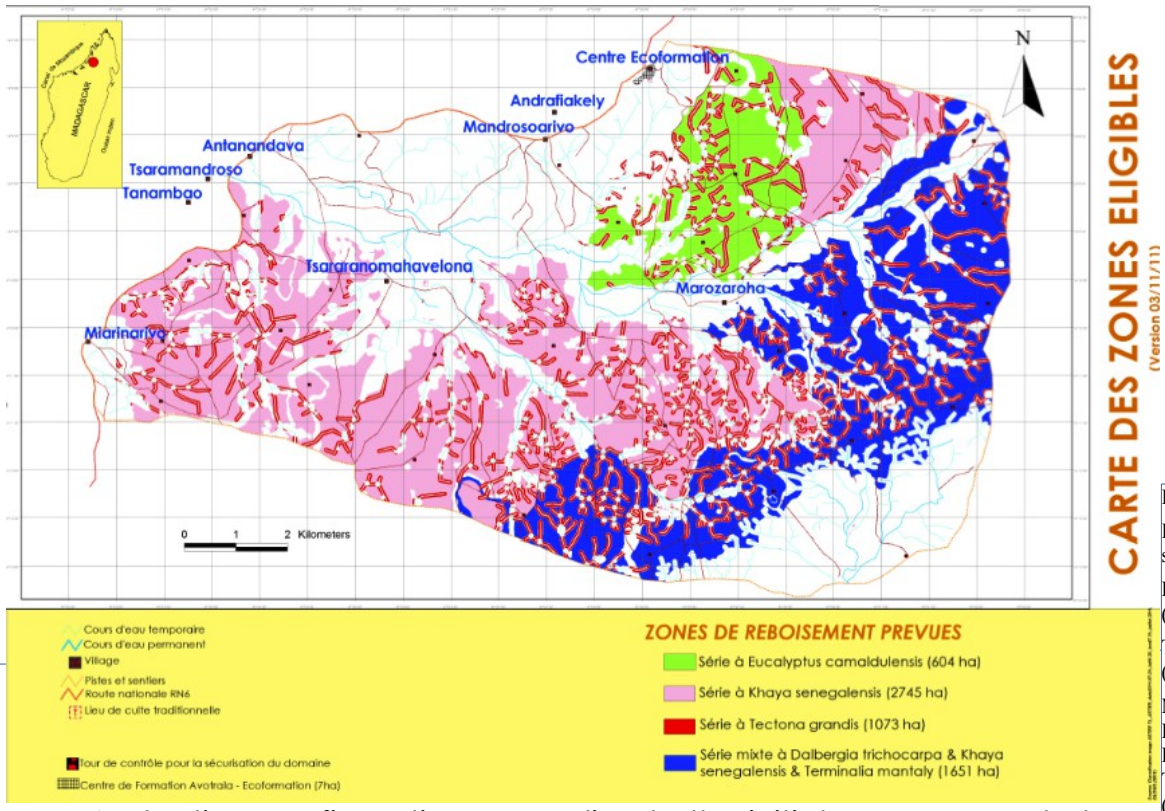
Planting configuration and regimes

The planting regime for the species of trees used to reforest the project site is as stated below:

- *Eucalyptus camaldulensis* : 2,5 m x 2,5 m, about 1'600 stems/ha (to be cultivated on tanety[3])
- *Khaya senegalensis* : 4 m x 10 m, about 250 stems/ha (to be cultivated on tanety, in association with *Dalbergia t.* et *Terminalia m.*), or 2,5 m x 2,5 m, about 1'600 stems/ ha (to be cultivated on it own on *tanety*)
- *Terminalia mantaly* : 4 m x 10 m, about 250 stems/ha (to be cultivated on tanety, en hauteur, in association with *Dalbergia t.* et *Khaya s.*).
- *Tectona grandis* : 2,5 m x 2,5 m, about 1'600 stems/ha (to be cultivated on tanety)

The spatial allocative key of the species used for reforestation is:

- *Khaya senegalensis* serie : 2'745 ha
- *Tectona grandis* serie : 1'073 ha
- *Eucalyptus camaldulensis* serie : 604 ha
- *Dalbergia trichocarpa* & *Khaya senegalensis* & *Terminalia mantaly* mixed serie : 1'651 ha



Map of eligible VCS areas (Version 03/11/11)

Temporary rivers
Permanent rivers
Village
Trails
National road (RN6)
Traditional places of worship

Control tower for the security of the area

Avotrola-Ecoformation Training Centre (7 hectares)

Planned reforested areas

Eucalyptus camaldulensis series (64 hectares)

Khaya senegalensis series (2'745 hectares)

Tectona grandis series (1'073 hectares)

Mixed series with Dalbergia trichocarpa & Khaya senegalensis & Terminalia mantaly (1'651 hectares)

Map 6: Planting configuration according to the initial management plan.

Maintenance process and activities (thinning, pruning, etc)

All maintenance activities such as pruning and thinning have been planned for the 60 first years of the project activity. The table on the following page shows the plantation schedule:

3 Tanety is the malagasy word for a high and fairly level ground

Species	Year							Total
	2011	2012	2013	2014	2015	2016	2017	
Khaya senegalensis	0	0	0	500	700	745	800	**2745**
Tectona grandis	0	500	50	130	131	131	131	**1073**
Eucalyptus camaldulensis	73	100	50	96	95	95	95	**604**
Mix Dalbergia t. & Khaya s. & Terminalia m.	0	0	0	274	474	429	474	**1651**
TOTAL	**73**	**600**	**100**	**1000**	**1400**	**1400**	**1500**	**6073**

Table 2: Plantation schedule (in hectares)

For each species / mix a separate management has been developed. A detailed description is provided below. Reference and sources of information used for the development of the management plans for the various species can be found in the annexed Management Plan page 35 ff.

EUCALYPTUS CAMALDULENSIS SERIES

The plantations of Eucalyptus will be managed by the coppice with standard system accordingly to forestry requirements hereafter. Note that the felling of the main stump is done at less than 40 cm of the ground. The first thinning happens the 10th year and the first cutting happens 5 years after for the cops of *Eucalyptus*.

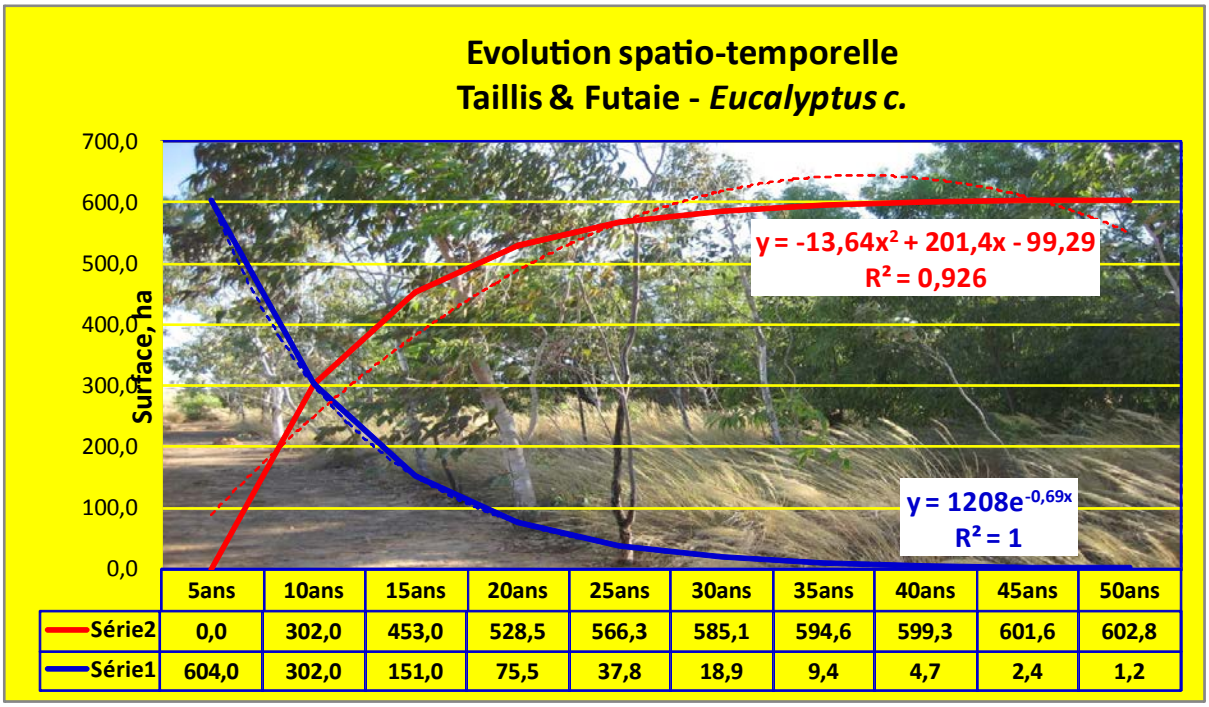
The surface of each scheme varies with time (see the graphic below), which means that the standard tends to progressively disappear after two rotations (2 X 25 years) to become only felling on a surface of about 604 ha after 50 years (with only a few seed bearer).

Those are the equations of the corresponding tendency curve:

For felling : $y_t = -13,64\ x^2 + 201,4x - 99,29$ **(with $R^2 = 0,926$)**

For standard : $y_f = 1208e^{-0,69x}$ **(with $R^2 = 1$)**

Where y et x designate respectively the surface in hectares and the years of vegetation dividable by 5 (with $5 \leq x \leq 50$ et $y_f + y_t = 604$)



Surface, hectares
An = years
Série= series

Table 3: Spatio-temporal evolution of Eucalyptus in coppice with standards

Eucalyptus C. Shrubbery regime (5 years) under cluster of trees (25 years)

Initial Plantation

First glade (cluster of trees)

Second glade (cluster of trees)

First hewn (shrubbery)

Third glade (cluster of trees)

Second hewn (shrubbery)

Fourth glade (final hewn – cluster of trees)

Third hewn (shrubbery)

EUCALYPTUS C. Régime taillis (5 ans) sous futaie (25 ans)	Age (ans)	Dhp moyen [cm]	Hauteur totale [m]	Densité à l'hectare			Ecartement [m]	Volume sur pieds [m³/ha]		Accroissement (m3/ha/an)	
				avant	après	exploité		fût	total	fût	total
Plantation initiale				1'600	1'600	0	2,5 x 2,5				
1è éclaircie (futaie)	10	15-16	15	1'600	800	800	5 x 2,5	75	112	7,5	11,2
2è éclaircie (futaie)	15	25-30	20	800	400	400	5 x 5	139	208	9,2	13,9
1è coupe (taillis)	5	12	8	800 x 3 rejets	0	2'400 tiges	5 x 2,5	77	115	15,3	23
3è éclaircie (futaie)	20	35-40	25	400	200	200	10 x 5	170	255	8,5	12,7
2è coupe (taillis)	5	11	8	(800 x 4 rejets) + (400 x 3 rejets)	0	4'400 tiges	5 x 2,5	118	177	23,6	35,4
4è éclaircie (coupe finale - futaie)	25	40-50	30	200	0	200	10 x 5	266	399	10,7	16
3è coupe (taillis)	5	10	8	(800 x 5 rejets) + (400 x 4 rejets) + 200 x 3 rejets)	0	6'200 tiges	5 x 2,5	138	206	27,5	41,3

Eucalyptus C. Shrubbery regime (5 years) under cluster of trees (25 years)

Age(years)

Average dbh [cm]

Total height [m]

Density per hectare (before/after/ecploited)

Distance [m]
Standing volume [m3/ha] (trunk/total)

Growth (m3/ha/year) (trunk/total)

Rejet = shoot
Tige = stem

Table 4: Forestry requirements for Eucalyptus camadulensis in coppice with standards

Note: the translation of the table above is valid for the ones below as well (see table 4 to 9), so please refer to this table when needed.

TECTONA GRANDIS SERIES

The plantations of *Tectona* are managed under the standard system; their **rotation period is of 40** years. A series of thinning are planned at the 5th, the 15th and the 30th year to respectively reduce the initial plantation density of 1'600 stems/ha to 800, 400 et 200.

TECTONA G. Régime taillis (5 ans) sous futaie (25 ans)	Age (ans)	Dhp moyen [cm]	Hauteur totale [m]	Densité à l'hectare			Ecartement [m]	Volume sur pieds [m³/ha]		Accroissement (m3/ha/an)	
				avant	après	exploité		fût	total	fût	total
Plantation initiale				1'600	1'600	0	2,5 x 2,5				
1è éclaircie	5	15	8	1'600	800	800	5 x 2,5	40	60	8,0	12,0
2è éclaircie	15	25	12	800	400	400	5 x 5	83	125	5,5	8,3
3è éclaircie	30	35	20	400	200	200	10 x 5	136	204	4,5	6,8
Coupe finale	40	40	25	200	0	200	10 x 5	222	333	5,5	8,3

Table 5: Forestry requirements for Tectona under plantation system

KHAYA SENEGALENSIS SERIES

The *Khaya s.* series are managed with the plantation system. We can distinguish 2 series of *Khaya* :

- Serie in association with *Dalbergia* t. et *Terminalia* m. in which the initial density is of 250 stems/ha. A thinning is planned for year 15 in order to reduce the final cut density to 125 stems/ha.
- Serie of *Khaya* only in which the initial density is of 1'600 stems/ha. Thinning is planned at the 10th, 15th and 20th year in order to reduce the density to 800, 400 et 200 stems/ha.

Number of stems per hectare

KHAYA S. Régime futaie (révolution 25 ans)	Age (ans)	Dhp moyen [cm]	Hauteur totale [m]	Nombre de tiges par hectare			Ecartement [m]	Volume sur pieds [m³/ha]		Accroissement (m3/ha/an)	
				avant	après	exploité		fût	total	fût	total
Plantation initiale				250	250	0	4 x 10				
Eclaircie	15	30	15	250	125	125	8 x 10	47	70	3,1	4,7
Coupe finale	25	40	20	125	0	125		140	211	5,6	8,4

Table 6: Forestry requirements for Khaya senegalensis in association with Dalbegia t. and Terminalia m. under the plantation system

KHAYA S. Régime futaie (révolution 25 ans)	Age (ans)	Dhp moyen [cm]	Hauteur totale [m]	Nombre de tiges par hectare			Ecartement [m]	Volume sur pieds [m³/ha]		Accroissement (m3/ha/an)	
				avant	après	exploité		fût	total	fût	total
Plantation initiale				1'600	1'600	0	2,5 x 2,5				
1è éclaircie	10	15	15	1'600	800	800	5 x 2,5	75	112	7,5	11,2
2è éclaircie	15	27	20	800	400	400	5 x 5	162	243	10,8	16,2
3è éclaircie	20	37	22	400	200	200	10 x 5	167	251	8,4	12,5
4è éclaircie (coupe finale)	25	40	25	200	0	200		222	333	8,9	13,3

Table 7: Forestry requirements for Khaya senegalensis under plantation system

TERMINALIA MANTALY SERIES

The *Terminalia* will be managed under plantation system with a rotation period of 20 years (as shown in table below). It will also be in association with *Dalbergia t.* et *Khaya s.* A thinning is planned for year 10 after plantation in order to reduce the initial density to 250 stems/ha.

TERMINALIA M. Régime futaie (révolution 20 ans)	Age (ans)	Dhp moyen [cm]	Hauteur totale [m]	Nombre de tiges par hectare			Ecartement [m]	Volume sur pieds [m³/ha]		Accroissement (m3/ha/an)	
				avant	après	exploité		fût	total	fût	total
Plantation initiale				250	250	0	4 x 10				
Eclaircie	10	25	15	250	125	125	8 x 10	33	49	3,3	4,9
Coupe finale	20	45	20	125	0	125		140	211	7,0	10,5

Table 8: Forestry requirements for Terminalia mantaly series under plantation system

DALBERGIA TRICHOCARPA SERIES

The *Dalbergia* series will be managed under the plantation system with a rotation period of 60 years.

DALBERGIA T. Régime futaie (révolution 60 ans)	Age (ans)	Dhp moyen d'une tige [cm/d']	Hauteur totale [m]	Nombre d'individus par hectare			Ecartement entre individus [m]	Volume sur pieds [m³/ha]		Accroissement (m3/ha/an)	
				avant	après	exploité		fût	total	fût	total
Situation zéro	1 - 10	1-8	0,5-2	variable			variable				
Regarnissage et/ou dépressage et /ou 1er élagage (3 tiges / individu à garder)***	1-10 = âge 0	1-8	0,5-2	variable	2'500	variable	2 x 2				
2è élagage (2 tiges / individu à garder)	5	7	2	2'500	2'500	2'000 tiges*	2 x 2	5	8	1,1	1,6
3è élagage (1 tige / individu à garder) suivi d'une 1ère éclaircie	15	12	5	2'500	1'250	(2 tiges x 1'250 individus abattus) + (1 tige x 1'250 individus élagués) = 3'750 poteaux ou perches	2 x 4	75	112	5	7,5
2è éclaircie	25	25	8	1'250	625	625	4 x 4	87	130	3,5	5,2
3è éclaircie	40	34	10	625	312	313	4 x 8	100	151	2,5	3,8
3è éclaircie	50	40	12	312	156	208	6 x8	111	166	2,2	3,3
Coupe finale	60	43	12,5	156	0	208		133	200	2,2	3,3

Table 9: Forestry requirements for Dalbergia trichocarpa series under plantation system

*** : one tree can have many branches**

***** : pruning consists of taking of the epicormic shoots by eliminating stems/branches and by keeping a maximum of 1 to 3 stems. The goals being to have straight stems with no "wounds" and to speed up their growth**

Due to the rotation period considered (40 to 60 years), the age normalization of the trees wouldn't be necessary. In fact, the actual rotation would be of 50±10 years if we account for the heterogenous age of the present planting.

Relining consists in filling the gaps by bringing back the density to 2'500 stems per hectare.
Clearing consists in bringing the density back to 2'500 stems per hectare in case of "over-regeneration" in the plantation area. In that case, the young trees taken out can be replanted in other areas not as well stocked or kept in nurseries for the next plantation period.

1.9 Project Location

Situated in the North-West part of Madagascar, in the Rural District of Bekoratsaka in the Sofia Region, the project area has been precisely delineated by the land registry authorities and the EcoFormation's technical partner, Savaivo. The map[4] below points the project site on the island.

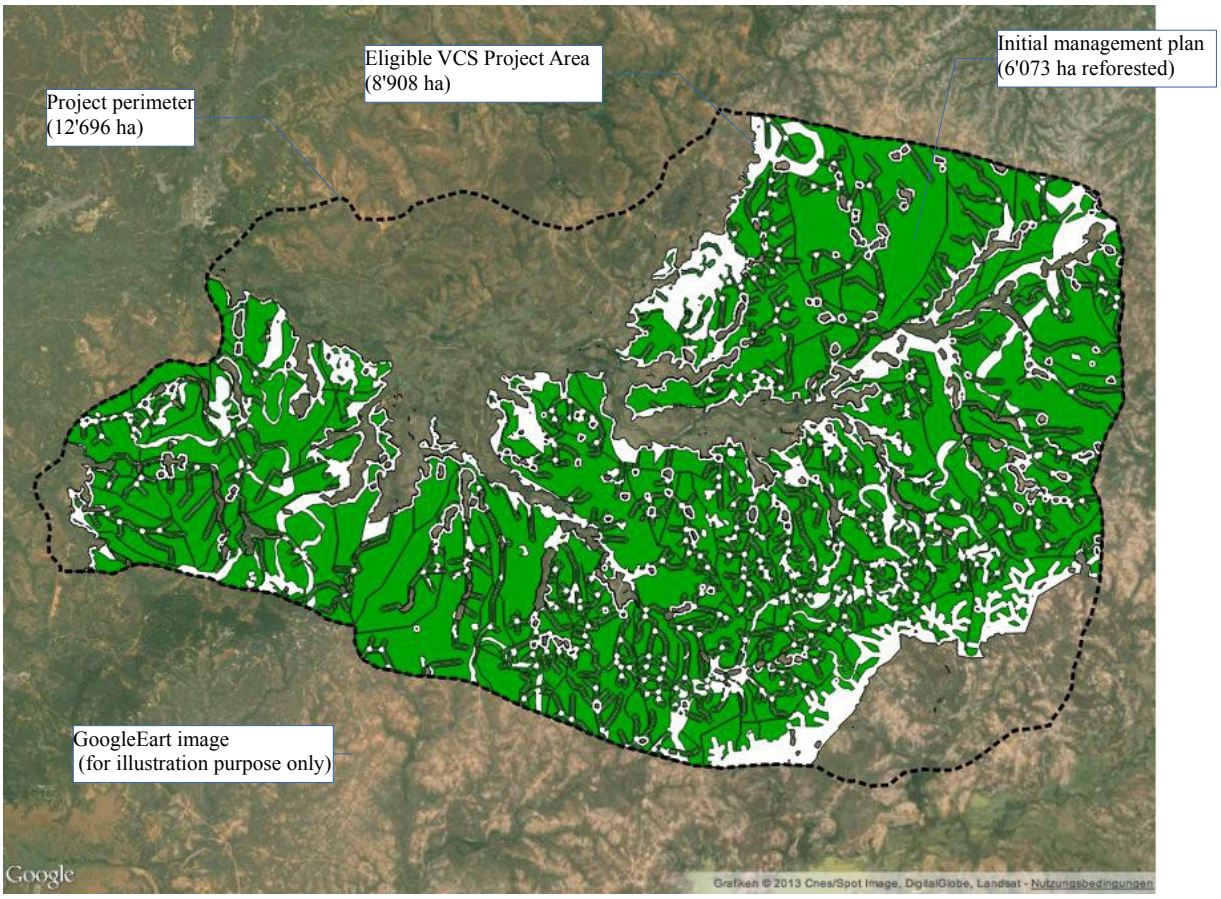
In order to lighten this project Document, the precise boundaries (in WGS 84 coordinates) of the project area can be found in separate GIS files in Annex 13a and 13b.

Table 10: Map of Madagascar with an arrow pointing the project location

4 http://www.ezilon.com/maps/africa/madagascar-maps.html

1.10 Conditions Prior to Project Initiation

Within the project perimeter, a zone of 8'972 ha suitable for reforestation activities and eligible according VCS requirements has been identified (VCS project area). Basis for the delimitation has been the availability of land for the project (distance from community areas) and the pre-project land cover. Surfaces covered by an accumulation of trees / shrubs with diameter at breast height DBH > 5cm have been excluded from the VCS project area, even in case the surfaces were much smaller than 1 ha. The delimitation of the VCS eligible project area is provided in Annex 13b



Map 7: Delimitation of the VCS Project Area (white color, 8'972 ha) and illustration of the initial management plan (green color, 6'073 ha)..

"Procedure to demonstrate the eligibility of lands for afforestation and reforestation CDM project activities" version 01

In order to demonstrate that the project has not been implemented to generate GHG emissions for the purpose of their subsequent reduction the CDM tool "Procedure to demonstrate the eligibility of lands for afforestation and reforestation CDM project activities" version 01 has been applied.

1. Project participants shall provide evidence that the land within the planned project boundary is eligible for an A/R CDM project activity by following the steps outlined below.

