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AFS4Food

Agroforestry for food security

Second Interim Narrative Report

October 1st, 2012– April 3rd, 2013

Didier Snoeck, CIRAD (Tree crop based Systems)

17/05/2013

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Content

AFS4FOOD

Second Interim Narrative Report

Period: October 1st, 2012– April 3rd, 2013

1. Description

1.1. Name of beneficiary of grant contract: Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD)

1.2. Name and title of the Contact person: Dr Didier SNOECK

1.3. Name of partners in the Action:

- Institut de Recherche Agricole pour le Développement (IRAD)
- International Centre for Research in Agroforestry (ICRAF)
- Centre Technique Horticole de Tamatave (CTHT)

1.4. Title of the Action: Enhancing food security and well-being of rural African households through improved synergy between Agro-Forestry Systems and Food-crops.
Project designator: **AFS4Food**

1.5. Contract number: AURG/031/2012

1.6. Start date and end date of the reporting period: 01/10/2012 – 03/04/2013

1.7. Target countries:

- **Cameroon**: Centre Province: Bokito, Talba
- **Kenya**: Central region: Muranga District
- **Madagascar**: East Fénérive and Sainte Marie Island

1.8. Final beneficiaries & target groups :

- Smallholders in the target regions and in similar agro-ecological, demographic and market conditions.
- Farmers and their organisations in the target cocoa, coffee, and clove dominated landscapes.
- Local research and extension institutions focusing on food-crops and AFS in the target zones.
- Stakeholders and policy makers at local, national and regional levels.

1.9. Countries in which the activities take place (if different from 1.7): -

2. Assessment of implementation of Action activities

2.1. Executive summary of the Action

This progress report covers the second semester of the first year of the project; i.e. from 1st October, 2012 to 31st March, 2013. It is the second progress report. It follows the first report, which covered the period of April 1st to September 30th, 2012. The first report was submitted upon request of the AU management Unit. The second progress report was done to support the first year of the project. Both reports are submitted together as supporting documents to request for pre-financing payment after first year.

During this period (second semester of year 1), we could continue the activities as planned in the timetable (see Annex 1). These activities include the following: 1. Management and scientific coordination; 2. Spatio-temporal dynamics; 3. Assess interactions between agroforestry systems and cash crops and pathways to improve synergies; 4. Characterization of agroforestry systems product quality, and drivers of agroforestry systems product quality; 5. Dissemination of results.

In addition to the scheduled activities, we could start some activities of work packages 2, 3, and 4. These are: 1) the consultation of bibliographic data, the exchanges conducted with researchers from different fields concerned (Kenya, Madagascar, Cameroon), and 2) the early start of some activities on both Kenya and Madagascar sites. The activities could be started earlier because they benefited from other sources of funding. Therefore, during this semester, they are not always recorded in the financial report. But they are reported here because they will directly impact the project activities, either because the results contribute directly to the development of new activities to be undertaken by the project or because they will be continued in the framework of the project.

Two meetings were organized during the first semester: i) a management and financial progress meeting in June; ii) a scientific progress meeting early July.

One workshop was organised in Cameroon (one of the project countries). The next workshop will be organised in Kenya from 21st to 25th October 2013.

A budget management application was developed, with the access on Internet and the main database on Extranet, so as to allow rapid and accurate follow-up of financing of activities. Both applications are maintained by the management unit.

The visibility of the project is guaranteed through a bilingual website that has been created.

The current status of the financial report is provided in annex 5.4 for information. A separate financial report will be provided together with the annual narrative report.

2.2. Activities and results

2.2.1. Scientific coordination of the project

The project is divided into five work packages (WP), each with activities distributed into the three countries of the project. To organize the activities and manage the project, we have organized two progress meetings and create a tool for managing the budget online.

A one-week workshop was organized in October 2012 (8th to 13th) in Cameroon. It was the occasion to introduce the AFS4Food project to the partners. A meeting with all Cameroonian partners was held in Yaoundé on October, 11th. This presentation was attended by farmers' representatives (cacao planters) and women farmers' association (producing food crops) of Bokito, and representatives of the ACEFA programme (Improvement of the Competitiveness of the Family Farms in Cameroon). At the end of this meeting, it was decided that the ACEFA programme would be part of the advisory committee of the AFS4Food project for Cameroon. This program has technical and economic references in particular on the principal food and commercial agricultural productions for the Great South Cameroon; and we found it interesting to cross their information with those produced by AFS4Food in these fields.

The meetings were followed by a field visit of the innovative cocoa-based agroforestry systems (AFS) in the Bokito zone.

The 9th, 10th, and 13th of October were devoted to the presentation by the leaders of the three countries involved in the project (Cameroon, Kenya, Madagascar) of the main features of each studied AFS and to clarify the objectives and planned activities for the different WPs for the period of November 2012 to April 2013. Particularly, these exchanges helped