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

i. Vegetation on the land is below the forest thresholds

The forest definition from the Designated National Authority in Madagascar[5] is :

For afforestation and reforestation project activities - Host Party's selected single minimum:		
A single minimum tree crown cover value between 10 and 30 per cent	A single minimum land area value between 0,05 and 1 hectare	A single minimum tree height value between 2 and 5 metres
30	1	5

The project area has been delineated to include only savannah with very low density of shrubs. In particular it does not include any forests or accumulation of trees / shrubs with diameter at breast height DBH ≥ 5 cm[6]. The 8'972 ha of the resulting VCS eligible project area are composed of :

Occupation type	**Area (ha)**
A. Savannah without shrubs	3'866
B. Savannah with individual *Ziziphus* and/or *Dalbergia shrubs*	3'738
C. Savannah with some regeneration of *Ziziphus* and/or other native species (*Ficus* sp, *Terminalia* spp., …)	454
D. Savannah with some *Ziziphus* shrubs	914
Total of eligible area	8'972

Characteristics for each type of vegetation :

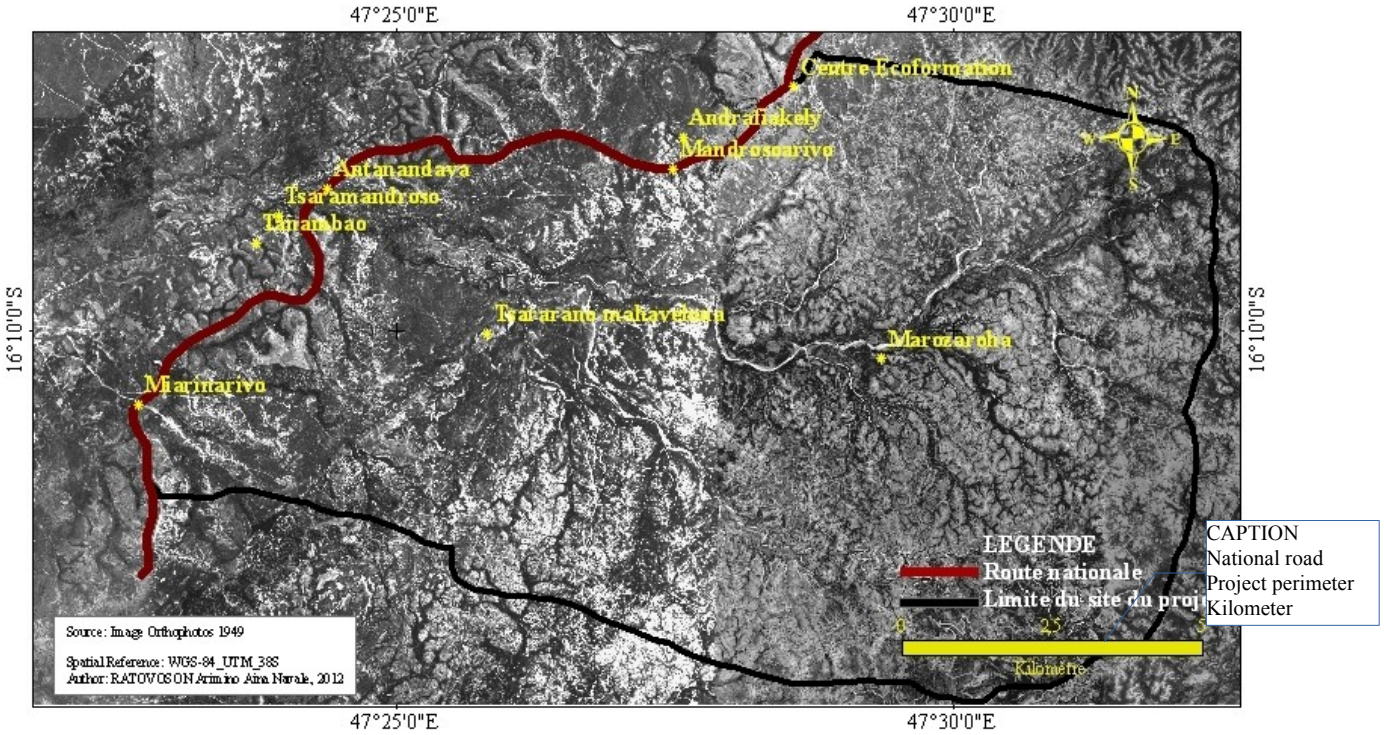
Type	**Density**	**Height**
A. Savannah without shrubs (3'866 ha)	0 – 5 specimen/ha	N/A
B. Savannah with individual *Ziziphus* and/or *Dalbergia* shrubs (3'738 ha)	1-25 specimen/ha	0.5-1.2m
C. Savannah with some regeneration of *Ziziphus* and/or other native species (*Ficus* sp, *Terminalia* spp., …) (454 ha)	25-400 specimen/ha	0.5-2.5m
D. Savannah with some *Ziziphus* shrubs (914 ha)	7-35 specimen/ha	0.5-2.5m

The trees / shrubs present on the project area don't reach a DBH of 5cm. As stated in the tables above, the minimum thresholds of forest are not reached.

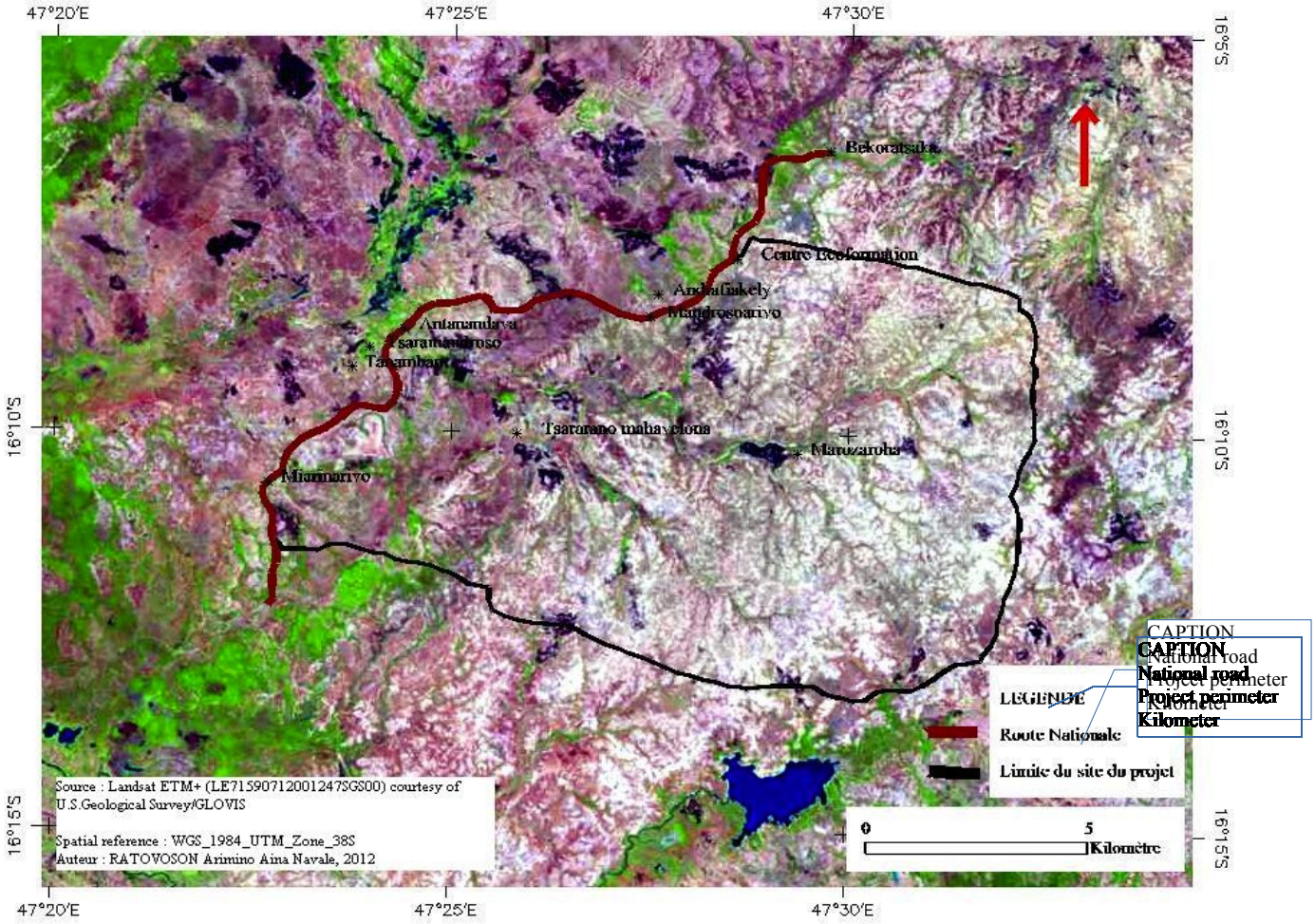
The pictures on the following pages show the evolution of the vegetation cover of the area from 1949 to today.

5 See forest definition on the CDM UNFCCC website (http://cdm.unfccc.int/DNA/index.html?click=dna_forum)

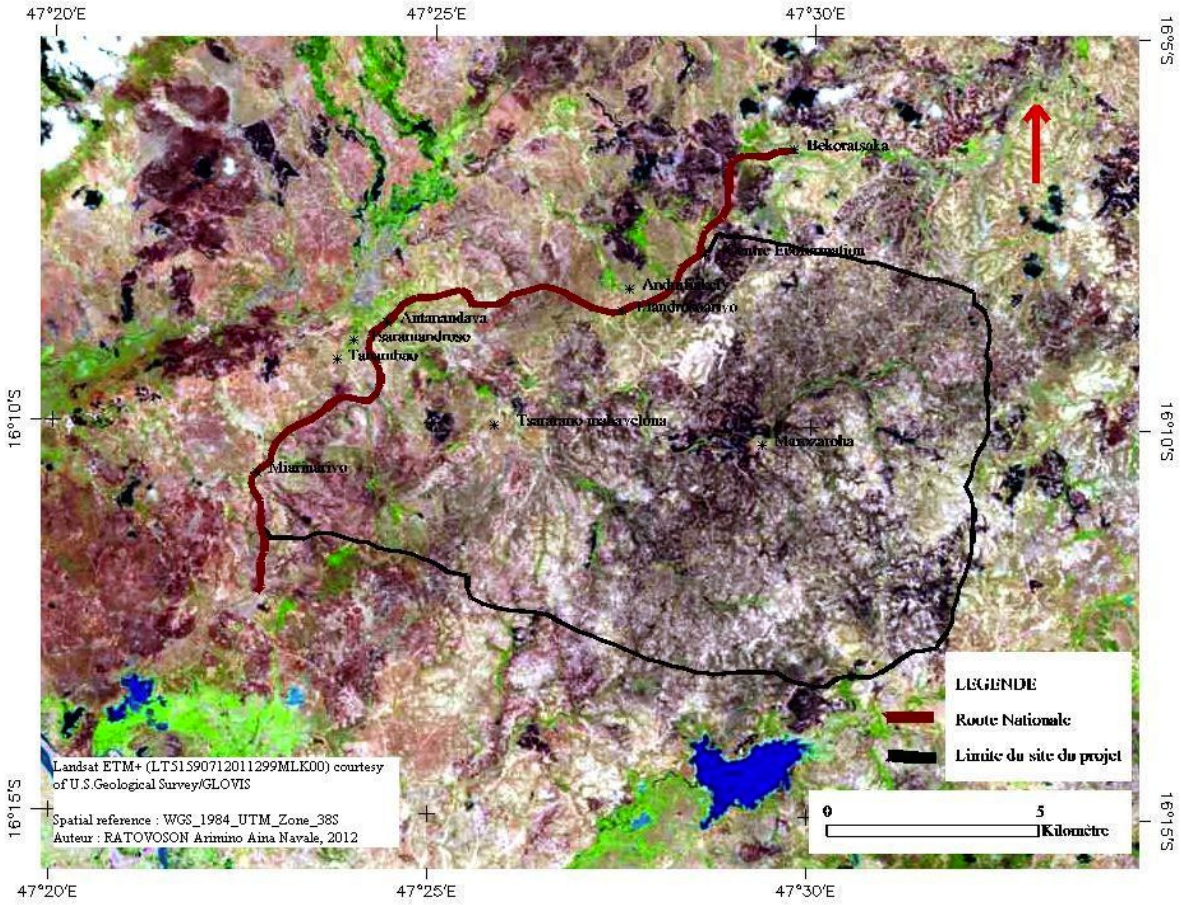
6 In order that individual trees / shrubs with DBH ≥ 5cm existing in the project area prior to the project start are not considered as project carbon stocks, pre-project trees and shrubs are excluded from monitoring (see Monitoring Plan, section 4.3).



Map 8: Situation in 1949 (grey corresponds to forest and white to grassy areas)



Map 9: Situation in 2001 (green corresponds to forest remainder, the purple are shrubby areas (mainly Ziziphus), the white-grey colour are grassy areas and the black spots are burnt areas).



Map 10: Situation in 2011 (green corresponds to forest remainder, the purple are shrubby areas (mainly Ziziphus), the white-grey colour are grassy areas and the black spots are burnt areas)

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

As shown in the above pictures, the situation is getting worse as the years go by. Fire is set to the zone more and more frequently (see evolution of black spots between picture of 2001 and 2011) and the tree cover is diminishing.

Frequent fire contribute to the soil depletion (lack of organic soil) and the lack of vegetation contributes to erosion which prevent the encroachment of vegetation and therefore prevent all natural stands and plantation to reach the minimum threshold of the forest definition.

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

The land is not temporarily unstocked du to human activities, see picture from 1949, 2001 and 2011 above.

b) *Demonstrate that the activity is a reforestation or afforestation project activity:*

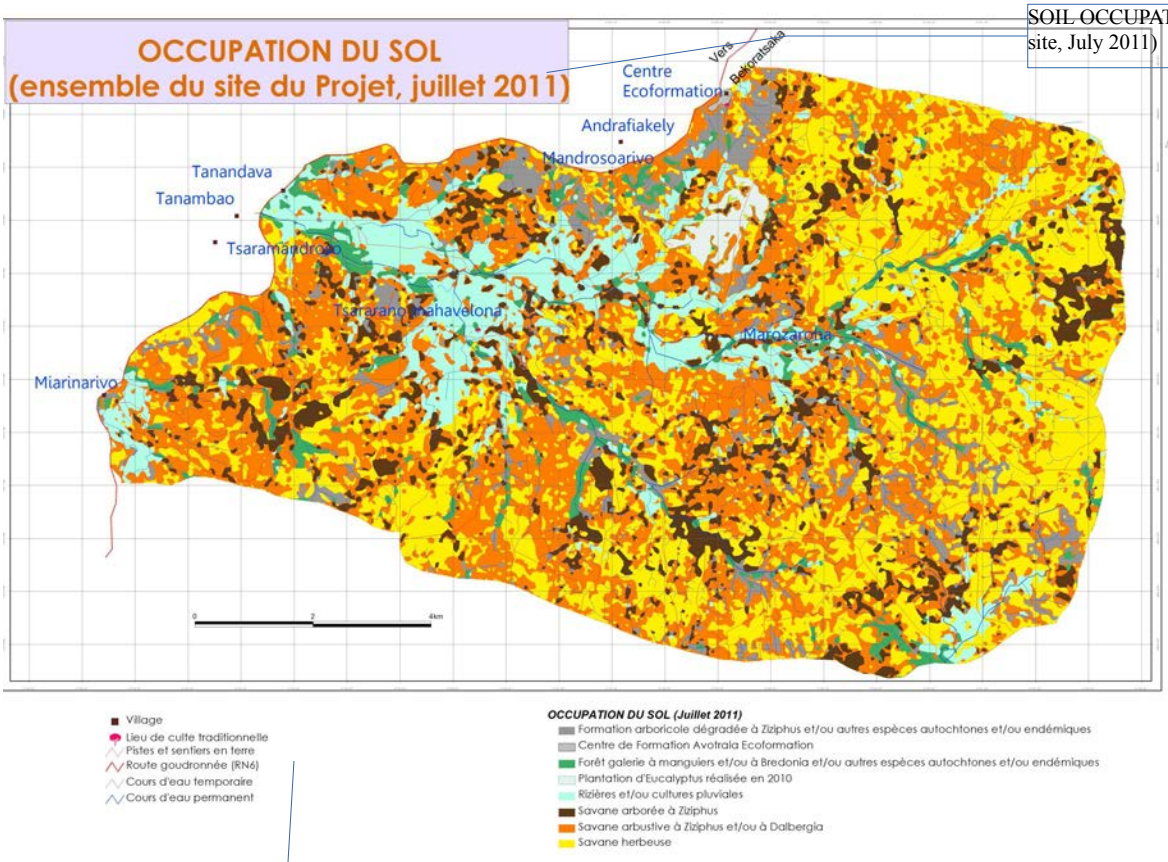
i. For reforestation project activities, demonstrate that the land was not forest by demonstrating that the conditions outlined under (a) above also applied to the land on 31 December 1989.

The habit of slashing-and-burning isn't new. It was the case in 1949 and it was still the case a few months ago since the locals didn't see the land as a source of revenue others than grass for their wandering cattle.

The slashing-and-burning has depleted the soil which now erodes because of the lack of vegetation. Natural encroachment of trees and shrubs in the eligible VCS area isn't possible anymore, the only vegetation that grows is grass.

2. In order to demonstrate steps 1 (a) and 1 (b), project participants shall provide information that reliably discriminates between forest and non-forest land according to the particular thresholds adopted by the host country, inter alia:

To address this requirement, the map of the reforestation zones (below) has been developed. This map is the result of ground surveys as well as aerial photographs analysis. The delimitation has been done jointly by Savaivo and the land register authorities as well as with the help of local villagers.



SOIL OCCUPATION (overall Project site, July 2011)

Map 11: Pre-project soil's occupation

Village
Traditional places of worship
Earth trails
Tarmac roads (RN6)
Temporary rivers
Permanent rivers

Soil occupation (July 2011)
Ziziphus damaged tree formation and/or other native and/or endemic species
Training Centre Avotrola Ecoformation
Gallery Forest with mango trees and/or Bredonia and/or other autochthonous and/or endemic species
Eucalyptus forest planted in 2010
Paddy fields and/or rain crops
Ziziphus savannah
Shrubby Ziziphus and/or Dalbergia savannah
Grassy savannah

Climate

With its 1' 400 to 1' 600mm annual precipitation, the climate of Sofia is of the sub-wet to semi-arid type. Two seasons can be distinguished:

- dry season from May to October;
- wet season from November to April.

Pluviometric anomalies can be noted, according to the season and the geographical position of the site:

- relative increase in rainfall from the north (approximately 1' 400mm) to the south (1 ' 500 mm);
- concentration of annual rain over 3-4 months, between December and April, torrential rain lasting a few hours every day

The zone is subject to humid and regular trade winds (Varatraza), which permanently blow in SE-E direction, and of the monsoon (Talio), which blows from west to east. The annual average temperatures are relatively high; they vary between 20°C and 25°C. The Potential Evapotranspiration (ETP) is strong (> 1' 200mm); the relative evapotranspiration is reduced to 50 to 60% of the ETP. The total index of moisture lies between -35 and +20 (Chaperon et al, 1993). The analysis of the Gaussen ombro-thermics curve theoretically shows that for this type of climate (Chaperon et al, 1993):

- the streaming and the drainage appear between December and April (rainy season)
- the use of the ground water reserve (max 100 mm) is carried out between April and May
- water deficiency during the dry months appears between May and November
- the reconstitution of the ground water reserve takes place during November and December

Geology and pedology

The Project zone contains:

- Tropical ferruginous ground which is slightly washed red on sandstone (NE area around Mandrosoarivo, Ambodimadiro II and Andrafiakely)
- Ground with shallow gley in the area of temporary total floods (around Antanandava and Antanambao)
- Tropical ferruginous ground washed yellow brown on old alluvia (Southern part, around Antanambao)

The whole zone lies on argillaceous and marly impermeable layers of the Vohibory system of the Malagasy crystalline base.

Below is the soil's characteristics by topographic units:

Topographic unit	**General characteristics**	**Use / current promotion by the local population**	**Possibilities**	**Constraints (limits)**	**Development axis and possibilities of promotion in the Development and Management Plan**
Shallow areas (slope < 0,5%, altitude 75-80 m, total temporary flooding, about 491 ha, i.e. 73% of the pilot area surface)	· Clay loam alluvial provision, clay content: 30-40% of the particle size · Total temporary flood · Plant cover with mango trees and other autochthonous plants like Breonadia salicina (Adina microcephala)	· Privileged area to grow rice · Floodrecession crops (lentils, corn, potato, onions) at the baiboho	· Possibility of using heavy agricultural machinery (tractor) · Water available, particularly during the rainy season · Still moderate soil acidity (pHwater about 5.5) on the first 30 cm · High cationexchange capacity (CEC) (25-40me% of the soil) · Moderate total nitrogen content: (0.12-0.18%)	· Light Kexchange content (between 0.2 - 0.4me% for clay loam) · Light content of available phosphorus (<5 ppm) · When dry, the soil is very compact and cracked · Frequent flooding risk · Shortage or even lack of hydroagricultural infrastructures restricting field exploitation during the fry season · Light organic matter content (total carbon: 1 – 2%)	Hydroagricultural development for a better 44 water management (retention dam, drip-drip irrigation) · Rotation technique and crop association management; cultivated species diversification according to local demand, market and season (water level rise and drop) · Intensive rice growing techniques promotion (SRA, SRI)
Hillsides (slope 0.5-2.5%, altitude 80-85 m, about 73 ha, i.e. 11 % of the pilot area)	Sandy (sand content: over 75% of the particle size), red or yellowbrownish ferruginous soil · Fairly concentrated hydrographical network	Extensive grazing area (where bush fires arise) and pluvial crops (manioc, peanuts, lentils,…) · Grassy shaded **(Ziziphus)** and shrubby **(Dalbergia)** formations	· Possibility of using heavy agricultural machinery (tractor), given the light slope · Very light stoninessrockiness · Still moderate soil acidity (pHwater about 5.8) on the first 30 cm · Moderate K exchange	· Light or very light cationic exchange capacity CEC (<6 me5 of the soil) · Light organic matter content (total carbon < 1%) · Light available phosphorus content (<5 ppm) · Very compact	Fostering of agricultural methods that allow both erosion management and the improvement / maintenance of soil fertility: dead or living agroforestry layer · Organic fertilizer use

			content: (between 0.1 and 0.4 me% for sandy soils)	soil in the dry season · Prone to erosion and gully erosion when barren · Slightly excessive drainage due to the very sandy soil texture (quite permeable soil)	promotion (park manure, green fertilizer compost) to improve the soil organic statute, particularly for intensely cultivates parcels) · Crop rotation and association · Increased depths of useful crops (deep ploughing, dead / living layer, agroforestry
Hillside and top (slope > 2.5%, altitude 85-100 m, about 106 ha, i.e. 16% of the pilot area	· Deteriorated shrubby/shaded formation, example of woody specie: Dalbergia t. · Gully erosion areas, particularly at the slope break level	Grassy shrubby formations (Dalbergia, Ziziphus)	· Possible mechanisation, given the almost flat surfaces · Still moderate soil acidity (pHwater about 5.8) on the first 30 cm · Moderate K exchange content: (between 0.1 and 0.4 me% for sandy soils) · Sandy (sand content: over 80% of the particle size), red, ferruginous soil	· Light or very light cationic exchange capacity CEC (<6 me5 of the soil) · Light total nitrogen content (0.05 – 0.12%) · Light available phosphorus content (<5 ppm) · Prone to erosion and gully erosion when barren · Slightly excessive drainage due to the very sandy soil texture (quite permeable soil) · High rockiness in some spots limiting root development	· Natural regeneration promotion by protecting the parts which are still covered by forest relics · Increased useful depths for the young trees to be planted (deep mechanised ploughing / deep hole digging to break up the underlying compact horizon limiting the young plants normal root development · Use of sylvicultural species resisting to quite a long lack of water during the dry season

Hydrography

The pilot zone has a rather dense hydrographical network which is organized primarily around the Marozaoro river.

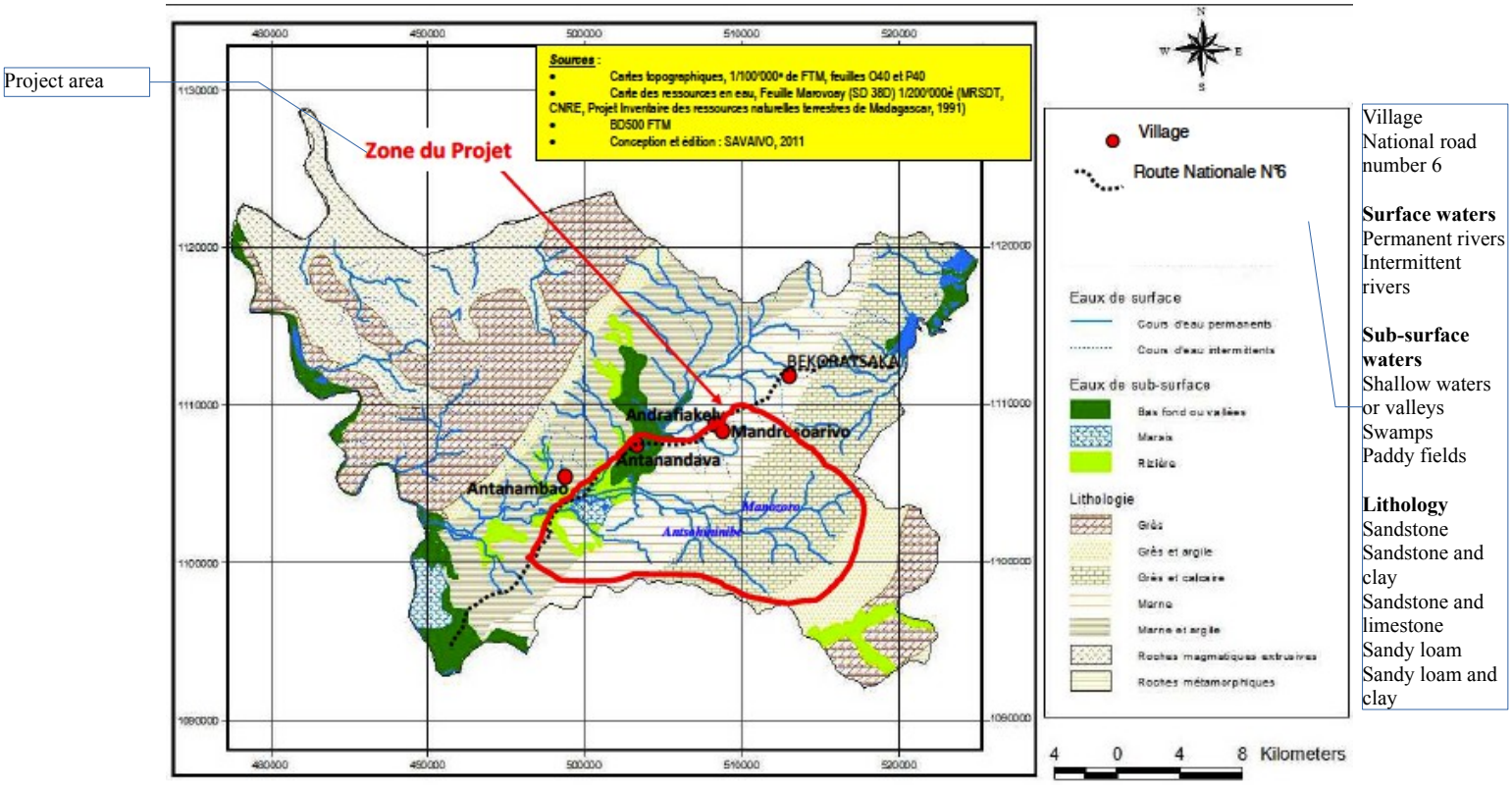
One can see:

- the temporary rivers whose source is in the hills
- the permanent rivers which run through the deep bottom of impermeable layers (marl/clay)

Taking into account the weak slope (50m of level difference on a 20km course, i.e. almost 2,5% from the collection water zones in the East of Mandrosoarivo to the discharge area of Antanandava) on the one hand, and the structure of the surface layers of the substrate (sandy-muddy on the surface, therefore permeable, and argillaceous in depth, thus their impermeability), on the other hand:

- the rivers experience strong swelling in the rainy season, in particular at times of intense rain of short duration and tropical cyclones. Indeed, the speed of drainage is very slow after saturation of the permeable layers where water saturation takes only a few minutes after rainfall.
- the rivers dry up easily due to the low water-retention capacity of their sandy layers

Map 11 shows the hydrogeology of the zone (identification of the project area with the red line).



Map 12: Hydrology map of the zone of the project

Vegetation – description of the situation before the project

The vegetation of the zone (including area excluded from the VCS project boundary) consists of:

- Shrubby areas of Dalbergia trichocarpa
- Shaded areas of Ziziphus
- Grassy gramineous areas
- River bank areas with mango trees, Breonadia salicina, Syzygium sakalavarum

In terms of biodiversity, the "low bottom" unit contains 51% of the total species listed inside the pilot site. The slopes of the hills contain 49% of them, while the peaks contain only about 20 species, i.e. nearly 34% of the inventoried species.

The pilot zone contains about thirty families and more than fifty species (graminaceous, lianas and ferns not included). With at least 7 types, the Fabaceae family is the richest. The Dalbergia species appears the most frequently within this family. Occupying the slopes and peaks of the hills, it constitutes a shrubby formation whose characteristics are:

- Low area with Aristida (a grass of 20-40 cm in height, ground rate cover of up to 80% if the date of the last fire on the area exceeds 2-3 years)
- As principal shrubs, we have Dalbergia trichocarpa (Dhp ranging between 2 cm and 10 cm, 3 to 12 rejections per tree, 30 to 120 cm total height, density varying between 100 and 3' 000 plants per hectare

With regards to the arborous area, this is primarily made up of Ziziphus jujuba of 0,5 - 4,5m total height, 2-5 rejections per tree, and a density varying between 150 and 2'000 feet /ha, according to the degree of anthropisation of the site.

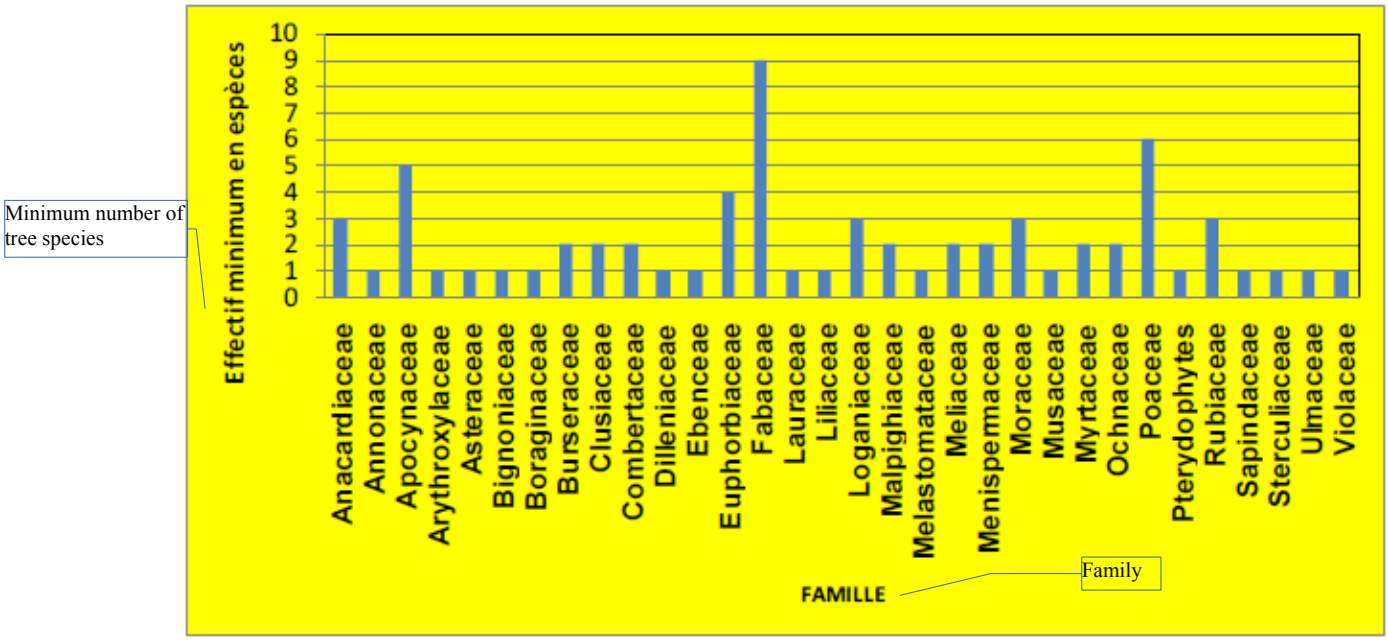


Table 11: List of the minimum number of tree species in the project area

The local anthropic vegetation use is briefly presented in the following paragraph:

- The species used in construction/fencing are: Harungamadagascariensis, Psorospermum brachypodum, Terminalia bivinii, Arythroxylon platycladum, Antidesma madagascariensis, Bridelia pervilleana, Phyllanthus erythroxyloides, Albizia boivinii, Dalbergia mollis, Dalbergia trichocarpa, Syzygium sakalavarum, Breonadia salicina, Gardenia rytenbergiana, Deinbollia

pervillei, Bismarkia nobilis, Raphia farinifera, Mascarenhasia arborescens, Mascarenhasia lisianthiflora, Voacanga thoursii, Stereospermum euphoroides, and Commiphora aprevalii.

- Those used as working wood are primarily Breonadia salicina, Dalbergia trichocarpa and Dalbergia. mollis Considering the scarcity of exploitable wood from these 3 species, the local population also tries to develop the species hereafter by producing small bits of furniture for local use: Voacanga thoursii, Commiphora aprevalii, Phyllantus erythroxyloides and Syzygium sakalavarum.
- The species hereafter are recognized for their medicinal use: Petchia erythrocarpa, Vernonia kenteocephala, Cordia myxa, Abrus precatorius, Acrisocarpus excelsus, Tristellateia madagascariensis, Dichaetanthera crassinodis and Byttneria heterophylla. It should be noted that the use of these species in pharmacopeia has been to date limited on a local scale. No industrial exploitation of these plants exists in the zone.
- The species used as heating wood and/or coal is Ziziphus, Tamarindus and mango trees. At present, the farmers are using the few Eucalyptus or Acacia which they planted in 2007-2008.

Vegetation dynamics

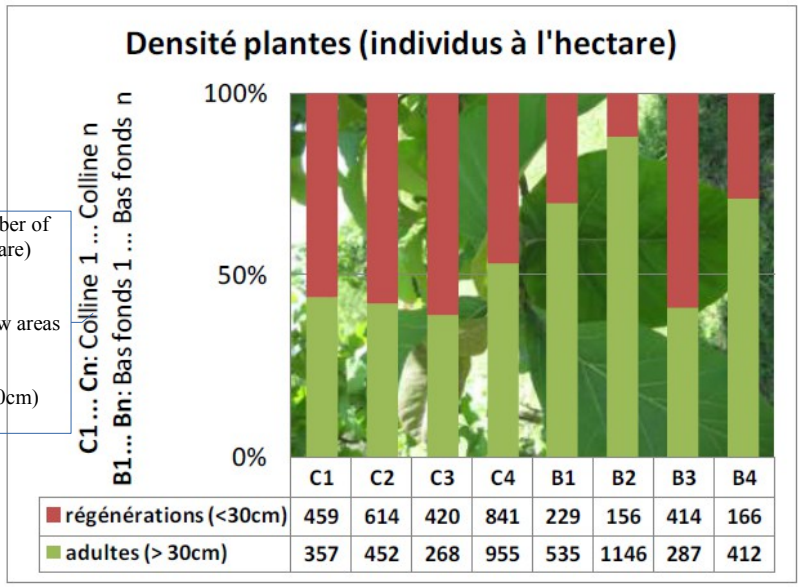
Most of the zone, in particular the alluvial small valleys and the hillsides, was covered by open forest. Following the various forms of clearing (vegetation fires and selective tree cutting for construction and the making of furniture), this woody area was increasingly degraded, to become in less than ten years, a shrubby area. The floral composition of vegetative covering thus changed according to this degradation dynamic (see figure below).

	60 years ago	**15 years ago**	**Currently**
Hills	Dried forest with *Dalbergia mollis, Dalbergia trichocarpa*	Tree formation with *Ziziphus ;* Shrubby formation with *Dalbergia, Arythroxylon*	Shrubby formation with *Dalbergia, Arythroxylon, Ziziphus, Bismarkia*
Shallow areas	Gallery forest with *Breonadia, Dalbergia mollis, Diospyros aculeata, Syzygium, …*	Relictual gallery forest with mango trees, *Breonadia*	Fairly open relictual gallery forest with mango trees, *Breonadia, Harunga, Trema*
Comments	The population used to fall mainly hillside species to stock up with timber, therefore there is an shaded formation. The shallow areas have been spared from the clearing, therefore they are relatively rich regarding their flora	The shallow areas mango trees are spared because they are not used as energy timber. Valuable essences (Dalbergia m., Dyospyros, Syzygium) have disappeared because they are much looked after. The Ziziphus formation extension is linked to bovine farming (natural regeneration through cowpats)	Mango trees remain in the shallow areas. The growth of Harunga and Trema show that it is a deteriorating formation. Breonadia is currently much looked after. Some coalers begin to use mango tree timber.

Table 12: Vegetative dynamic

The reconstitution dynamics of vegetation seems, however, to be rather effective if one looks at the regeneration of the plants (see figure):

- More than 50% of the specimens listed on C1, C2, C3 hills and the lower level B3 consist of young seedlings of less than 30 cm in height (see table 13 for definition C1, C2, C3 and B3)
- Nearly one third of the regeneration listed on tanety consists of Dalbergia trichocarpa
- Young seedlings were observed on the level of each topographic unit; in fact the tanety which regenerate most (394 regenerations/ha on the hills compared to 266 and 166 respectively on the lower levels and forest ground)



	C1	C2	C3	C4	B1	B2	B3	B4
régénérations (<30cm)	459	614	420	841	229	156	414	166
adultes (> 30cm)	357	452	268	955	535	1146	287	412

Plant density (number of individual per hectare)

C1…Cn:… Hill n
B1…Bn:… Shallow areas n

Regenerations (<30cm)
Adults (>30 cm)

Table 13: Density (stems/ha)

Dbh (cm)
Regeneration density (/ha)
Adult number density (/ha)
Number of species / ha
Typical species

	Bas fond ripicole			Colline			Bas fond forestier		
	minimum	maximum	moyenne	minimum	maximum	moyenne	minimum	maximum	moyenne
Dhp (cm)	2,6	10,4	6,7	2,4	9,1	5,2	4,1	14,4	8,2
Densité régénérations (/ha)	156	414	266	420	841	583	80	200	166
Densité individus adultes (/ha)	287	1 146	656	268	955	508	200	700	412
Nombre d'espèces à l'hectare	10	31	19	8	24	16	25	32	28
Espèces caractéristiques	Manguiers, Raphia			*Dalbergia , Ziziphus, , Arythroxylon, Bismarkia*			*Monanthotaxis, Pteridium, Viguieranthus, Syzygium, Stereospermum, Mascarenhasia, Dalbergia m., Voacanga, Breonadia, Albizia, Diospyros*		

Riparian shallow areas (min., max. average)
Hills (min., max. average)
Forest shallow areas (min., max. average)

Mango trees, raffia

Dalbergia, Ziziphus, Arythroxylon, Bismarkia

Monanthotaxis, Pteridium,Viguieranthus, Syzygium, Stereospermum, Mascarenhasia, Dalbergia m., Voacanga, Breonadia, Albizia, Diospyros

Table 14: Characteristics of the natural regenerations

- Regeneration dynamics exist not only on the lower levels but also on the hills
- This resumption of vegetation is quite obvious on tanety, in particular at the beginning of the rainy seasons, where the average diameter of the trees is approx. 5.2 cm
- The hills are less rich in species than the lower forest grounds

Based on the analysis of the vegetation, the boundary for the VCS project has been carefully delimited to only include areas dominated by herbaceous vegetation and with individual shrubs. In particular, it does not include any vegetation that could be considered as forest, neither does it include accumulations of trees / shrubs with diameter at breast height DBH >= 5cm.

Fauna

Direct observations carried out have made it possible to note the existence of at least forty avian species in the zone. The ethno-ecologic and bibliographical investigations also pointed out the presence of 53 species of bird of which 23 are endemic (e.g.: Atelornis crosleyi, which is a threatened breed; Brachypteaicias leptosomus which is classified as vulnerable).

Below is a list of the existing species of birds in the project area region:

Genus and species Statute

Endemic and threatened
Endemic and vulnerable
Endemic

Genre et espèce	Statut
Alectroenas madagascariensis	
Atelornis crosleyi	Endémique et menacé
Berneria cinereiceps	
Berneria madagascariensis	
Berneria tenebrosa	
Berneria zosterops	
Brachypteaicias leptosomus	Endémique et vulnérable
Buteo brachypterus	
Butorides striatus	
Calicalicus madagascariensis	Endémique
Canirallus kioloïdes	
Centropus toulou	
Copsychus albospecularis	Endémique
Coracina cinerea	
Coracopsis nigra	
Coracopsis vasa	
Alcedo vintsioides	
Crossleyia xanthophrys	
Cuculus rochii	
Cyanolanius madagascariensis	
Dicrurus forficatus	
Dromaeocercus brunneus	
Falco newtoni	
Falco zoniventris	Endémique
Foudia omissa	Endémique
Gallinula chloropus	
Hartertula flavoviridis	
Upupa epops	
Hypsipetes madagascariensis	Endémique
Leptopterus chabert	Endémique
Leptopterus viridis	Endémique
Leptosomus discolor	
Lophotibis cristata	
Merops superciliosus	
Monticola sharpei	

Monticola sp.	
Motacilla flaviventris	Endémique
Mystacornis crossleyi	Endémique
Nectarinia notata	
Nectarinia soimanga	
Neodrepanis coruscans	Endémique
Neomixis striatigula	Endémique
Neomixis tenella	Endémique
Neomixis viridis	Endémique
Nesillas typica	Endémique
Newtonia amphichroa	Endémique
Newtonia brunneicauda	Endémique
Oxylabes madagascariensis	Endémique
Philepitta castanea	
Ploceus nelicourvi	Endémique
Ploceus sakalava	Endémique
Polyboroides radiatus	
Pseudobias wardi	
Randia pseudozosterops	Endémique
Sarothrura insularis	
Saxicola torquata	
Schetba rufa	Endémique
Streptopelia picturata	
Terpsiphone mutata	
Tylas eduardi	
Vanga curvirostris	
Xanthomyxis sp.	
Zosterops maderaspatana	

Picture 6: Nest of Ploceus sakalava in a mango tree

The presence of mammals locally called “lambo” and “jaboady” (Viverricula indica) has been confirmed due to traces observed in the zone (trampling on the ground). Micro mammals (see complete list in table on next page) such as Tenrec ecaudatus and Suncus murinus also exist in the zone. Recently, their population has experienced a considerable decrease, according to villager’s statements.

Famille	Genre et espèce	Statut
Tenrecidae	*Tenrec ecaudatus* *Suncus madagascariensis* *Suncus murinus* *Setifer setosus*	Endémique
Muridae	*Eliurus sp* *Macrotarsomys sp** *Rattus rattus*	Endémique
Chiropteridae	*Hipposideros commersoni*	

* : Endémicité non confirmée malgré le fait que « *Voalavonala* » ou *Macrotarsomys sp* soit une espèce endémique d'Ankarafantsika (à quelques kilomètres du site du Projet).

Family Genus and species Statute
Endemic

Table 15: List of micro mammals of the region

Endemicity not confirmed, despite the fact that "Vaolavonala" or Macrotarsomys sp is an endemic species of Ankarafantsika (a few kilometers away from the Project site).

Some species of amphibians (Blommersia wittei) and reptiles (Leioheterodon madagascariensis, Dromicodryas quadilineata, Liophidium torquatum, Acrantophis madagascariensis) have been seen in plains and low ground. Their complete list was obtained by recording of documentation. The amphibians of the zone are all endemic.

Famille	Genre et espèce	Statut
Microhylidae	Ptychadena mascariensis	Endémique
	Heterixalus luteostriatus	Endémique
	Heterixalus tricolor	Endémique
	Scaphiophrune aff. Calcanata	Endémique
	Discophus insularis	Endémique
	Laliostoma labrosum	Endémique
Mantellinae	Blommersia wittei	Endémique
	Mantella ebenaui	Endémique
	Mantidactylus ulcerosus	Endémique

Table 16: List of the reptiles and amphibians of the region

Famille	Genre et espèce	Statut	Appellation locale
Chamaleonidae	*Brookesia stumpffi*	Endémique	
	Furoifer oustaleti	Endémique	
	Furoifer rhinoceratus	Endémique	
Iguanidae	*Oplurus ouvieri*	Endémique	Androngotany, katsatsatany
Gerrhosauridae	*Zonosaurus laticaudatus*	Endémique	
Scincidae	*Trachylopsis elegans*	Endémique	
	Trachylopsis madagasoariensis	Endémique	
	Madasoinus intermedis	Endémique	
	Madasoinus melanopleura	Endémique	
	Amphiglossus reticulus	Endémique	
Gekkonidae	*Geokolepsis maculata*	Endémique	
	Geokolepsis melanopleura	Endémique	
	Hemidactylum frenatus	Endémique	
	Hemidactylum mercatorius	Endémique	
	Parodura stupffi	Endémique	
	Uroplatus henkeli	Endémique	
	Lygodactylus tolampyae	Endémique	
	Phelsuma madagasoariensis	Endémique	
	Phelsuma lineata	Endémique	
Boidae	*Sanzinia madagasoariensis*	Endémique	*Mandobolotany*
	Acrantophis madagasoariensis	Endémique	*Do*
	Madagasoarophis colubrinus	Endémique	*Lapata*
Colubridae	*Stenophis variabilis*	Endémique	*Fandrefiala*
	Leioheterodon madagasoariensis	Endémique	*Menarana*
	Langaha madagasoariensis	Endémique	*Filoala*
	Ithycyphus miniatus	Endémique	*Fandrefiala*
	Liophidium torquatum	Endémique	*Tompotany*
	Bibliava lateralis	Endémique	*Bibindrano*
	Dromicodryas quadrilineata	Endémique	*Marolongo*
	Mimophis mahafalensis	Endémique	*Bibimora*

Local name

Table 17: List of reptiles present on the project area

With regard to insects, the two Cincidèles and Microlépidoptères groups populate the zone. In fact, the insects set up a vast taxonomic group of which many species are still not well known or identified.
The groups above are selected because they represent indicating taxonomic groups. Thus, for example, Cincidèles are recognized by many authors as good indicators of the distribution of the biodiversity in the bird population (Pearson and Cassola, 1992., Razafimahatratra and Andriamampianina, 1995). The members of this family gather in a vast habitat.
The reptiles (list in figure 19below) in this zone are numerous, according to the bibliographical investigations, direct observations and surveys carried out within the population. They all are endemic.

Process of data collection

The process of data collection for the conditions prior to project initiation (as well as the rest as the information in the Project Document) is explained below.

Elaboration process of the Management Plan has followed the steps below:

- Comprehension of the ins and outs of the project
- Definition of the development goals
- Field exploration : forest and biological inventory, actual land use and actual vegetation units mapping, data collection about the promising local techniques about agricultural and forestry planning, organization of focus groups (data collection and discussion about the content of the Management Plan)
- Identification of the agricultural and forestry species and techniques from data collected on-site (on-site reality and farmers wishes)
- Elaboration of the management Plan: planning directives, forest management, planification of the interventions, calculation of the possibilities, evaluation of the financial, human and equipment resources, elaboration of the follow-up methods
- Validation of the provisory Management Plan by the various partners, of which EcoFormation, Avotrala, the local population and authorities
- Writing of the final Management Plan on the basis of the commentaries and analysis of the various partners above

Soil analysis

A preliminary analysis has been done from documents about the biophysical conditions of the studied zone. The goal was to collect basis informations allowing the identification of the main morpho-pedological units characterizing the studied zone. Six types of map have been used during this exploratory phase:

- Vegetation map, scale 1/500'000e from "l'Atlas de la végétation de Madagascar (Royal Botanic Garden – KEW, 2007)" ;
- Geographic conditions map for the agricultural promotion of Madagascar, 1/500'000e (ORSTOM which has become IRD, 1981), feuille Nord
- Soil resources map, 1/200'000e (INRAT, 1990) ;
- Hydro-geological and water ressources map, 1/200 000e (INRAT, 1990) ;
- Topographic map, 1/100'000e de FTM, feuilles O40 et P40 ;
- Aerial pictures and numerical model of and (MNT), scale 1/10'000e of the studied zone, established from aerial pictures (1/40'000e) of FTM, mission 1949.

On-field, all morpho-pedological units has been studied; the physical and morphological characteristics have been observed according to the type of vegetation cover and it's topographical position. The observations and samples done mainly concern the first 30 centimetres of the superficial part of the soil.

The description of the environment from an observation point has been done with the help of description guide. The history of use of each observation point as well as the farmer's perception of the characteristics and soil fertility of the area have especially been the centre of attention. The informations given by the farmers have been compared with the informations coming from scientific observations and analysis.

A total of 13 observation points have been kept and were subject to laboratory chemical and physical analysis. The laboratory has done the following analysis: granulometry (clay, sand and silt), pH, total nitrogen (N), assimilable phosphorus (P), exchangeable potassium (K), total carbon, cation exchange capacity (CEC).

Three parameters have been used to define the soil capability units :

- Topographic conditions of the slopes (in %) and altitude (in meters);
- Intrinsic characteristics of the soil, chemical fertility (essential nutrients content) and the physical fertility (erosion sensitivity, compactness, granulometry, ...)
- Water availability

Vegetation analysis

The data collection about the vegetation has been performed with 8 transects of 10 m x 500 m (of which 4 were on slopes and 4 in the river-banks), in which inventory circles of 5m diameter spaced out by 20 meters have been delineated (FOFIFA, 2000 ; Jariala USAID, 2007). The inventory was limited to the woody vegetation. The parameters here after have been picked up during this operation :

- Vernacular name (scientific name obtained after identification of the specimens in the FOFIFA laboratory in Antananarivo
- Forest measurements of each woody species: DBH, total height, trunk height, density (specimens/ha)
- Socioeconomic and cultural use of each species. Surveys with the local population have then been done.

The dendrometric parameters above have been used to calculate the volumes V (Rajoelison, 1997) and the volume density increase A below:

- V exploitable log in m3/ha = 0,53 x earthy area per ha x mean exploitable log height in m

- V total aerial biomass in m3/ha = 0,53 x earthy area per ha x mean total height of trees in m
- A exploitable login m3/ha/year = V exploitable log in m3 per ha / year of vegetation of the tree
- A total aerial biomass in m3/ha/year = V total aerial biomass in m3 per ha / year of vegetation of the tree

Note that the results obtained by those classical formulas can be compared to the one from allometric relations about the cubic measurements suggested by some authors, such as Nasi et *al.* (1988) for the case of *Khaya senegalensis*. In fact, those authors suggest the below rate for a plantation in Mali :

$$V = -0{,}00537 + 0{,}06233\ C + 0{,}54878\ C^3$$

où V = volume brut sur écorce (en m³) jusqu'à la découpe 10 cm de circonférence

C = circonférence à 1,30 m (en m)

Domaine de validité = $22 < C < 150$ cm

La fraction du volume total (V) utilisable en bois d'œuvre (RBO) et en bois de feu (RBF = V – RBO) a été calculée au Mali.

V= - 0.00537 + 0.06233 C + 0.54878 C3
V= raw volume on bark (in m3) until cutting 10 cm circumference
C= circumference at 1.3m (in m)
Validity domain = 22 < C < 150 cm
The total usable timber volume (V) ratio (RBO) and energy wood (RBF = V – RBO) was calculated in Mali.

Circonférences à 1,30 m	RBO	RBF
C > 0,7 m	0	1
0,7 ⩽ C < 1 m	0,29	0,71
C ⩾ 1 m	0,34	0,66

Socio-economic analysis

Three types of tools have been used during the data collection:

- Consultation of documents such as "Plan Communal de Développement (PCD) de la Commune Rurale de Bekoratsaka" elaborated by SAGE (2005)
- Informal surveys, during which interviews about the use and management of the vegetation cover were done. 4 women, 3 charcoal makers, 5 household chiefs, 2 breeders and 5 farmers have been interviewed in the Fokontany of Andrafiakely, Mandrosoarivo, Antanambao et Antanandava.
- The focus groups during which all socio-professional groups were invited to a presentation followed by a discussion about the Management Plan, it's content, it's goals and it's implementation. About 50 people per presentation from various socio-professional categories have participated to those interactive workshops in the Fokontany of Mandrosoarivo (with Andrafiakely), Tanandava, Tanambao and Ambodimadiro II.

The focus group guide as well as picture of these meetings can be found in annexe 9.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

In order to comply with all relevant local, regional ad national laws, statutes and frameworks, many contacts with all levels of authorities have ensured the project to follow all relevant rules.

A summary of the various contacts and meetings (as well as their outcomes such as letter of support) can be found in annexe 10. Those various contacts are part of the procedure that has allowed Avotrala to the free use of the land for an undetermined period of time and which ends only if the goals and owner change.

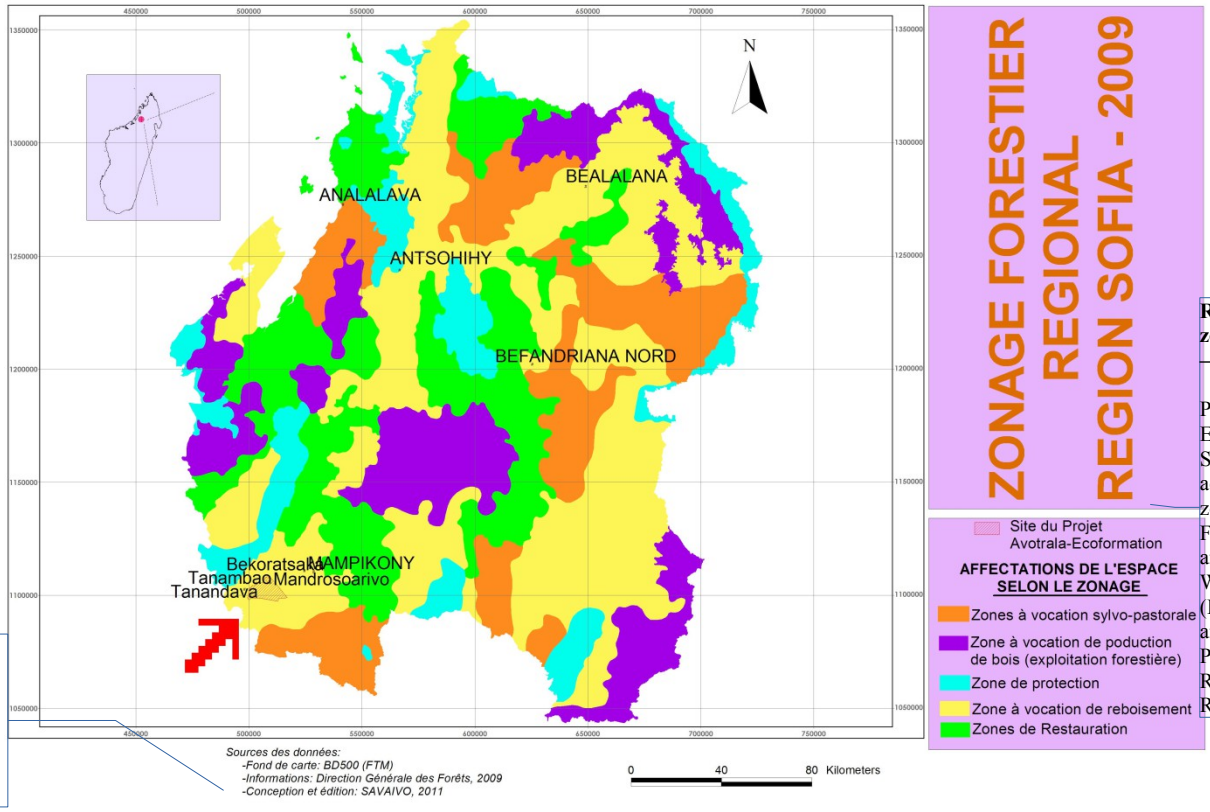
The art 10 of the n°60.146 Decree of the 3rd of October 1960 specify that this right of title enables the owner of the title to 3 privileges which are:

- the usus (right to use the land)
- the fructus (right to keep the civil, natural and industrials fruits)

- the abusus (which is the right to give up or sell if it is not specified by the law, which is in the case of this title)

To implement a forestry project the “Schéma Régional d’Aménagement du Territoire” (SRAT) of the Sofia Region must be followed and the Management Plan mustn’t present contradictions with this regional development tool.

Following this regulation, the project site is on a zone which is dedicated to reforestation as shown below[7]:



Regional forest zoning Sofia Region – 2009

Project site Avotrala-Ecoformation
Space occupation according to the zoning
Forest-pastoralism areas
Wood production (Forest exploitation) areas
Protection areas
Reforestation areas
Restoration areas

Data source:
Map: BD500 (FTM)
Information: Forest General Management, 2009
Design and edition: SAVAIVO, 2011

Map 13: Forest zoning of the Sofia region

No specific law or rule are to be followed when planting trees near a water source. It is legally allowed to plant trees beside water sources or rivers.

However, the following have been taken into account to create the Management Plan:

- precautionary principle
- local farmers' concern about the fact that tall trees such as Eucalyptus are voracious with water and could affect the water sources nearby
- technical concern about the fact that tree plantation could be in competition with cultivation when they are put side to side

To address those concerns, the following technical measures have been implemented:

- 50m buffers free of any tree plantation around the cultivation crops in order to alleviate the potential competition over water, sun and nutriments between crops and trees)
- teak plantations mustn’t be done inside a 50m radius around the river banks and water sources

7 Source: Fond de carte BD500 (FTM) and General Direction of the Forest (2009)

- Eucalyptus mustn't cover more than 20% of the total surface of the site and must be planted in areas with very few rice crops

In accordance with international regulations (International Convention ratified by Madagascar) and national regulations (Charter of the Malagasy environment, MECIE decree and the sectoral and interdepartmental texts) in force, the Reforestation and Maintenance of Biodiversity Project initiated by the AVOTRALA Co-operative (or KOP' ALA) in the Rural District of Bekoratsaka requires an environmental evaluation due to the technical synopsis hereafter:

- Presence of endemic and/or protected species such as amphibians and reptiles in the Project zone; these species are protected by the CITES convention
- Almost all the amphibians and reptiles in the zone are endemic
- More than a third of the birds listed in the zone are endemic
- Existence of endemic plants such as Antidesma madagascariensis, Tristellateia madagascariensis, and of threatened species (e.g. the Atelornis crosleyi bird) in the zone
- Sensitivity of the Project zone because of the above-mentioned biological endemic rates on the one hand, and because of the fragile nature of the site regarding flooding and sediment movement (mechanism of flooding in the plains and lower ground), on the other hand. In this sense, the zone can be described as "sensitive", in accordance with the Interministerial Decree n° 4355/97 of May 13, 1997.
- Spacial and temporal scale of the Project, which extends on the short, medium and long term (more than 60 years). The reforestation activities relate to 60 km ², i.e. nearly a quarter of the surface of the Rural District of Bekoratsaka. The induced effects of the reforestation and the agro-forestral activities (sale of the agro-forestry products) can affect other vast areas such as the Sofia Area, and even the national territory.
- The socio-economic range of the Project: nearly a quarter of the population of the Rural District of Bekoratsaka is concentrated in the 6 Fokontany areas in the the Project. Hundreds of direct and indirect jobs will be created thanks to the Project. A certain number of stakes (e.g. land) will preoccupy the administrative leaders and the local authorities. Moreover, the reforestation and agroforestery activities will modify the local agro-sylvo-pastoral practices insofar as these new economic guidelines will take an important place in the life of the population from now on.

With regard to these arguments, the control of an EIE proves essential insofar as the Project initiated by AVOTRALA could harm the environment, and this, in accordance with articles 3 and 4 of Decree 99-954 of 15/12/99, modified by Decree 2004-167 of 03/02/04. With a view to sustainable development and to conform with the international and national regulations nationals in force, KOP'ALA, by the means of this EIE, takes into account the precaution principle evoked by:

- The Rio convention, which in its n° 15 principle stipulates the need for pre-evaluating the impact of an unspecified Project with the aim of identifying precaution measurements which are essential;
- Article 3 of the Malagasy Environment Charter (law n° 90-033 of 21/12/90) which recommends taking the environmental dimension into account in a development project;
- Article 4 of the MECIE Decree, according to which "… all establishments or installation modifications, work and work likely, due to their technical nature, their adjacency, their dimension size or the sensitivity of the set-up area, to have damaging consequences on the environment" … must be subject to an environmental study.

1.12 Ownership and Other Programs

Proof of Title

Upon request from the cooperative Avotr'Ala, the Ministry of Development and Territorial Management placed the land at the disposal of the cooperative on 9th February 2012 (see decree and notification letter in annex 27). At the date of writing this PDD (October 16th 2013) 4'685 ha out of the 8'972 ha VCS project area have been demarcated by geometers of the Ministry and titled in favour of the cooperative Avotr'Ala. The demarcation of land for the project has been done through consultation of the local population. Accordingly, the protocol of the demarcation was signed by representatives of the communities (see annex 29). The work of demarcation and titling is ongoing, with the objective of finally securing the 6'073 ha within the VCS eligible project area until the first verification, 5 years after project registration.

However, from a legal point of view, the state remains the owner of the land, but transcribes with above mentioned decision, the rights on land-use to the so-called “superficiary”. The legal basis for this is in Paragraph 3 of Art. 26 of Low No. 2008.014 (see Annex 27a). The rights associated to this free disposal are further specified in Art. 10 and Art. 12 of Low No. 60.146 and include the right of *usus*, *fructus* and *abusus*.

No legal text exist at the moment that explicitly specifies the ownership of carbon credits (see R-PP Madagascar, Version January 2013) and the right to valorise carbon credits lies within the general right of the superficiary to use the fruits of land he manages. Evidence for this can be found in the various carbon projects that are already registered to voluntary markets through private entities (see VCS and CDM Gold Standard registries).

The placing of the land at someones disposal is not limited in time and thus no period is mentioned in the letter or the decision. Within Low No. 2008.014 the state preserves the right to regain full ownership of the rights at any time. However, as the Ministry at the time of signing the letter and the decision was aware of the long-term nature of the project activity, a premature cancellation of the cooperative's land-use rights would be against the principle of equity and good faith.

Finally, with the official disposal of the land for the benefit of the cooperative, the project participants have the right to conduct the planned project activity and to use its fruits, until the state reclaims these rights. The Madagascan low does not provide a guarantee with regard of the time period, nor the detailed content of the right (i.e. carbon credits).

This is a risk factor for the project that is included in the projects risk assessment (see Project Longevity in the AFOLU non-permanence risk assessment in the Annex 28). To assure that the project area is still at the disposal of the project participants at time of verification, the following monitoring parameter is introduced:

Data Unit / Parameter:	**Tenure**
Data unit:	boolean
Description:	Project participants right of *usus* and *fructus*
Source of data:	Demonstration that the project are is still at disposal of the project participants.
Measurement procedure (if any):	-
Monitoring frequency:	Prior each verification
QA/QC procedures:	-
Any comment:	In case the project area isn't further at disposal of the project participants (Tenure = FALSE), credits shall only be issued on written confirmation of regional and / or national authorities.

Distribution of carbon credits / use of revenues

As specified in the convention between EcoFormation and the Avotr'Ala Cooperative and its additional clause (see annexes 2 and 3), EcoFormation will have the right to pertain and procure and commercialize carbon credits until the end of the crediting period in 2041. 30% of the net revenues will go to the cooperative and be distributed to its members, according to a previously defined and agreed investment plan. Another share of maximum 30% (depending on the revenues from timber sales) will be used for financing the project operations (training centre, nurseries, maintenance of plantations, ...). The reminder, i.e. a minimum 40% of the net revenues from carbon markets, remain with EcoFormation for the realization of similar projects / up-scaling of the activities.

Emissions Trading Programs and Other Binding Limits

Madagascar is not involved in any emission trading programs at jurisdictional level until know and no higher-level accounting of emission reductions is done. Preparations for national action plans for climate change mitigation and participation in an international REDD+ scheme are ongoing. However, no legal frameworks clarifying roles and rights have been developed so far (see R-PP, Version January 2013).

However, it seems from current discussions, that Madagascar will implement kind of a nested approach, allowing for co-existence and separate carbon accounting of national programs and projects (VCS Jurisdictional REDD+).

For further information see Madagascar's R-PP, version January 2013, available at the FCPF homepage (http://www.forestcarbonpartnership.org/madagascar).

To ensure, that no double-counting will be done, the following monitoring parameter is introduced:

Data Unit / Parameter:	**Double-counting**
Data unit:	boolean
Description:	Double-counting of the project's GHG removals
Source of data:	Two options: a) proof that the project is registered in a national GHG registry (-> national registry); or b) demonstration that there is no national / regional carbon accounting system (-> national and regional authorities) and no other land-use carbon project in direct proximity accounting for the same removals (-> carbon market registries).
Measurement procedure (if any):	-
Monitoring frequency:	Prior each verification
QA/QC procedures:	-
Any comment:	In case the same carbon credits are claimed by another entity (DC = TRUE), no credits shall be issued, or only the credits that are not accounted twice if there is partial double-counting.

Participation under Other GHG Programs

N/A

Other Forms of Environmental Credit

N/A

Projects Rejected by Other GHG Programs

N/A

1.13 Additional Information Relevant to the Project

Eligibility Criteria

N/A

Leakage Management

The leakage being considered “insignificant” according to the “Guidelines on conditions under which increase in GHG emissions related to displacement of pre-project grazing activities in A/R CDM project activity is insignificant” (see below), the leakage doesn't have to be calculated.
However, here are some information about the relocation of the agricultural activities from areas of land located within the project boundary to areas of land located outside the project boundary.
The cattle has always been wandering on the project area but has never been brought to this area in order to graze.
Being aware of the fact that the cattle must still be fed in the area, EcoFormation and Avotrala have decided to make available the fire buffer zones for the farmers to let their cattle graze while they work on the project site. This way the cattle helps getting rid of the grass that could lead to fire (this way the grass doesn't have to be cut by machines).
Barriers made of jatropha have been planted around the fire buffer (inside the buffer), in order to prevent fire and also in order to prevent the cattle from going into the project area while grazing on the buffer zones.
Furthermore, the area is covered with zones similar to the project area (before the project implementation). The fact that the cattle won't be able to wander on the project site doesn't mean there is no other place for them to graze on. On the contrary, on the other side of the RN6, there is the exact same type of ares that are free.

Following the “Guidelines on conditions under which increase in GHG emissions related to displacement of pre-project grazing activities in A/R CDM project activity is insignificant”[8], it is stated that the increase in GHG emissions due to displacement of pre-project grazing activities attributable to the A/R CDM project activity is insignificant if the total number of animals expected to be displaced is more than 40 LSU, and the n-40 LSU (where: “n” is the total number of animals, in our case a maximum of 2'855, n-40 equals to 2'845, expressed in LSU, which are expected to be displaced) are displaced to:
(i) Areas of land that can be identified as degraded or degrading. The identification shall be conducted using the most recent version of the “Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities”.

The area of the project as well as the connecting areas where the cattle is expected to graze has been classified as “severely degraded or degrading” (see p. 49 of PD). Consequently, the GHG emissions due to displacement of pre-project grazing activities attributable to the project activity is insignificant. The methodological tool “Estimation of the increase in GHG emissions attributable to the displacement of pre-project agricultural activities in A/R CDM project activity” therefore doesn't have to be applied.

8 See http://cdm.unfccc.int/EB/051/eb51_repan13.pdf

For the evidence on the number of cattle, those numbers come from the study called “Plan Communal de Développement – Commune rurale de Bekoratsaka, District de Mampikony” done by Sage in 2005 (see details about this reference below).

As for the agricultural zones, an on-site zoning has been done by the authorized register of land. This authority has come and done the zoning after the visit of the auditors where a village and rice crops had been found on-site.

According to SAGE (2005) in « PCD – Plan Communal de Développement – Commune Rurale de Bekoratsaka, Mampikony District:

- The total surface of the Rural Municipality of Bekoratsaka is 950 km Ç = 95'000 ha
- The number of zebus was 45'000 in 2003

By deduction:
The zebu density for the Bekoratsaka Commune was 0.47 per ha in 2003

- Out of 6'073 ha of eligible zones, we can calculate heads of zebu (6'073ha*0.47 LSU / ha = 2'855 LSU).
- Cultivated fields within the Project site extend on 1'249 ha[9].

Since the only potential leakage of the project is the displacement of the cattle wandering on the project site, the CDM tool “Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity” has been applied.

All the areas used for agricultural purposes have been excluded from the project boundaries.

Step 1: Estimate the area subject to pre-project agricultural activities that is expected to be afforested/reforested (therefore the activities have to be displaced) during year *t* since the start of the A/R project activity (Ad_t).

Project participants may:

(a) Estimate the area, Ad_t directly, e.g., using maps and/or land surveys and/or Participatory Rural Appraisal; and/or

(b) Estimate the area, Ad_t indirectly from the data on number of head of livestock to be displaced (possibly converted to livestock equivalent units - LSU) divided by the appropriate sustainable stocking rate.

Both approaches above may be combined according to data availability.

Calculate:

$$D_{t^*} = \frac{\sum_{t=1}^{t^*} Ad_t}{A}$$ = 6'073*1/6'073 = 1

A	6'073 ha
Ad_t	Total area, 6'073 ha[10]
†	The project activity started in 2011 so the years elapsed since the start of the project equals 1

9 Based on an surface assessment with GIS; information provided by image processing ASTER TL_ASTER_date2011-07-21_lat16.20_lon47.31.juillet2011 (Glovis, 2011)

10 All the area is subject to the wandering of between 200 to 500 zebus according to the Chief of the Bekoratsaka Community estimate as well as on-site led by the Savaivo office.
According to the SAGE report the calculated estimation of LSU for the area is of 2'855LSU.

where:

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

Step 2:

Take:

ΔC_t: - annual change in carbon stock in all selected carbon pools for year *t* ; t C yr^{-1},

as calculated following requirements of the baseline and monitoring A/R CDM methodology within which this tool is used (e.g., calculated using equation 12 in the approved consolidated afforestation and reforestation baseline and monitoring methodology AR-ACM0002: "Afforestation or reforestation of degraded land without displacement of pre-project activities" - Version 01).

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

$$\Delta C_{t=t_{ver}} = \sum_{t=1}^{t_{ver}} \Delta C_t * 1year$$ = 164'874[11]

t	1 since the project started in 2011
ΔC_t	164'874[12]
t_{VER}	2016, it is planned to have the verification in 2016

where:

$\Delta C_{t=t_{ver}}$	Sum of annual changes in carbon stock in all selected carbon pools since the start of the A/R CDM project activity to the year of verification t_{ver}; t C
ΔC_t	Annual change in carbon stock in all selected carbon pools for year *t*. Note that for each verification event data for ΔC_t will be known for each year through the year of verification; t C yr^{-1}
t_{ver}	Year of verification event; yr

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

= 164'874

$\Delta C_{t=tVER}$	164'874
D_{t*}	1

11 Addition of the sequestration of the five first years since verification has to be done in the following five years after validation.

12 Addition of annual change in carbon stock from year 2012 to year 2016 (included)

where:

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

Step 4: Estimate the factor *f*, as the fraction of land covered by forest (according to the national definition of forest) in the region containing the A/R CDM project activity. The region shall be the smallest territorial administrative division/s encompassing all areas of land included in the A/R CDM project activity for which data on forest cover are publicly available. If more than one territorial administrative division is involved then *f* shall be calculated as weighted average of the individual divisions' fraction of land covered by forest using area as a weight. Satellite images or other types of remote sensing data may be used as source of data on forest cover, if available to project participants.

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

$$LK_{Agric,\,t^*} = \frac{44}{12} * \frac{f}{T_{cred}} * \Delta Cd_{t^*} \qquad = (44/12)*(0/30)*164'874 = 0$$

f	0, none of the land eligible for VCS project is covered by forest according to the DNA definition
T_{cred}	30 years
t	1 since the project started in 2011
ΔCd_t	164'874

where:

$LK_{Agric,\,t^*}$	Leakage due to displacement of agricultural activities in year t^*; t CO_2-e
f	Fraction of land covered by forest (according to the national definition of forest) in the region containing the A/R CDM project activity; dimensionless
T_{cred}	Number of years contained in the first crediting period; dimensionless
ΔCd_t	Sum of annual changes in carbon stock in all selected carbon pools since the start of the A/R CDM project activity to the year of verification t_{ver} attributable to the area subject to pre-project agricultural activities that are displaced during year t since the start of the A/R project activity; t C
t	*1, 2, 3, ...* t^* years elapsed since the start of the A/R CDM project activity
44/12	Ratio of molecular weight of CO_2 to carbon; t CO_2-e t C^{-1}

Leakage being non-existent (0), no leakage management plan has to be implemented.

Commercially Sensitive Information

N/A

Further Information

N/A

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

The following CDM Methodologies and Tools have been used for the elaboration of the project:

- AR-ACM0003: “Afforestation and reforestation of lands except wetlands”, version 1.0.0 (http://cdm.unfccc.int/UserManagement/FileStorage/CDM_ACMZOCHO8KW19650M36KQREWZ9QKZGOZ1)
- AR-TOOL 14: “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities“, version 3.0.0 (http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-14-v3.0.0.pdf)
- Additionality Tool: “Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities”, version 01 (http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-02-v1.pdf)

Although not directly refered to by the methodology AR-ACM0003 and its tools, the following CDM tools and guidelines have been considered for guidance :

- “Guidelines on conservative choice and application of default data in estimation of the net anthropogenic GHG removals by sinks”, version 02 (http://cdm.unfccc.int/EB/050/eb50_repan23.pdf)
- “Guidelines on conditions under which increase in GHG emissions related to displacement of pre-project grazing activities in A/R CDM project activity is insignificant”, version 01 (http://cdm.unfccc.int/EB/051/eb51_repan14.pdf)
- “Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities”, version 01.0.0 (http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-17-v1.pdf)
- “Calculation of the number of sample plots for measurements within A/R CDM project activities”, version 02.1.0 (http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-03-v2.1.0.pdf)

In addition, the following VCS Methodologies and Guidelines have been used :

- VCS AFOLU Requirements: "Agriculture, Forestry and Other Land Use (AFOLU) Requirements”, version 3.3 (http://v-c-s.org/sites/v-c-s.org/files/AFOLU%20Requirements%20v3.3_0.pdf)
- VCS AFOLU Risk Tool: "AFOLU Non-Permanence Risk Tool”, version 3.2 (http://v-c-s.org/sites/v-c-s.org/files/AFOLU%20Non-Permanence%20Risk%20Tool,%20v3.2.pdf)
- VCS Process: "Registration and Issuance Process”, version 3.4 (http://v-c-s.org/sites/v-c-s.org/files/Registration%20and%20Issuance%20Process%2C%20v3.4.pdf)

2.2 Applicability of Methodology

AR-ACM0003 is applicable under the following conditions:

(a) *The land subject to the project activity does not fall in wetland category;*

IPCC wetland definition[13]:"A typical wetland soil with a high water table and an organic layer of at least 40 cm thickness (poorly drained organic soil)". No such soils exist in the project area.

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

i. *Land containing organic soils;*

As shown by the soil analysis in annexe 8, there are no organic soils in the project area

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

The project area consists mainly of moderately – severely degraded grassland, without any inputs which are not listed in the appendices of the methodology. Rice production in the valleys is done in full tillage systems with no or very little input of external organic material, which is neither listed in the appendices.

The project baseline further builds up on the AR-ACM0001 eligibility criterion for demonstrating that baseline carbon stocks are decreasing: *The A/R CDM project activity is implemented on degraded lands[14], which are expected to remain degraded or to continue to degrade in the absence of the project, hence the land cannot be expected to revert to a non-degraded state without human intervention.*

As described in the "Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities", an initial screening of lands to determine whether the area has been classified as "degraded" under any verifiable local, regional, national or international land classification system or credible study produced within the last ten years has been done.

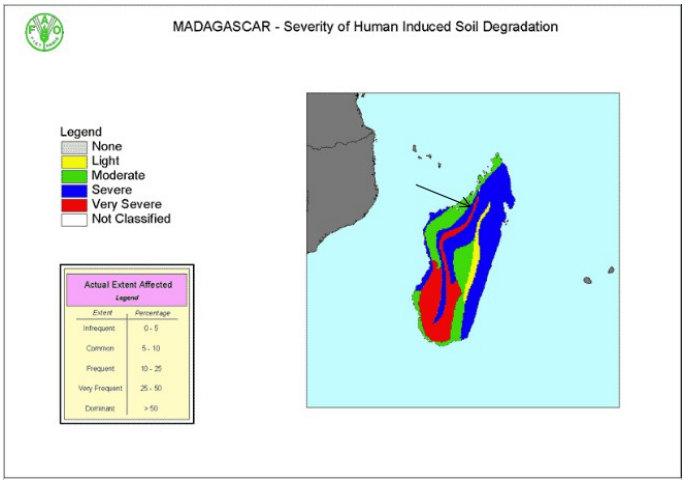
The FAO map from 2004 below[15] shows the erosion situation in Madagascar. The Sofia Region (pointed on the map by an arrow) in the Mahajanga District is classified under "severe".

Since the classification of the project area is as a degraded land and the data not older than 10 years, the land can be considered as "degraded".

13 Definition from the IPCC, 2003, Volume 4, Chapter 4

14 The latest version of the tool "Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities" shall be applied for demonstrating that lands are degraded or degrading.

15 http://www.wildmadagascar.org/maps/erosion.html



Map 14: Madagascar soil degradation

2.3 Project Boundary

Carbon pools

Carbon Pools	Selected (Yes, No)	Justification/Explanation of choice
Above-ground biomass	Yes	Major carbon pool subject to the project activity
Below-ground biomass	Yes	Major carbon pool subject to the project activity..
Litter	No	Insignificant carbon pool which can be conservatively excluded according to the methodology
Dead Wood	No	Insignificant carbon pool which can be conservatively excluded according to the methodology
Soil Organic Carbon	No	A certain increase of soil organic carbon SOC can be expected due to the project activity on the long-run. However, measuring of changes in SOC at a the required precision-level is too costly. Exclusion of SOC from the project boundary is conservative and eligible according to the methodology.

Tree and shrub differentiation

Since there is no official definition of what a tree is in the Kyoto Protocol, FAO[16] or any other official institution, it is hard to differentiate a tree from a shrub. However, the more common distinction between tree and shrub « is that trees have a single central stem or trunk, while shrubs often have multiple, thinner stems. Trees also tend to have a distinct shape and crown, while shrubs may consist of a large hedge that spreads over the ground.» Considering the size « trees are generally thicker in the trunk and taller than shrub. Trees, for instance, typically are greater than 10 ft in height (about 3 meters) and can grow over a hundred feet, while many shrubs are only a few feet tall. (Tall shrubs can grow to around 20 ft.) »[17]

An inventory has been made to delineate the eligible areas of land. 8'972 ha of area without accumulation of trees has been identified as VCS eligible area at disposal for reforestation activities. The following vegetation types have been identified:

Occupation type	Characteristics	Density	Height
A. Savannah without shrubs (3'866 ha)	Thick grass ward	0 – 5 specimen/ha	N/A
B. Savannah with individual *Ziziphus* and/or *Dalbergia* shrubs (3'738 ha)	Thick grass ward scattered with sparse shrubs	1-25 specimen/ha	0.5-1.2m
C. Savannah with some regeneration of *Ziziphus* and/or other native species (*Ficus* sp, *Terminalia* spp., …) (454 ha)	Thick grass ward containing small shrubs (30%), trees (40%) and regeneration / undergrowth (30%)	25-400 specimen/ha	0.5-2.5m
D. Savannah with some *Ziziphus* shrubs (**914** ha)	Thick grass ward containing sparse trees (70%) shrubs (30%)	7-35 specimen/ha	0.5-2.5m

Referring to the distinction between tree and shrub, the vegetation referred to as « tree » in the table above have « single central stem or trunk », reason why it is referred to as « tree ». But the minimum height of 10 feet (approximately 3 meters) is not reached. The vegetation on the eligible areas can therefore not be considered as « tree » but as « shrub ».

Neither the methodology AR-ACM0003 nor its tool for “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities“ specifies minimum criteria for what has to be considered as tree and/or shrub for determining carbon stock baseline and for monitoring.

The project only considers biomass of trees with diameter at breast-height (DBH, measured at 1.30 m) of 5 cm or more for baseline determination and monitoring. It thus follows an established and widely used approach for the quantification of above-ground biomass (e.g. Winrock 2012, Standard Operating Procedures for Terrestrial Carbon Measurement). The project boundary (see annex 13a) has been delimited to not include accumulations of trees with DBH ≥ 5cm (see table above, maximum height is 2.5 m). Individual pre-project trees with DBH ≥ 5cm are excluded from monitoring of project carbon stocks (see Monitoring Plan in section 4.3).

Excluding trees/shrubs with DBH < 5 cm from the project boundary is conservative as project biomass of trees/shrubs with DBH < 5 cm (saplings, regrowth) can reasonably be assumed to be higher than shrub biomass in the baseline scenario. Initial biomass at project start can thus be ignored.

16 http://www.fao.org/forestry/tof/en/
17 http://www.ehow.com/facts_5783931_difference-between-tree-shrub.html

Emission sources and associated GHGs

According to the AR-ACM0003 methodology, the following emission sources and GHGs have to be considered in the GHG accounting:

Source	Gas	Included?	Justification/Explanation
Burning of biomass	CO_2	No	CO_2 emissions due to burning of biomass are accounted as a change in carbon stock
	CH_4	Yes	Burning of woody biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology
	N_2O	Yes	Burning of woody biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology

Not applicable to the project activity

As the project activity will neither make use of biomass burning for site preparation nor as part of forest management activities, the sources above are not applicable for the project activity.

Part of the harvested wood might be used as fuel wood outside the project boundary. However, as it will be used to replace fuel wood or charcoal from other sources, it will have no impact on overall CH_4 and/or N_2O emissions. In contrary, using part of the harvest as fuel-wood can reduce the use of wood from unsustainable sources and thereby reduce the degradation of carbon stocks outside the project boundary (positive leakage).

Buffer zones

Two type of buffer zones have been implemented on the project site.

Fire breaks of 6 metres and “water” buffers of 50 metres around the crops in order to avoid water competition between trees and crops.
As well as the rest if the project area, those two types of buffer zones have been delineated and are not included in the area to be reforested under the VCS (they are not included in the total reforestation area of 6'073 ha in the management plan).

The total area of fire breaks in the initial management plan is 361 hectares and of 725 hectares for the buffers around crops.

2.4 Baseline Scenario

To identify and justify the baseline scenario the “Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities” has been applied.

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

Brief project activity description

- Reforestation of a deforested zone of Madagascar in the Sofia Region in the Mampikony District.
- The reforestation will claim for carbon offset (VCS Voluntary Emission Reductions)

Geographic area delimitation:

- Madagascar: too wide area with too many specific soil, meteorological and cultural conditions, etc. It is therefore not suitable as a geographic area.
- Sofia Region : regional area with two agro-ecological areas (D3 and F1, see Map 15 p. 57: Agro-ecological zones), it is therefore not suitable as a geographic delimitation
- Mampikony district : smaller regional area than the region but too few projects take place in this district, it is therefore not suitable as a geographic area.
- Agro-ecological area : area with similar conditions[18] (this zoning is the result of the combination of cultural, climatic, topographical, pedological and pluviometric factors). It is therefore suitable to use this area as the accurate geographic delimitation.

Evidence that the starting date of the project was after 31 December 1999

Start date of the project: February 18th, 2011 (replanting of the pilot site only)
See annexe 1 for proof of evidence (bills for manpower, rent of tractor, etc.).

Evidence that the incentive from the planned sale of the VER was seriously considered in the decision to proceed with the project activity

Since Madagascar has often been stolen from it's precious wood by foreigners, the Malagasy are cautious with foreign project developers. They mostly fear that their lands (and the goods coming from that land) will be taken away from them. Therefore a Cooperative (Avotrala) owned and managed only by the local population has been set up to be a partner in the EcoFormation reforestation project. The Cooperative will own the land and has the rights over the wood products (for their own use, for construction, for sale) as long as the forest is maintained and protected. Therefore, the carbon credits were necessary for EcoFormation to proceed with the project.
To ensure the continued existence of the forest new financial means (apart from wood) had to be found to finance the Cooperative and the EcoFormation foundation so that both organizations can continue their activity.
Avotrala continues to protect and manage the forest which brings more revenues on the long term if it's not cut or burned down (revenues from the wood coming from the forest maintenance and revenues from the selling of the carbon credits).
The revenues from the selling of the VER also enables EcoFormation to initiate new projects in their regions of Madagascar and other countries as well.
For more information on this topic see annexe 11 (financial sheet).

18 See page 23 of report « Madagascar : Analyse de la sécurité alimentaire et de la vulnérabilité » done by World Food Program (http://documents.wfp.org/stellent/groups/public/documents/vam/wfp083809.pdf)

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

Sub-step 1a. Identification of credible land use scenarios to the proposed A/R project activity

Considering the fact that the community of Bekoratsaka, in the Sofia Region is in a remote and very rural area, only agricultural or forest projects are justified. There are some agricultural activities near the project site (rice field) and some pastoral activity on the project site (grazing of loose housing zebus). Before those activities the area was forest but the region has been deforested long ago (see aerial picture from 1949 in section 1.10 of PD).

The credible land use scenarios are as follows:

- Continuation of pre-project land-use which means maintaining the status quo: the land stays unused (apart from occasional grazing of zebus) and remains degraded (and continues to degrade) and non-productive.
- Project scenario which is reforestation of the project area with carbon offset.
- Reforestation of the project in the same way as the EcoFormation project but without VER.
- Commercial reforestation with only one type of tree (for example, precious wood only in order to sell timber, charcoal woods only in order to produce and sell energy, etc.).

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

All the identified options above comply with the laws and regulations (see above section 1.11 “Compliance with Laws, Statutes and Other Regulatory Frameworks” for more details).

STEP 2. Barrier analysis

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

Investment barrier

- No private capital is available due to the risks associated with investments in Madagascar.
- No information is available from the notation agencies such as Standards & Poor or Moodys but the rating of the Global Finance Magazine states ranking from 2010 and Madagascar is at rank 176 on 183 for getting credit (section best countries for doing business[19]). The world bank confirms this fact with their 2011 indicators as Madagascar is ranked 140th out of 183 economies in Doing Business 2011[20].

It is mainly the political instability that is the cause of this lack of investors.

On the next page is the comparison of Madagascar situation with the situation in Switzerland (see the “political stability” bar[21] in Illustration 2).

19 http://www.gfmag.com/gdp-data-country-reports/228-madagascar-gdp-country-report.html#axzz1g2ktyI8t

20 http://rru.worldbank.org/BESnapshots/Madagascar/default.aspx

21 Extract from the WGI website (http://info.worldbank.org/governance/wgi/sc_chart.asp#), data from December 9th 2011.

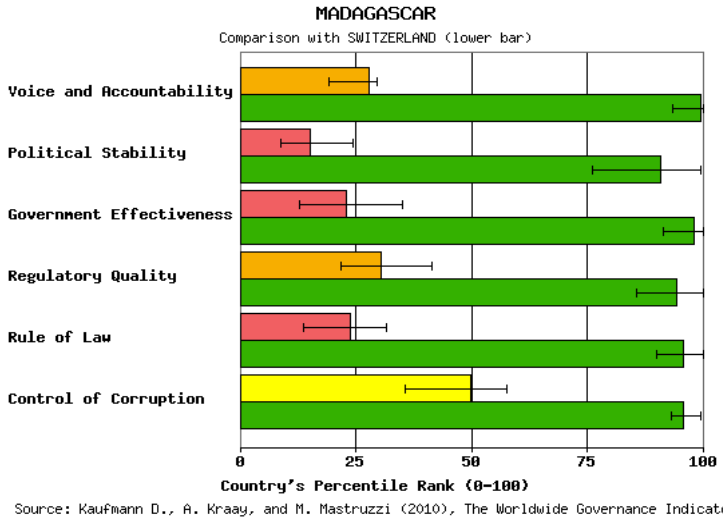


Illustration 2: World Bank Madagascar indicators

This barrier prevents the following alternative land use scenario :

- Reforestation of the project in the same way as the EcoFormation project but without VER.

Barriers due to local conditions

Slashing-and-burning is common practice for the Madagascan people[22]. It's common use to set fire to the forests first to produce charcoal and when the land is cleaned of forest for cultural and pastoral reasons (zebus grazing). There is a strong belief in Madagascar that green grass is more nutritive for the cattle than dried grass, it is therefore very hard to stop the local populations setting fire to the land.

Incentives must then be given to the local communities so that they have more interest in replanting and taking care of the forest than burning it down. Those incentives have been determined together with the local population through presentations and discussions (for more information on this topic see "Stakeholder comment" section).

News sources of income, such as an interest in the selling of the carbon credits, is an argument that the local communities are interested in and which prevents from the slashing-and-burning activities.

This barrier prevents the following alternative land use scenario :

- Commercial reforestation with only one type of tree (for example, precious wood only in order to sell timber, charcoal woods only in order to produce and sell energy, etc.).
- Reforestation of the project in the same way as the EcoFormation project but without VER.

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

Elimination of the following land use scenarios prevented by one or more of the identified barriers:

- Commercial reforestation with only one type of tree (for example, precious wood only in order to sell timber, charcoal woods only in order to produce and sell energy, etc.).
- Reforestation of the project in the same way as the EcoFormation project but without VER.

22 http://www.wwf.mg/ourwork/climatechange/howwework/adaptation_in_the_agriculture_and_husbandry_sector/ (WWF article stating the slash-and-burn problem in Madagascar and the priority actions in climate change adaptation measures such as reforestation)

List of the land use scenarios that are not prevented by any barriers:

- Continuation of pre-project land-use which means maintaining the status quo: the land stays unused (apart from occasional grazing of zebus) and remains degraded (and continues to degrade) and non-productive.
- Project scenario which is reforestation of the project area with carbon offset.

Sub-step 2c. Determination of baseline scenario

Following the steps described in the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activity", we will determine the baseline scenario.

Is forestation without being registered as an A/R CDM project activity included in the list of land use scenarios that are not prevented by any barrier?

No.

→ *If no, then: Does the list contain only one land use scenario?*

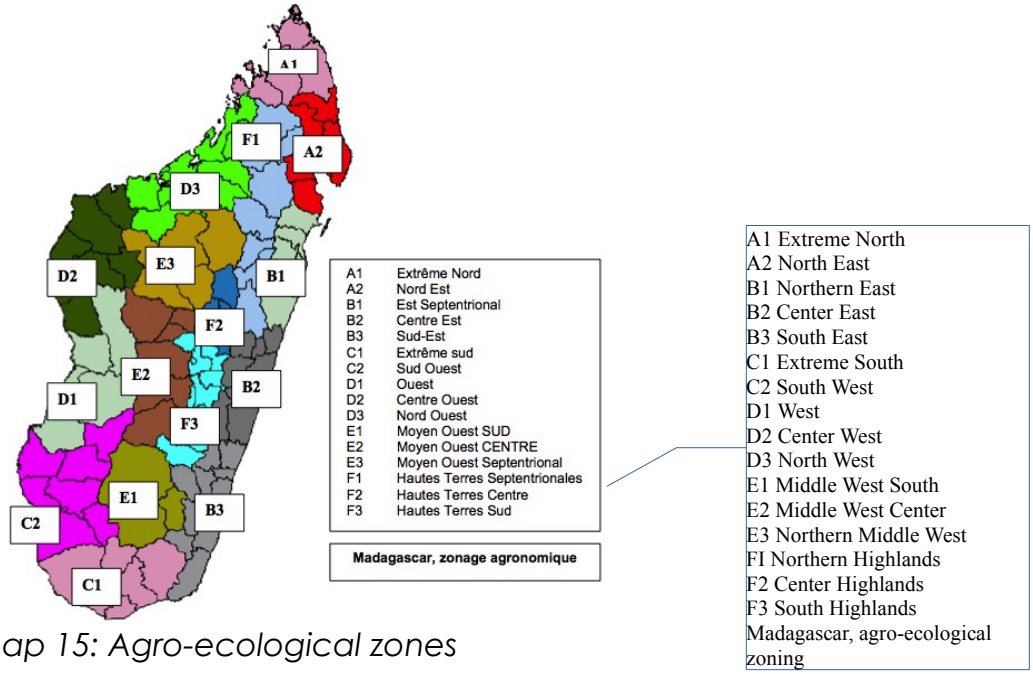
Apart from status quo, yes the list contains only one land use scenario.

→ *If yes, then the remaining land use is the baseline scenario. Continue with Step 4: Common practice test*

STEP 4. Common practice analysis

To undertake the common practice analysis, similar forestation activities must be identified.
Similar forestation activities are defined as that which are of similar scale, take place in a comparable environment, inter alia, with respect to the regulatory framework and are undertaken in the relevant geographic area.

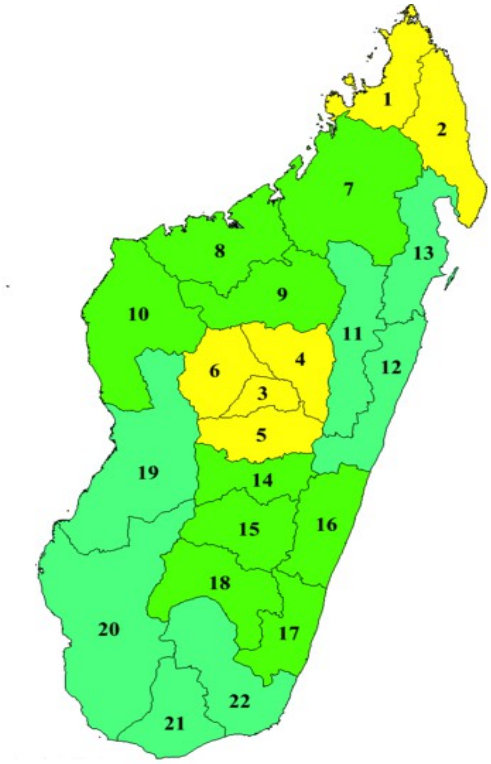
Project scale: 6'073 ha
Comparable environment: the same agro-ecological area[23] has been chosen to select the similar projects, the relevant agro-ecological area is D3 (North-West).



Map 15: Agro-ecological zones

23 World Food Program (http://documents.wfp.org/stellent/groups/public/documents/vam/wfp083809.pdf)

Relevant geographic area: The relevant area is the Sofia Region (7)[24], which includes the agronomic zones D3 (North-West) and F1 (Northern highlands)



Diana (1)
Sava (2)
Itasy (3)
Analamanga (4)
Vakinankaratra(5)
Bongolava (6)
Sofia (7)
Boeny (8)
Betsiboka (9)
Melaky (10)
Alaotra-Mangoro (11)
Atsinanana (12)
Analanjirofo (13)
Amoron'i Mania (14)
Haute Matsiatra (15)
Vatovavy-Fotovinany (16)
Atsimo-Atsinanana(17)
Ihorombe (18)
Menabe (19)
Atsimo-Andrefana (20)
Androy (21)
Anosy (22)

Map 16: Regions of Madagascar

A few projects have taken place in the sixties, they were initiated by regional Authorities (of Environment and Forest) but since the timeframe limits the considerations to any period since 31 December 1989, those projects are not relevant.
Below, you will find the similar reforestation projects taking place in the same agro-ecological area (see definition of geographic area above) as the EcoFormation's project.

Similar Projects

Mada Woodlands
The first project is called Mada Woodlands[25]. This project is located in the rural community of Malakialina in the Mampikony District (which stands about 15 Km South-Est of the Training Center of EcoFormation).

It is a reforestation project that officially started the 14th of February 2009 on an area of 20'000 ha.
The species planted on the project site are *Eucalyptus camaldulensis, Acacia auriculiformis, Tectona grandis, Khaya senegalensis.*

The financing comes from norwegian investors but it is not really clear which investors. However, we strongly suspect that the main investor is a company called Os Skog[26] because the Managing Director of the company and Mada Woodlands seem to be the same person, Øystein Hansen.

Below are the main points of Mada Woodlands' goals as stated on their website (under “Policy”):

- To do business on foresting while simultaneously reestablishing the rainforest.

24 Wikipedia map (http://fr.wikipedia.org/wiki/Madagascar)
25 http://www.madawoodlands.com/english.html
26 http://www.osskog.no/more.html

- Therefore, Mada Woodlands is committed to plant, grow and cut forest on a renewable and sustainable basis.
- In exchange for the right to use the land for this reforestation project, Mada Woodlands will transfer technology and competences to the local population in order to combine rational business with development of the Malagasy society.

Since the suspected investors of Mada Woodlands are specialized in the following services (information taken from their website):

- Purchasing and sale of timber[27]
- Consultation on forest management
- Planting and care of forest plants
- Operational planning in accordance with the management standards (e.g. ISO 14001)
- Trimming and cutting of trees under power lines
- Manual and machine logging
- Forwarding
- Chipping
- Transportation of timber
- Storage on wharves for shipping

Apparently Mada Woodlands is also seeking for carbon credits with their reforestation project in Mampikony District[28] but this information is not clear.

The essential distinctions between Mada Woodlands and EcoFormation's project are explained below.
The political stability of Madagascar has been worsened drastically in January 2009 when the President Ravalomanana has been overthrown by the actual President of Transition Authority (Haute Autorité de Transition), the President Rajoelina.
Mada Woodlands official start date was February 14th 2009 just a few days after the political overthrow. The investors had given their consent to the project before end of January 2009 (choice and acquisition of land, setting up of nurseries, etc.). It also must be underlined that the investor's Managing Director is apparently also the Managing Director of Mada Woodlands.
The situation for EcoFormation was completely different since the project started in February 2010 and was undertaken by a non-for-profit foundation. At this time (and it is still the case today), it was impossible to find an investor for the project because of this political instability (see Illustration 2 « World Bank Madagascar indicators » above). As an illustration, even the swiss government through the Development and Cooperation Department[29] has suspended it's activities in the country since the 2009 overthrow.
It was then imperative for the project to be strongly supported by the local population (hence the Avotrala Cooperative and the 60% of the carbon revenues as well as the 100% rights over wood products) and also to be interesting for investors (hence the carbon revenues through the VCS standard). Which is another distinction between MadaWoodlands and EcoFormation since as of today, MadaWoodlands has stoped it's activities after suffering a massive criminal fire in their plantation which is not the case for EcoFormation's project. The slashing-and-burning is therfore a barrier to do purely commercial reforestation since the local population doesn't recognize the benefits they can have from such projects and therefore tend to slash-and-burn those areas.

27 http://www.osskog.no/About.html
28 http://www.cci.mg/index.php?p=actualite&id=10&id_det=1872
29 Direction du Développement et de la Coopération (http://www.ddc.admin.ch/)

Imperial Tobacco Project[30]

SOCTAM, entity of Imperial Tobacco Group has set the rule that each farmer producing tobacco has to replant eucalyptus that is used to dry the leaves (flue-cured tobacco). The ratio is 2500 square meters per hectare of tobacco field.
Therefore, a reforestation project initiated by Imperial Tobacco is taking place between Port Bergé and Antsohihy.
The plantation is of *Eucalyptus camaldulensis* only and the wood is used to produce flue-cured tobacco.
The project doesn't seek for carbon revenues and is in the reforestation category but the two projects can not be considered as similar since :

- Only one type of tree is replanted
- The wood is used internally for the treatment of the tobacco and not as a source of revenue for local populations.
- The ROI scheme is not at all similar. Imperial Tobacco invests in the reforestation in order to produce tobacco whereas EcoFormation's reforestation activity is to reestablish the original forest and biodiversity of the reforestation area.

Conclusion
EcoFormation's project can not be considered similar to the other two reforestation projects of the same agro-ecological zone. Therefore, the project activity is additional.

2.5 Additionality

See demonstration part 2.4 above.

2.6 Methodology Deviations

N/A

30 For more information about this entity see the following websites :
http://www.imperial-tobacco.com/index.asp?page=315
http://www.inter-reseaux.org/IMG/pdf_115_Filiere_Tabac.pdf

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

Baseline stratification

Since the project area is homogenous and the fact that the methodology states in paragraph 12 that "For baseline net GHG removals by sinks, it is usually sufficient to stratify the area according to major vegetation types and their crown cover and/or land use types", no specific stratification has been made for the baseline scenario.

Baseline net GHG removals by sinks

As stated in the AR-ACM0003 methodology, the baseline net GHG removals by sinks is the sum of the changes in carbon stocks in the selected carbon pools within the project boundary that would have occurred in the absence of the A/R CDM project activity.

As the land is degraded and further degrading (see 2.2 and satellite images in 1.10), changes in carbon stock of above-ground and below-ground biomass of tree and non-tree vegetation may be conservatively assumed to be zero for all strata in the baseline scenario. Following the tool for the "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities", ΔB_{FOREST} can be assumed to be zero as the land is subject to regular slash-and-burn practices in the baseline. Thus the tool's equation 28, for the calculation of the baseline carbon stock changes in tree biomass, resolves to zero. Soil, deadwood and litter carbon pools have been conservatively excluded from project boundary (see section 2.3)

$\Delta C_{BSL,t}$ = 0 tCO_2e

$$\Delta C_{BSL,t} = \Delta C_{TREE\_BSL,t} + \Delta C_{SHRUB\_BSL,t} + \Delta C_{DW\_BSL,t} + \Delta C_{LI\_BSL,t} \quad \text{Equation (1)}$$

Where:

$\Delta C_{BSL,t}$	=	Baseline net GHG removals by sinks in year *t*; t CO_2-e
$\Delta C_{TREE\_BSL,t}$	=	Change in carbon stock in baseline tree biomass within the project boundary in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e
$\Delta C_{SHRUB\_BSL,t}$	=	Change in carbon stock in baseline shrub biomass within the project boundary, in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e
$\Delta C_{DW\_BSL,t}$	=	Change in carbon stock in baseline dead wood biomass within the project boundary, in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e
$\Delta C_{LI\_BSL,t}$	=	Change in carbon stock in baseline litter biomass within the project boundary, in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e

The tool requires that initial tree carbon stocks are deducted from project carbon stocks at first verification:

34. For the first verification, the variable C_{TREE,t_1} in Equation (14) is assigned the value of carbon stock in the tree biomass at the start of the A/R CDM project activity, that is: $C_{TREE,t_1} = C_{TREE\_BSL}$ for the first verification, where t_1 = 0 and t_2 = year of the first verification.

As project boundaries have been delimited to not include any trees with DBH ≥ 5cm, initial tree biomass is zero (individual pre-project trees / shrubs with DBH > 5 cm are excluded from monitoring of project carbon stocks, see Monitoring Plan in section 4.3). Subtraction of pre-project shrub biomass is not required by the tool and does not impact the accounting as the project will not account for biomass of plants with DBH < 5 cm.

3.2 Actual net GHG removals by sinks

Project stratification

As stated in the AR-ACM0003 methodology, the stratification for ex ante estimations shall be based on the project planting/management plan. It has been done and stratification has been done considering year of plantation and tree species, according to the following table:

	Eucalyptus camaldulensis	Tectona grandis	Khaya senegalensis	Mix Dalberghia + Terminalia mantaly + Khaya senegalensis
2011	**E11** (73 ha)			
2012	**E12** (100 ha)	**T12** (500 ha)		
2013	**E13** (50 ha)	**T13** (50 ha)		
2014	**E14** (96 ha)	**T14** (130 ha)	**K14** (500 ha)	**D14** (274 ha)
2015	**E15** (95 ha)	**T15** (131 ha)	**K15** (700 ha)	**D15** (474 ha)
2016	**E16** (95 ha)	**T16** (131 ha)	**K16** (745 ha)	**D16** (429 ha)
2017	**E17** (95 ha)	**T17** (131 ha)	**K17** (800 ha)	**D17** (474 ha)

Project sequestration calculation

The actual net GHG removals by sinks has been estimated as follows:

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t} \qquad \text{Equation (2)}$$

Where:

$\Delta C_{ACTUAL,t}$ = Actual net GHG removals by sinks, in year *t*; t CO_2-e

$\Delta C_{P,t}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e

$GHG_{E,t}$ = Increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year *t*, as estimated in the tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; t CO_2-e

No sources have been identified where increases of GHG emissions have to be expected due to the project activity. According to the methodology, the only source of non-CO_2 emissions to be considered is the burning of woody biomass. As no biomass will be burned neither for site preparation no for forest management, this source has been excluded from project boundary (see 2.3). Consequently

$GHG_{E,t}$ = 0 tCO_2e

As changes in the soil, deadwood and litter carbon pools are conservatively excluded from the project boundary, and the threshold for biomass accounting is set to DBH >= 5cm (see 2.3), equation (2) and (3) of the methodology resolve to **$\Delta C_{ACTUAL,t}$ = $\Delta C_{TREE\_PROJ,t}$**, which is calculated using the

methodological tool for “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”

Ex-ante estimation of changes in carbon stocks have been done using the Stock Change Method and the BEF technique. The following formula and parameters have been used. The calculations can be found in the Excel file in annexe 12 delivered with this PD.

First, for each planting and management regime, the above- and below-ground biomass is estimated by applying default biomass expansion factors and root-shoot ratios to the volume tables of the management plan.

$$B_{TREE,j,p,i,t} = V_{TREE,j,p,i,t} \times D_j \times BEF_{2,j} \times (1 + R_j) \qquad \text{Equation (1)}$$

Where:

$B_{TREE,j,p,i,t}$	=	Biomass of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t dry matter (d.m.)
$V_{TREE,j,p,i,t}$	=	Stem volume of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*, estimated by using the tree dimension(s) as entry data into a volume table or volume equation; m^3
D_j	=	Density (overbark) of tree species *j*; t d.m. m^{-3}
$BEF_{2,j}$	=	Biomass expansion factor for conversion of stem biomass to above-ground tree biomass, for tree species *j*; dimensionless
R_j	=	Root-shoot ratio for tree species *j*; dimensionless

With $D_j = D_{wood,j} * (1 - \%Bark_{volume}) + D_{bark,j} * \%Bark_{volume}$

Parameters:

- **$BEF_{2,j}$ = 3.4 (dimensionless)**
  (Source: IPCC GPG-LULUCF 2003, table 3.A.1.10 , BEF2, over-bark, for broadleaved species)
- **$D_{wood,\ Eucalyptus\ c.}$ = 0.82 t d.m. m^{-3}**
  (Source: Cirad 2012, Atlas des bois de Madagascar, see calculation in Annexe 12)
- **$D_{wood,\ Tectona\ g.}$ = 0.60 t d.m. m^{-3}**
  (Source: Zanne et al. 2009, DRYAD Global Wood Database, average density of Tectona g. samples in Africa, n=33)
- **$D_{wood,\ Khaya\ s.}$ = 0.63 t d.m. m^{-3}**
  (Source: Zanne et al. 2009, DRYAD Global Wood Database)
- **$D_{wood,\ Dalbergia\ t.}$ = 0.82 t d.m. m^{-3}**
  (Source: Zanne et al. 2009, DRYAD Global Wood Database, no values available for endemic species D. Trichocarpa. Average density of Dalbergia spp. samples in Madagascar used, n=8)
- **$D_{wood,\ Terminjalia\ m.}$ = 0.57 t d.m. m^{-3}**
  (Source: Zanne et al. 2009, DRYAD Global Wood Database, average density of Terminalia m. samples in Madagascar, n=5)
- **$\%Bark_{volume}$ = 15% (dimensionless)**
  (Source: default value AR-ACM0003)
- **$D_{bark,j}$ = 0.40 t d.m. m^{-3}**
  (Source: default value AR-ACM0003)
- **R_j = exp(-1.085 + 0.9256 * ln(A))/A (dimensionless)**
  with A being the above-ground biomass. No further factor for increased root-shoot ratio after

coppice regeneration in Eucalyptus c. plantations is considered, which is conservative.
(Source: default value AR-ACM0003, IPCC GPG-LULUCF 2003, table 4.A.4)

Biomass stocks were calculated for each strata separately (see strata definition in the beginning of this section), and changes in carbon stocks between management interventions were averaged over the period to get an estimation of biomass stocks for each year in the crediting period. Based on these values, total tree biomass within the project boundary was estimated as follows:

31. Total tree biomass within the project boundary at a given point of time in year *t* is estimated as follows:

$$B_{TREE,t} = A \times b_{TREE,t} \qquad \text{Equation (12)}$$

Where:

$B_{TREE,t}$	=	Total tree biomass within the project boundary at a given point of time in year *t*; t d.m.
A	=	Sum of areas of the biomass estimation strata within the project boundary; ha
$b_{TREE,t}$	=	Mean tree biomass per hectare within the project boundary at a given point of time in year *t*; t d.m. ha^{-1}
t	=	*1, 2, 3, …* years counted from the start of the A/R CDM project activity

The equivalents in tCO_2e were calculated using the following formula:

$$C_{TREE,t} = \frac{44}{12} \times B_{TREE,t} \times CF_{TREE} \qquad \text{Equation (13)}$$

with a default carbon fraction of tree biomass CF_{TREE} = 0.47 t C $(t\ d.m.)^{-1}$

Annual changes in carbon stocks have been calculated by using $\Delta C_{TREE,t} = C_{TREE,t} - C_{TREE,t-1}$.

As the project includes harvesting activities, the project's overall carbon sequestration is calculated based on the average Long-Term Average GHG Benefit, as defined by the “VCS AFOLU Requirements” and further specified by the “VCS AFOLU Guidance: Example for Calculating the Long-Term Average Carbon Stock for ARR Projects with Harvesting”.

The overall Long-Term Average Carbon Stock of the project has been calculated over a period of 90 years (maximum crediting period if renewed twice) and is 2'883'562 tCO_2e. Only CO2 sequestrations up to this level are considered as GHG removals.

3.3 Leakage

Leakage (AR-ACM0003, equation 4) is insignificant and does not have to be considered. See part 1.13: Leakage management

3.4 Summary of GHG Emission Reductions and Removals

18. The net anthropogenic GHG removals by sinks shall be calculated as follows:

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t \qquad \text{Equation (5)}$$

Where:

$\Delta C_{AR-CDM,t}$ = Net anthropogenic GHG removals by sinks, in year *t*; t CO_2-e

$\Delta C_{ACTUAL,t}$ = Actual net GHG removals by sinks, in year *t*; t CO_2-e

$\Delta C_{BSL,t}$ = Baseline net GHG removals by sinks, in year *t*; t CO_2-e

LK_t = GHG emissions due to leakage, in year *t*; t CO_2-e

With insignificant leakage and decreasing baseline carbon stocks that are conservatively ignored, the net anthropogenic emission reductions and removals are determined by changes in project biomass carbon stocks: $\Delta C_{AR,t} = \Delta C_{TREE,t}$

Ex-ante calculation (estimate) of baseline emissions/removals, project emissions/removals (using the VCS long-term average GHG benefit concept), leakage emissions and net emission reductions and removals over the crediting period (30 years).

Years	Estimated baseline emissions or removals (tCO2e)	Estimated project emissions or removals (tCO2e)	Estimated leakage emissions (tCO2e)	Estimated net GHG emission reductions or removals (tCO2e)
2012	0	2983	0	2983
2013	0	23695	0	23695
2014	0	27401	0	27401
2015	0	60648	0	60648
2016	0	106816	0	106816
2017	0	152978	0	152978
2018	0	157486	0	157486
2019	0	194128	0	194128
2020	0	191977	0	191977
2021	0	204107	0	204107
2022	0	214411	0	214411
2023	0	238328	0	238328
2024	0	273364	0	273364
2025	0	226870	0	226870
2026	0	264027	0	264027
2027	0	289393	0	289393
2028	0	254951	0	254951
2029	0	0	0	0
...	0	0	0	0
2041	0	0	0	0
Total	0	2883562	0	2883562

Monitoring and verification for issuance of carbon credits will be done in an interval of 5 years. For issuance of credits under the Verified Carbon Standard VCS, part of the removals will not be issued as carbon credits, but remain in the VCS buffer, following the "VCS Registration and Issuance Process" and the project risk assessment following the "VCS AFOLU Non-Permanence Tool". The risk rating is used for buffer buildup is 29.5% (see Annex 28 AFOLU non-permanence risk assessment). The buffer release is 15% from the second verification onwards (see VCS Registration and Issuance Process). The result looks like this (details are provided in Annex 12 Sequestration calculations):

Years	Verified emission reductions (tCO2e)	VCS Buffer (tCO2e)	VCS Buffer release (tCO2e)	Issued carbon credits (tCO2e)
2012	–	–	–	–
2013	–	–	–	–
2014	–	–	–	–
2015	–	–	–	–
2016	**221543**	**65355**	**0**	**156187**
2017	–	–	–	–
2018	–	–	–	–
2019	–	–	–	–
2020	–	–	–	–
2021	**900676**	**265700**	**49658**	**684635**
2022	–	–	–	–
2023	–	–	–	–
2024	–	–	–	–
2025	–	–	–	–
2026	**1216999**	**359015**	**96062**	**954046**
2027	–	–	–	–
2028	–	–	–	–
2029	–	–	–	–
2030	–	–	–	–
2031	**544344**	**160582**	**105740**	**489502**
2032	–	–	–	–
2033	–	–	–	–
2034	–	–	–	–
2035	–	–	–	–
2036	**0**	**0**	**89879**	**89879**
2037	–	–	–	–
2038	–	–	–	–
2039	–	–	–	–
2040	–	–	–	–
2041	**0**	**0**	**76397**	**76397**
Total	**2883562**	**850651**	**417735**	**2450646**

4 MONITORING

Introduction

The ex post monitoring of the project site will be done accordingly to a methodology developed in Madagascar and accepted by the Environment, Forest and Tourism Ministry[31] and which takes local specificity. This « *Manuel d'Inventaire Forestier* » is part of a set of documents governing the sustainable lay out and management of forest resources. This standard therefore corresponds to the requirements stated in the monitoring part of the AR-ACM0003 methodology.

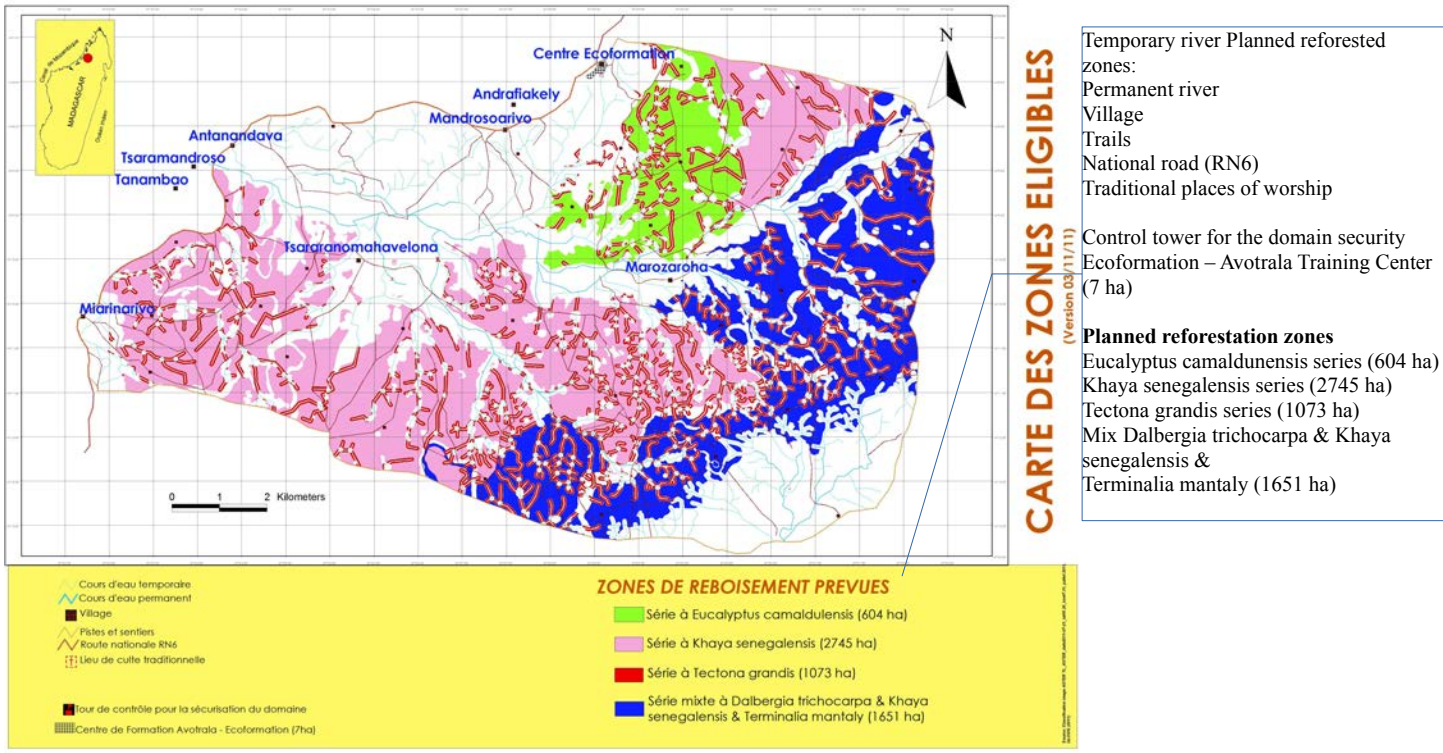
The monitoring plan follows the stock-change method, using an allometric equation approach.

Sampling design and stratification

The stratification to be used for ex-post monitoring is defined in the present document under the forms of species and mix of species of homogenous site. The strata are as follows :

- Mix *Dalbergia t. & Khaya s. & Terminalia m.*
- *Eucalyptus c.* pur
- *Tectonia g.* Pur
- *Khaya s.* Pur

The map below illustrates the distribution of the strata on the project site :



Map 17: Preliminary project site stratification

The final stratification to be used for monitoring will be depend on the actual implementation of the activities and thus be reviewed accordingly before each monitoring event.

31 République de Madagascar, Ministère de l'Environnement, des Forêts et du Tourisme (2009) : Manuel d'inventaire forestier. En collaboration avec USAID

Precision requirements

Considering the eligible reforestation area (6073 ha), it is obvious that a statistical inventory by samples will be done. For practical implementation reasons, permanent sample plots evenly distributed on equidistant trails will be installed With number of plots varying from one strata to another since they don't have identical surfaces.

According to the methodology, the Maximum Relative Error, i.e. the uncertainty of mean change in tree biomass, has to be less or equal 10% at a 90% confidence-level. Otherwise a deduction of estimated change in carbon stocks has to be accepted. Following the tool "Calculation of the number of sample plots for measurements within A/R CDM project activities", the number of required sample plots for achieving this precision is calculated using the formula

$$n = \left(\frac{t_{VAL}}{E}\right)^2 * \left(\sum_i w_i * s_i\right)^2 \qquad (2)$$

where:

n	Number of sample plots required for estimation of biomass stocks within the project boundary; dimensionless
t_{VAL}	Two-sided Student's *t*-value at infinite degrees of freedom for the required confidence level; dimensionless
E	Acceptable margin of error (i.e. one-half the confidence interval) in estimation of biomass stock within the project boundary; t d.m. (or t d.m. ha^{-1}), i.e. in the units used for s_i
w_i	Relative weight of the area of stratum *i* (i.e. the area of the stratum *i* divided by the project area); dimensionless
s_i	Estimated standard deviation of biomass stock in stratum *i*; t d.m. (or t d.m. ha^{-1})
i	*1, 2, 3, …* biomass stock estimation strata within the project boundary

with parameters:

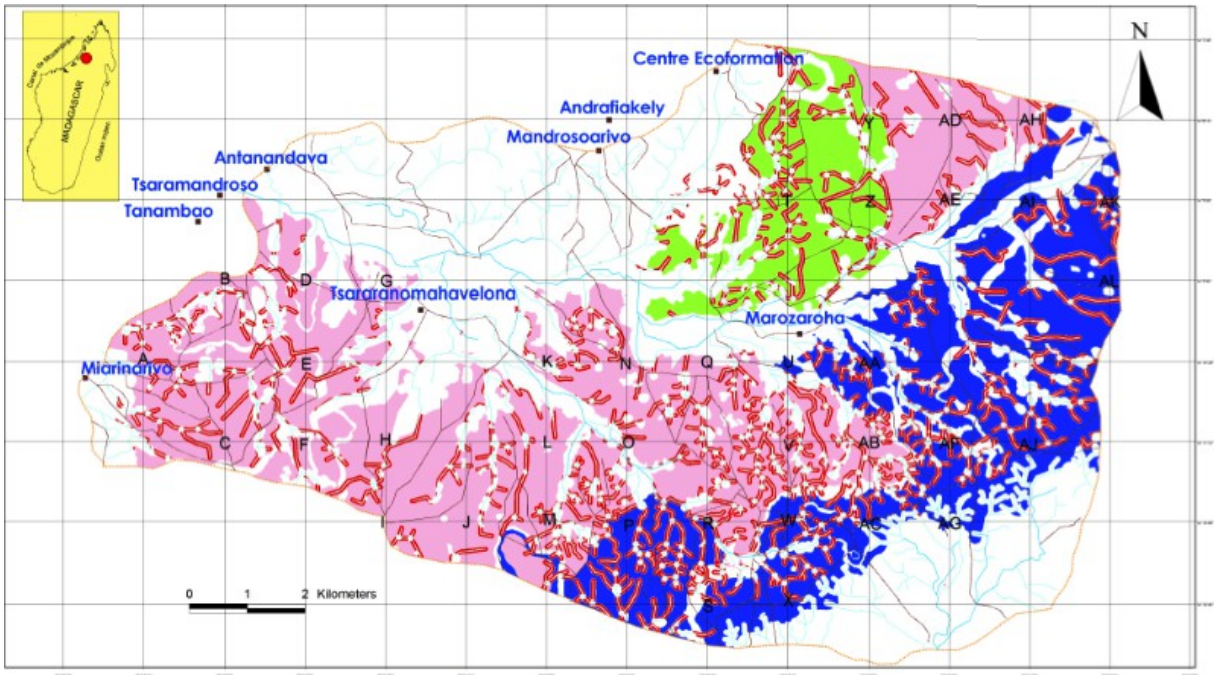
- **t_{VAL} = 1.645** (value at infinite degrees of freedom and 90% confidence level)
  (Source: Calculation of the number of sample plots for measurements within A/R CDM project activities)
- **E = 0.1** (acceptable error of 10%)
  (Source: Calculation of the number of sample plots for measurements within A/R CDM project activities)
- **s = 0.37** (coefficient of variation for artificial stands)
  (Source: According to the "Manuel d'inventaire forestier", Annexe 14, the Cv of artificial stands can vary between 20% and 50%. An intermediate value of 37% has been chosen for ex-ante estimation of required sample size)

Ex-ante estimation of sample plots required for obtaining a precision of +/- 10% at a 90% confidence level : n = 38

Samples are allocated to the different strates according their size:

• Mix *Dalbergia t. & Khaya s. & Terminalia m.*	(1'651 ha, 27.2%)	N = 10
• *Eucalyptus c.* only	(604 ha, 10.0%)	N = 4
• *Tectonia g.* only	(1'073 ha, 17.7%)	N = 7
• *Khaya s.* only	(2'745 ha, 45.2%)	N = 17

Plots will be determined according to the manual inventory in accordance with the number of plots per strata, and distributing them as follows:



Map 18: Map of the initial management plan with indicative sample plots

The exact localisation of the monitoring plots depends on effective implementation of the project (exact surfaces and localisation of plantations) and will be determined and recorded with GPS prior to the first verification. The center of the plots will be marked with a metal bar during first monitoring and the same plots will be revisited in subsequent monitoring events.

In case the 38 samples will not be sufficient and final sampling uncertainty of biomass carbon stocks remains higher than 10% at 90% confidence-level, additional temporary sample plots will be installed, using the observed variance as a measure to determine the number of additional plots required to reduce uncertainty below 10%.

Conservative approach and uncertainties

The following measures will be taken to assure a conservative assessment of biomass carbon stock changes, taking into account the « Guidelines on conservative choice and application of default data in estimation of the net anthropogenic GHG removals by sinks »:

Delineation of the project boundary:

- The boundary within which reforestation activities are accounted for carbon (6073 ha) is rather limited, excluding any project areas stocked with trees. Nevertheless the project will conduct activities outside the carbon project boundary that sequester additional GHG, but for which no carbon credits are claimed: Reforestation of another 1000 ha, establishing agroforestry systems on 1000 ha and restoration of degraded forests on about 800 ha (see Management Plan in Annex 13). A pilot site of 101 ha has already been reforested in 2010/11 with Eucalyptus to demonstrate the feasibility of the concept (mobilization of local population). This pilot plantation is not considered in the carbon project.

Choice of carbon pools and baseline change in carbon stocks:

- Baseline changes in biomass carbon stocks are ignored, although stocks will further decrease due to an ongoing degradation process caused by regular fires, grazing and fuel-wood collection.
- Soil organic carbon, deadwood and litter carbon pools are excluded from the project boundary, although they can reasonably be expected to increase, together with the biomass carbon pool, in the project case and to further decrease in the baseline case.

Default values:

- Wherever available, default values provided by the methodology and its tools are used. All other default data used are published in scientific literature or official documents and apply to conditions that are similar to the project (same ecological zone, same species). In case species-specific information is not available (e.g. wood-density of D. Trichocarpa), values specific to the genus in the same ecological conditions are used.

4.1 Data and Parameters to be obtained from existing sources

The following parameters of the methodology AR-ACM0003 and its tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" are not applicable to the stock-based approach and allometric equation technique chosen for ex-post monitoring of biomass carbon stock changes in vegetation with DBH ≥ 5cm and are thus not considered in the monitoring plan:

$\mathbf{BEF}_{2,j}$	Biomass expansion factor fore conversion of stem biomass to above-ground biomass for tree species of group of species j
$\mathbf{BDR}_{SF}$	Ratio of biomass per unit area in land having a shrub crown cover of 1.0 and default above-ground biomass content in forest in the region/country where the A/R CDM project is located
$\mathbf{B}_{FOREST}$	Default above-ground biomass content in forest in the region/country where the A/R CDM project is located
$\Delta\mathbf{B}_{FOREST}$	Default average annual increment in above-ground biomass in forest in the region/country where the A/R CDM project is located
$\mathbf{D}_j$	Density (overbark) of tree stem for tree species j
$\mathbf{R}_S$	Root-shoot ration for shrubs

The following parameters will be used for monitoring of the GHG removals:

Data Unit / Parameter:	$\mathbf{R}_j$
Data unit:	Dimensionless
Description:	Root-shoot ratio for tree species *j*
Source of data:	The value of Rj is calculated as R = exp[-1.085+0.9256*ln(A)]/A, where A is above-ground biomass content (t d.m. ha -1) [Table 4.A.4 of IPCC GPG-LULUCF 2003]
Measurement procedure (if any):	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	This Data/Parameter is used in Equations (1) and (2)

4.2 Data and Parameters to be obtained from measurement

The following parameters of the methodology AR-ACM0003 and its tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" are not applicable to the stock-based approach and allometric equation technique chosen for ex-post monitoring of biomass carbon stock changes in vegetation with DBH ≥ 5cm and are thus excluded from the monitoring plan:

$\mathbf{A}_{SHRUB,i,t}$	Area of shrub biomass stratum i at a given point of time in year t
$\mathbf{CC}_{SHRUB,i,t}$	Crown cover of shrubs in shrub biomass stratum i at a given point of time in year t
$\mathbf{CC}_{TREE\_BSL,i}$	Crown cover of trees in the baseline, in baseline stratum i, expressed as fraction
$\mathbf{V}_{TREE,j,p,i,t}$	Stem volume of trees of species j in sample plot p of stratum i at a point of time in year t calculated using a volume table or volume equation

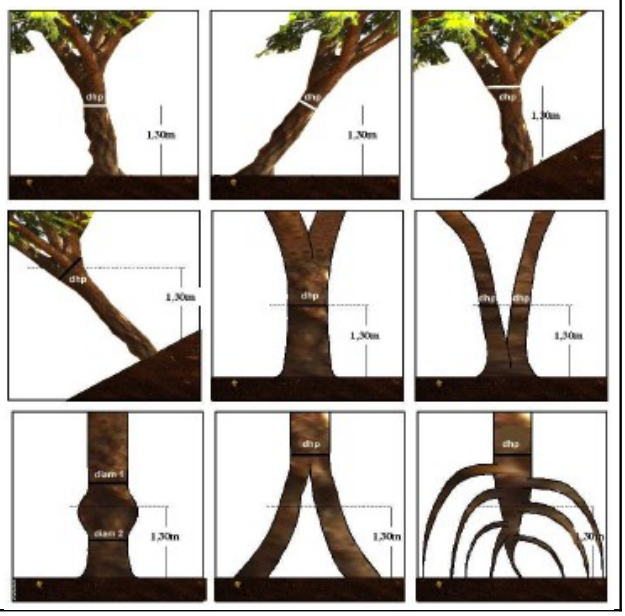
The following parameters will be used for monitoring of the GHG removals:

Data / Parameter:	A_i
Data unit:	ha
Description:	Area of stratum i (Comment: the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" lacks a description of this parameter!)
Source of data:	Field measurement
Measurement procedures (if any):	Boundaries of planted areas are registered with GPS and imported into GIS software where additional attributes are added (date of plantation, species and plantation densities), where surfaces are calculated using function implemented in the GIS and where polygons belonging to the same stratum are merged.
Frequency of monitoring/recording	The surfaces of strata will be continuously updated based on plantation activites and silvicultural interventions and relevant attributes (date and type of intervention) will be added to the GIS vector layer.
QA/QC procedures to be applied:	Before each verification, the delimitation of 10% of the parcels will be cross-checked in the field by forest engineers from the project team and from Savaivo
Any comment	The areas of the strata A_j will be used to determine to determine the effective project area $A = \sum A_j$ (used in equation 12) and to determine the weight of each strata $w_j = A_j/A$ (used in equation 9 and 10 and for determining the number of sample plots per stratum). The registered boundaries of the strata will be used for determining the exact location of the sampling plots.

Data / Parameter:	$A_{p,i}$
Data unit:	ha
Description:	Area of sample p in stratum *i*
Source of data:	Field measurement
Measurement procedures (if any):	The measurement method is done by sampling according to the monitoring plan, i.e. fixed surface plots with a radius between 4 – 18 m, depending on the age of the plantation (see management plan, table 16). The radius is chosen to cover between 12 and 20 trees per plot. It is measured with a cord or a distance meter (laser, vertex, ...). The corresponding plot area is calculated with the formula A = pi * r^2
Frequency of monitoring/recording:	During each monitoring event, i.e. every five year since the year of initial verification.
QA/QC procedures to be applied:	10% of all plots will be cross-checked by forest engineers from the project team and Savaivo
Any comment:	The center of the sample plot is registered with GPS and marked on the project map. For permanent sample plots (n=38) the center of the plot is marked with a metal pole. This Data/Parameter is used in Equations (6) and (18)

Data / Parameter:	$f_j(x1_{p,i,t}, x2_{p,i,t}, x3_{p,i,t}, ...)$
Data unit:	t d.m.
Description:	Function relating measured tree dimensions (x1, x2, x3, ...) to above-ground biomass
Source of data:	Either a) scientifically published and peer-reviewed allometric equations, applicable to the project area (ecological conditions, species / genus) and used by other project entities in the region or national authorities; or b) allometric equations developed by the project on a minimum of 30 sample trees and R^2 of 0.85 (see tool for "Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities")
Value applied	At the time of writing this PDD, the most appropriate allometric equation available is those of Chave et al. (2005) for moist forests, which takes into account tree DBH, height and wood density (see Vieilledent et al., 2012). Moist forest stands: $\langle AGB \rangle_{est} = \exp(-2.977 + \ln(\rho D^2 H)) \equiv 0.0509 \times \rho D^2 H$

	As these are the three most determinant factors for aboveground tree biomass, they will probably be used by any improved future allometric equation as well and will therefore be included in the monitoring plan.
Measurement procedures (if any):	Screening scientific progress on this issue and use of allometric equations in similar projects / national authorities. In case own equations will be developed, they have to follow scientifically proven methods and procedures (see for instance Vieilledent et al 2012).
Any comment:	As tree diameter, height and wood density are highly determinant for the biomass, independent of species and ecosystems, the trend goes towards generalized allometric equations, applicable to all ecosystems and species.

Data / Parameter:	***x1: DBH***
Data unit:	cm
Description:	Tree diameter at breast-height (1.30m) Parameter required by the allometric equation
Source of data:	Field measurement.
Measurement procedures (if any):	The DBH measure is done according to the "Manuel d'inventaire forestier (2009)"p. 16 (see annexe 14), using standard inventory instruments such as diameter tapes or forest callipers. The precision of the measurement is +- 0.1 cm. To avoid double counting and to assure completeness of the inventory, each tree recorded is marked with a chalk stick. Trees that were not planted by the project, but existed prior to the start of the project activity are not recorded. 

Monitoring frequency:	During each monitoring event, i.e. every five year since the year of initial verification.
QA/QC procedures:	10% of the plots will be cross-checked by forest engineers of the project and/or Savaivo
Any comment:	This Data/Parameter is used for the allometric equation (equation 2)

Data / Parameter:	***x2: H***
Data unit:	m
Description:	Total tree height Parameter required by the allometric equation
Source of data:	Field measurement
Measurement procedures (if any):	The height measure of the trees is done as described in ref. 1 p. 17 and 18 of the document called “Manuel d’inventaire forestier (2009)” (see annexe 14) with a clinometer or with Or with modern dendrometers allowing to measure tree heights and distances directly with laser or ultrasound technique. Tree height is measured with a precision of +- 0.1 m. Measuring tree height precisely is costly (instruments, time). Tree height is strongly correlated to diameter. In order to reduce costs, tree height can be estimated from diameter, once the species-specific relationship is known. The project aims to develop such relations based on precise measurement of diameter (+- 0.1 cm) and tree height (+- 0.1 m) of the different tree species planted. Requirement is (as for allometric equations) a minimum sample size of 30 trees per species and a R^2 of 0.85.
Monitoring frequency:	During each monitoring event, i.e. every five year since the year of initial verification.
QA/QC procedures:	10% of the plots will be cross-checked in the field by forest engineers (from the project team and from Savaivo)
Any comment:	This Data/Parameter is used for the allometric equation (equation 2)

Data / Parameter:	**x3: ϱ_j**
Data unit:	t d.m. m^{-3}
Description:	Basic wood density for species or group of species j
Source of data:	Data published in scientific literature or official documents. Species specific data, if available,

	average genus data otherwise. Currently used data is: **Eucalyptus camaldulensis: 0.82 t d.m. m^{-3}** Data specific to Madagascar from Cirad (2012) "Atlas des bois de Madagascar". Value calculated from dry wood density (0.92 t d.m. m^{-3}) and overall shrinkage during drying (12.83 %). No data for Madagascar available in the DRYAD database (Zanne et al 2009) **Tectona grandis: 0.60 t d.m. m^{-3}** No data from Madagascar available. Data used from DRYAD database of Zanne et al (2009) "Global Wood Database". Mean value of all samples available from Africa (n=33) **Khaya senegalensis: 0.63 t d.m. m^{-3}** No data from Madagascar available. Data used from DRYAD database of Zanne et al (2009) "Global Wood Database". Value corresponds well with the density reported for the endemic species of the same genus K. madagascariensis (0.61 t d.m. m^{-3}, Cirad 2012) **Dalbergia trichocarpa: 0.82 t d.m. m^{-3}** Endemic species with unknown wood density. The "Atlas des bois de Madagascar" reports densities of 0.94 t d.m. m^{-3}, for Madagascan species of Dalbergia (0.99 t d.m. m^{-3} dry density and shrinkage of 5.37%). The DRYAD database reports a mean density of 0.82 t d.m. m^{-3} for Dalbergia species from Madagascar (n=8). The latter value is used for reasons of conservativeness. **Terminalia mantaly: 0.57 t d.m. m^{-3}** The "Atlas des bois de Madagascar" reports densities of 0.60 t d.m. m^{-3} for T. Mantaly in Madagascar (0.65 t d.m. m^{-3} dry density and shrinkage of 8.46%). The DRYAD database reports a mean density of 0.57 t d.m. m^{-3} for T. mantaly samples in Madagascar (n=5). The latter value is used for reasons of conservativeness. Improved values will be used, once they become available.
Measurement procedures (if any):	-
Monitoring frequency:	Screening for improved data prior verification
QA/QC procedures:	-
Any comment:	This Data/Parameter is used for the allometric equation (equation 2)

Data / Parameter:	**T**
Data unit:	Year
Description:	Time period elapsed between tow successive estimations of carbon stock in trees and shrubs
Source of data:	Recorded time
Measurement procedures (if any):	N/A
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	If the two successive estimations of carbon stock in trees are carried out at different points of time in year t2 and t1, then a fractional value is assigned to T This Data/Parameter is used in equations (14), (26) and (36)

Two additional monitoring parameters *Tenure* and *Double-counting* have been defined in section 1.12 "Ownership and other programs" to assure land-use rights and undisputed carbon rights at the time of verification.

4.3 Description of the Monitoring Plan

Monitoring plan

The installation of the sampling plots and the protocol used for recording and collecting data, incl. quality control / internal audit, will follow the "Manuel d'inventaire forestier (2009)" (annexe 14), since this method has been recognized and recommended by the National Authorities (Direction Générale de l'Environnement et des Forêts).

The inventory protocol will follow a circular plot design, with fixed radius between 4 – 18 m, depending on the age of plantation, so that each plot includes between 12 – 20 trees (see management plan, table 16). Within these plots, species name and diameter at breast-height (DBH at 1.30m) of all planted trees with DBH ≥ 5cm are measured and noted. Trees that were not planted, i.e. existed on the site prior to the start of the project activity are not measured. For each tree, the biomass will be calculated using the following formula:

$$B_{TREE,j,p,i,t} = f_{j(x1_{p,i,t},x2_{p,i,t},x3_{p,i,t,\ldots})} \times (1 + R_j) \qquad \text{Equation (2)}$$

Where:

$B_{TREE,j,p,i,t}$	=	Biomass of trees of species *j* in sample plot *p* of stratum *i* at a given point of time in year *t*; t d.m.
$f_{j(x1_{p,i,t},x2_{p,i,t},x3_{p,i,t,\ldots})}$	=	Function relating measured tree dimensions (x1, x2, x3, …) to above-ground biomass. Tree dimensions are measured in sample plot *p* of stratum *i* at a given point of time in year *t*. Tree dimensions x1, x2, x3, … could be, for example DBH, height of tree, etc.
R_j	=	Root-shoot ratio for tree species *j*; dimensionless
j	=	*1, 2, 3, …* tree species in plot *p*
p	=	*1, 2, 3, …* sample plots in stratum *i*

The most robust allometric equations available at the moment are those of Chave et al (2005)[32]. Their validity for different types of natural forests in Madagascar has been demonstrated by Vieilledent et al. (2012)[33]. Most precise results were obtained by using the equations with parameters *DBH*, *tree height* and *wood density*. Current work for quantifying carbon stocks in Madagascars forests (coordinated by the Office National pour, l'Environnement) is using the same equations.

Moist forest stands:

$$\langle AGB \rangle_{est} = \exp\left(-2.977 + \ln\left(\rho D^2 H\right)\right) \equiv 0.0509 \times \rho D^2 H$$

Tree height seems to be an important predictor of biomass. However, it is very costly to measure the height for all sampled trees. As tree-heigt is highly correlated to DBH, species specific DBH-height relationships can be developed to estimate tree-heights instead of measuring them (e.g. Vielledent et al., 2005). Therefore, the project will develop species specific relationships (regression model) between DBH and height, based on at least 30 samples per species and a R^2 of at least 0.85:

$$H_{est,j} = f_j(DBH_j)$$

Where:

$H_{est,j}$ = Estimated height of tree of species j
f_j = Function relating measured DBH to tree-height, for species j
DBH_j = Diameter at breast-height /(1.30 m) of tree of species j

For wood densities, the same values as for ex-ante estimation are used, unless more precise data become available, i.e. through additional local and/or national measurements of wood densities of the planted species.

As other, more precise allometric equations might be developed in future, final decision on the equation to use will be done in the monitoring process and appropriateness of the allometric equations used will be demonstrated at time of verification using the tool “Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities”.The same applies for the root-shoot ratio: The current version of the methodology AR-ACM0003 proposes the IPCC default ratio of R_j = exp(-1.085+0.9256*ln(AGB))/AGB. In case another ratio is used at verification, information will be provided to justify this choice.

For each plot, the biomass density (t d.m. ha^{-1}) will be determined (equations 5 and 6 of the tool for "Estimation of carbon stocks and changes in carbon stocks of trees and shrubs in A/R CDM project activities"). Mean biomass density and variance will be calculated for each stratum (equations 7 and 8) and combined for obtaining mean biomass density and variance at project level (equations 9 and 10).

Based on this information, the uncertainty of the mean tree biomass per hectare within the project boundary is estimated using the following formula:

$$u_{bTREE,t} = \frac{t_{VAL} \times s_{bTREE,t}}{b_{TREE,t}} \qquad \text{Equation (11)}$$

Where:

$u_{bTREE,t}$ = Uncertainty of tree biomass per hectare within the project boundary at a given point of time in year *t*; %

t_{VAL} = Two-sided Student’s *t*-value for: (i) Degrees of freedom equal to *n* – *M*, where *n* is total number of sample plots within the project boundary, and *M* is the total number of tree biomass estimation strata; and (ii) a confidence level of 90%.
For example two-sided Student’s *t*-value for a probability value of 10% (which implies a 90% confidence level) and 45 degrees of freedom can be obtained in Excel spreadsheet as “=TINV(0.10,45)”[1] which returns a value of 1.6794

$s_{bTREE,t}$ = Square root of the variance of mean tree biomass per hectare within project boundary at a given point of time in year *t* (i.e. the standard error of the mean); t d.m. ha^{-1}

32 J. Chave et al (2005) Tree allometry and improved estimation of carbon stocks and balance in tropical forests

33 G. Vieilledent et al. (2012) A universal approach to estimate biomass and carbon stock in tropical forest using generic allometric models

Finally, the total biomass at time t is calculated using the formula:

$$B_{TREE,t} = A \times b_{TREE,t} \qquad \text{Equation (12)}$$

Where:

$B_{TREE,t}$	=	Total tree biomass within the project boundary at a given point of time in year *t*; t d.m.
A	=	Sum of areas of the biomass estimation strata within the project boundary; ha
$b_{TREE,t}$	=	Mean tree biomass per hectare within the project boundary at a given point of time in year *t*; t d.m. ha^{-1}
t	=	*1, 2, 3, …* years counted from the start of the A/R CDM project activity

and associated carbon stocks are calculated as follows:

$$C_{TREE,t} = \frac{44}{12} \times B_{TREE,t} \times CF_{TREE} \qquad \text{Equation (13)}$$

with IPCC default carbon fraction CF_{TREE} of 0.47 tC (t d.m.)$^{-1}$ unless better information is available at time of verification.

The change in carbon stocks which will determine the issuance of carbon credits, is calculated by subtracting carbon stocks at the prior monitoring/verification at time t-1 from the measured carbon stocks at time t.

Control of the replanted areas and of the plantation's quality

Boundaries of plantations are recorded with GPS and transferred into a GIS vector map with associated attribute table, where species and plantation densities are note, as well as any silvicultural interventions, including replanting.

Plantation quality will be monitored by.:

- By regular controls of reforested areas for losses, to determine the mortality and the quality of the plantation and for triggering silvicultural interventions (replacement plantings) additional to those foreseen in the Management Plan.
- The controls will be carried out at the end of the dry season following the planting. Once these completed, the controls will follow the pace of the silvicultural care measures according to the Management plan.
- They will be carried out by professors and students from the Training Center.
- 10% will be controlled by a board of independent study such as SAVAIVO or ESSA (College of Agricultural Sciences of the University of Antananarivo, Madagascar), for example.

Storing and measurements done during the verification

Data collected in the field will be written on paper by the leader of the inventory group, using templates as are described in details in the monitoring Chapter of the PD. After returning from the field, the data will immediately be entered into the computer (Excel Spreadsheet) by the leader of the inventory group and another member of the project team (for quality control). The paper version is filed in an archive folder on the project site, where it is available for verification.

After analysis and evaluation of data and successful verification, electronic versions of data, calculations and results, incl. monitoring and verification report, will be archived on a CD/DVD, on the project site in Madagascar, as well as in the EcoFormation Office in Switzerland.

Both the original paper versions and the electronic documents on the CD/DVD are kept for at least 2 years after the end of the crediting period, i.e. at least until 1st March 2041

Processing and interpretation of the measurements

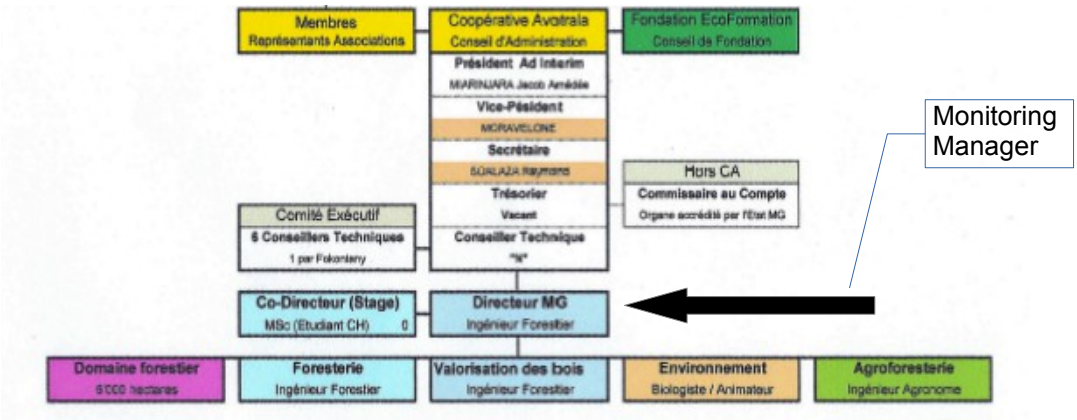
Plot measurement data will be transferred to Excel spreadsheets, which will allow us to process and analyse the data for carbon stocks, as required by the methodology AR-ACM0003 and associated tools. The carbon calculation sheets will be based on the "Winrock Terrestrial Carbon Stock Calculator Tool 2012"[34]

- Data entry table for each plot (raw data) and data processing:
  - Estimation of height of each tree (if not measured and DBH-H relationship available)
  - Determination of biomass for each tree (using allometric equation)
  - Calculating plot biomass density (t d.m. ha^{-1})
- Data aggregation and calculation of project carbon stocks:
  -
  - Calculation of mean biomass densities of the different strata (t d.m. ha^{-1})
  - Calculation of standard deviations per strata (t d.m. ha^{-1})
  - Calculation of mean biomass densities at project area (t d.m. ha^{-1})
  - Calculation of standard deviations at project area (t d.m. ha^{-1})
  - Calculation of project carbon stocks (t CO_2 ha^{-1})
- Accuracy analysis and calculation of emission reductions
  - Calculation of uncertainty of carbon stocks at project level
  - Calculation of annual emission reductions and emission reductions since last verification

34 Winrock Terrestrial Carbon Stock Calculator Tool – 2012 Version : http://www.winrock.org/ecosystems/files/Winrock_CarbonStockCalculator_Version2012.xlsx

Monitoring's organization

The chosen organization for monitoring is in principle the organization of the project, i.e.:



The monitoring will be carried out under the direction of the MG Training Center Director supported by the teachers' skills. They will carry out the annual inventory in the framework of the training classes as practical work, which will provide a regular monitoring of the development of the trees, and therefore the exploitable volumes of wood and the accumulated biomass. Teachers participating in these activities will be responsible for the operations and results.
Regarding QC/QA measures, external monitoring will be regularly carried out by an independent body (e.g. SAVAIVO or ESSA of the University of Antananarivo) of 10% of the plots, selected randomly.
There will also be an ex-post control of all the data processing and calculation of CO2 sequestration. If significant differences, exceeding the specified level of accuracy (10% with 95% of confidence limit) arise, the independent body will make a complete inventory of all the plots to produce convincing and justified results.

Data collected during monitoring will be archived for a period of a least two years after the end of the last crediting period of the project activity. Which means until March 2043 at least.

5 ENVIRONMENTAL IMPACT

An environmental impact study has been carried out by the Savaivo office. The main processes and conclusions have been summarized in this section.

The environmental impact assessment has been approved by national authorities. On 27. March 2013, the project received the environmental permission from the National Office for the Environment (ONE), together with a duties record book. Both documents have been included in the annex (annexes 15a and 15b).

The Environmental Impact Study is the result of various surveys and studies that have been aggregated.

The main desk and field researches that have been conducted are:

- project site analysis by browsing the site on foot with the help and comments of locals
- interviews and focus groups with locals (annexe 9)
- soil analysis done with samples by an independent laboratory (annexe 8)
- aerial picture analysis (maps 7 to 9)
- literature analysis (pages 66 and 67 of Management Plan – annexe 13)

The above surveys and studies have allowed the Savaivo office to produce the following:

- Socio-economic characteristics of the area
- Climate (and pluviometry) analysis (see p. 29 PD)
- Altitude map (see map 4)
- Slope map (see map 3)
- Geological analysis (see map 2)
- Soil analysis (see annexe 8) and map (see map 5)
- Hydrography map (see map 2)
- Vegetation map (see map 1) and analysis (species and number, see p. 33 to 36 of PD)
- Fauna analysis (species and status (endangered, etc.), see p. 37 to 40 of PD)

Those various analysis have conducted to the creation of the table below which summarizes the various positive and negative impacts that have been identified (more details about each impact can be found in the Environmental Impact Study in annexe 15)

ACTIVITIES SOURCE OF IMPACTS	IMPACT / RISK	REFERENCE IMPACT	NATURE	IMPORTANCE
A-PHASE DE PREPARATION				
1.Identification of the land (pilot site of 600 ha and total area of 6000 ha)	**a.** Development by the farmers of a mistrust feeling towards foreigners	**A1a**	*Negative impact*	***AVERAGE***
2.Set up of the drawings of the lands and land register formalization	**a.**Risks of land tenure conflicts between farmers, villagers, Fokontany themselves and between the project and the natives	**A2a**	*Negative impact*	***AVERAGE***

	b. Land tenure securisation and reduction of the conflicts linked with land tenure	**A2b**	*Positive impact*	***HIGH***
B-START PHASE				
1.Campaigns of IEC (Information, Education and Training) on the project site	**a.**Elimination of the doubts over the project and the joining of the population as members of KOP'ALA	**B1a**	*Positive impact*	***HIGH***
2.Lead of miscellaneous study such as the Management Plan	**a.**Elimination of the doubts over the project and the joining of the population as members of KOP'ALA	**B2a**	*Positive impact*	***HIGH***
3.Set up of the reforestation nurseries	a. Creation of jobs and increases of the revenues of the households	**B3a**	*Positive impact*	***HIGH***
C-IMPLEMENTATION PHASE				
1.Manual and mechanical plowing of the earth	**a.** Job creation and increase of the households revenues	**C1a**	*Positive impact*	***AVERAGE***
	b.Reduction of the vegetation fire risk	**C1b**	*Positive impact*	***HIGH***
2.Plantation and maintenance of the exotic and native species	**a.**Wildlife and floristic biodiversity reconstitution	**C2a**	*Positive impact*	***HIGH***
	b.Creation of a milder microclimate: temperature and evapotranspiration less important	**C2b**	*Positive impact*	***HIGH***
	c.Reconstitution of ecological niches and of wildlife populations	**C2c**	*Positive impact*	***HIGH***
	d.Improvement of the revenues of the Cooperative (therefore of its members) because of the selling of the carbon credits	**C2d**	*Positive impact*	***AVERAGE***
	e.Job creation and increase of the households revenues	**C2e**	*Positive impact*	***HIGH***
	f.Dissension between the project and the population after the desecration of objects and places of worship	**C2f**	*Negative impact*	***AVERAGE***
3.Implementation of the mechanical safety device for the fight against fire	**a.**Reduction of the unauthorized vegetation fires in the zone	**C3a**	*Positive impact*	***HIGH***
	b. Job creation (wardens and fire) and improvement of the households revenues	**C3b**	*Positive impact*	***HIGH***
4.Enclosing of the land (quickset hedge)	**a.**Land tenure securisation and reduction of the conflicts linked to cattle wandering	**C4a**	*Positive impact*	***HIGH***

	b.Improvement of the Cooperative's revenues (and therefore of its members) because of the sale of the by-products of the quickset hedge	**C4b**	*Positive impact*	***AVERAGE***
5.Promotion of the agroforestry activities	**a.** Improvement of the agricultural output, of the revenues and of the alimentary self-sufficiency period of the households	**C5a**	*Positive impact*	***HIGH***
	b.Improvement of the soils quality because of the agroforestery techniques	**C5b**	*Positive impact*	***HIGH***
	c. Valorization of the by-products of the cattle breeding which become additional source of revenue for the households	**C5c**	*Positive impact*	***AVERAGE***
6. Building of the Training Center	a. Improvement of the aesthetic of the landscape	**C6a**	*Positive impact*	***AVERAGE***
	b.Improvement of the educational level of the young malagasy and europeans	**C6b**	*Positive impact*	***HIGH***

The identified negative impacts are:

- Development by the farmers of a mistrust feeling towards foreigners
- Risks of land tenure conflicts between farmers, villagers, Fokontany themselves and between the project and the natives
- Dissension between the project and the population after the desecration of objects and places of worship

To work on the eventual mistrust feeling of the farmers towards foreigners, the Avotrala Cooperative has been set up. The Cooperative manages and is the only beneficiary of the free use the land given by the Malagasy State, EcoFormation only has a role of initiator. This structure has helped fight against the fear of the locals that they would be robbed of their land and goods by vazahas (white persons).

Concerning the risk of land tenure two things have been done. The first action was to delineate clearly the project area with state employees of the land register. The result is a clear and precise map of the area. The second thing was to exclude from the project site any land used by farmers. Even though the land isn't owned by those farmers, there is confrontation between traditional right of ownership of the land and the statutory official law. Indeed, the “land blur between the legitimate and the legal aspect” is a true reality in the Malagasy rural world and could constitute a major obstacle in the implementation of the Project. However, to avoid any conflict and fear, the plot that were already used have been excluded (and mapped) from the project area.

The potential dissension between the project activities and the population regarding their ancestral ritual sites (Fahdys places which means forbidden places) have been addressed by mapping those sites. The project area has been precisely analyzed with the help of locals to identify the ritual sites. Two of those sites have been identified. The coordinates of those site have registered and mapped. Anyone can go to those sites whenever they want. However, those Fahdy places are located outside the reforestation project area.

6 STAKEHOLDER COMMENTS

The stakeholders of the project are the local farmers and the population of the Rural Commune of Bekoratsaka,which are people living in or on the border of the project area.

Before starting the project, several meetings and workshops with the population of Bekoratsaka (which includes the Mandrosoarivo, Ambodimadiro II, Antanandava, Andrafiakely, Antanambao, Miarinarivo and Bekoratsaka Fokontanys) have been set up and led by Philippe Dubois with the purpose of presenting and explaining the project goals and how EcoFormation and Avrotrala will achieve them, together with the local populations.
The population was positive about the project and six Fokontany immediately wanted to join it, a seventh Fokontany decided to join afterwards.

During those workshops, the project area was delineated and the participation of the local population was formalised. The creation of a Cooperative, Avotrala, was decided as well as association for each village (or Fokontany). It was decided that 3 persons of each Fokontany (the wise men called raymandreny, the representative of the village and a young person) would constitute the Board of Directors of the Avotrala Cooperative. The land will be managed by Avotrala which is also the only beneficiary of the free use of the land given by the Malagasy State. This ensures the locals that the goal of EcoFormation is not to take over their land.
Below is the Cooperative organization chart :

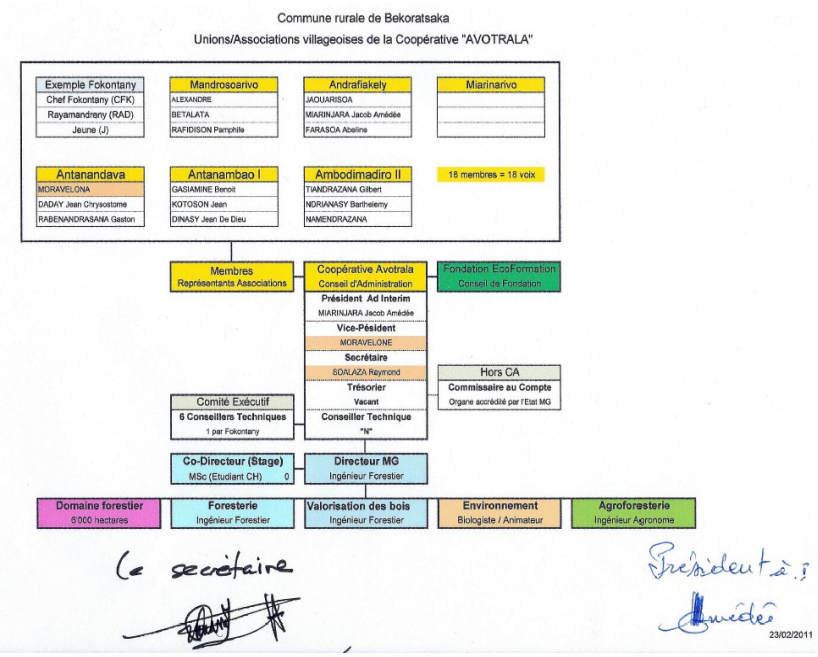


Illustration 3: Avotrala's organization chart

As shown in the organization chart above, EcoFormation has a role as project developer, coach and technical adviser. Avotrala is responsible for the training of the employees as well as for the day-to-day management of the project site. Therefore a training program has been set up in order to have trained staff. The training program can be found in annexe 16.

The land's products (agro-forestry and forestry) plus 60% of the carbon certificates marketing revenues which will be held by the Cooperative, 30% of this income is redistributed to the Cooperative Members, 30% is managed by the Cooperative to cover administrative and operation costs, and the remaining 40% will stay in EcoFormation's hands for development of similar project in Madagascar.

An ongoing communication process has been implemented. First for all, the persons in charge of the Cooperative are regularly exchanging information (progress, results and, of course, problems to be solved) with EcoFormation's management team (Philippe Dubois and Balz Gfeller).

At each visit and assessment of the pilot zone (about every two months) EcoFormation's representative organizes meetings with the Cooperative Board Members and with the local population in order to avoid any fear or potential breaks of the global project development and implementation.
Various meetings and workshops have been organized since 2010, all of them conducted in French and Malagasy.
The summarized outcomes of each of those meetings are stated below in chronological order.

March 2010

Presentation of the project (concept, action plan and structure) as well as the possible legal forms to the villagers.
Decision : The villagers support the project and decide that the best legal form in a Cooperative. Each village will have an association composed of 3 representatives designated as Members of the Board of the Cooperative.

June 2010

Meeting with the national and local authorities (Land Settlement Minister, Minister of the Waters and Forests, General Director of the Forests, Regional Director of the Forests, Chiefs of the Region and the District, Mayor of the rural district of Bekoratsaka and 7 Village Chiefs of the rural district of Bekoratsaka, 7 presentations in total done by Philippe Dubois and Andri Rakotomavo).

Creation of the local village associations and election of their representatives (members of the Board of the Cooperative) as well as delineation of the project area.

Picture 7: Picture of the villagers drawing the project boundaries

Picture 8: Picture of the villagers drawing the project boundaries

August 2010

Validation of the Avotrala Cooperative statutes, election of the Board of Directors of the Cooperative and registration of the Cooperative on the National level.

October 2010

A meeting was held with the wise men of the concerned Fokontany as well as with the Chief of the rural District of Bekoratsaka (see annexe 17 (minutes in French) and 18 (minutes in malagasy and signatures)).

December 2010

Work on the structure of the Cooperative with the Chiefs of the participating Fokontany, the Rayemandreny (wise men) and young people of the villages.

Picture 9: Picture of Philippe Dubois leading a workshop

Once this work was finished, the structure was presented to all the members.

Finalization and signature of the conventions between EcoFormation and Avotrala and between Avotrala and its members.

Meeting with the Board of Directors of the Cooperative and preparation of the internal rules as well as the specifications for the members of the Board of Avotrala and the allowances for meetings.

Decisions on the allowance and rules (work schedules, uniforms) for the staff (members and villages' associations) for the work done for the Cooperative.

Preparation of the specifications for the Technical Director to be recruited for the project site with Philippe Dubois and the Members of the Board.

For more details see the minutes taken during this meeting taken by Phlippe Dubois (annexe 19).

March 2011

18th of February 2011 Official start of the project with the first trees planted and a big party with all the villagers that wanted to come (about 800 people) but the actual starting plant date is the 1st of March 2011 (see annexe 1).

Picture 10: Picture of villagers dancing at the opening ceremony

Validation of the management plan by the Members of the Cooperative during an extraordinary meeting held on the 22nd of February. For more details about this meeting, see annexe 20 and 21 (minutes and presence list).

May 2011

18th, 19th and 20th of May : Workshops animated by Philippe Dubois in the 6 Fokontany that are members of the Cooperative and in one Fokontany which is interested to get into Avotrala (Bekoratsaka) The main outcomes of those workshops are the followings :

- The land used for agriculture must not be touched by the Vazahas (the white people) and the villagers want to make sure that the people from the Highlands (region of Antananarivo) don't take over their lands.
- The villagers outline the fact that work on the project is given to local manpower before looking for workmen and women outside the rural district of Bekoratsaka.
- The wage and social policy must be comparable to the other NGOs.
- The members ask for the opportunity to market the excess productions through the Cooperative.
- Enlarged market garden production in order to ensure for new sources of revenue.

Minutes of this meeting taken by Philippe Dubois in annexe 22.

August 2011

11th of August 2011
The National Environmental Office has done an onsite evaluation of the project.
The state employee had to make sure everything on the paper corresponded to the onsite reality. An other goal of this on site visit was to ensure that the local people agreed with the project and that their rights were respected. After doing a meeting in each Fokontany, they concluded that everything was in order after a consultation period of 15 days. During this period, the villagers that didn't care to speak in public or that couldn't assist to the meeting could raise their concern by going to the Bekoratsaka town hall.

Signed minutes of the meeting in annexe 23.

16th of August 2011
General assembly of the members of the Cooperative (the topics were the hiring process of workers, state of the project, zoning of the project area).

Signed minutes of the minutes in annexe 24.

September 2011

13th of September 2011

Picture 11: Picture taken during a workshop lead by a malagasy trainer

Workshop with the members of the Cooperative concerning :
The state of progress of the project

- Concept, convention and involvement of the Fokontany for the fight against fire
- Annex to the conventions between Avotrala and EcoFormation (increase of the duration of the contract from 10 to 30 years) and between Avotrala and the malagasy state (land transfer) and between Avotrala and the local associations (concerning the fight against fire and cattle wandering)
- List of the members of the Cooperative (by Fokontany)
- Selection of the technical advisors and wardens

- Questions and remarks

The agenda was covered and the topics explained. The main outcomes from this workshop concerning the stakeholder comments were during the questions and remarks. The main points of this section are below :

- Several questions were concerning the Board of Directors of the Cooperative (responsibilities, identity, wage)
- Questions about work were asked such as : When do the women start to work ? Are children allowed to work ? How takes care of the children during the time the women work ? Discussion about the wages. Etc.
- Questions about the possibility for members of the Cooperative to use Avotrala's work equipment.
- Questions why all the Fokontany in the project area aren't in the Cooperative
- Who gives the alert in case of fire ?

As always during workshops and General Assembly, all the concerns of members have been discussed and answered.

Minutes of the workshops in annexe 25.

The various meetings and discussions have also shown that some ancestral cultural site (called Fahdy places) are situated on the project site (but outside the reforestation areas) and that the local populations were concerned about them.
They wanted to be sure that they could always go to those site even with the project's implementation.
Therefore those ritual site have been marked on the project site map (see map 1 page 11) and anyone is welcome to go and visit them.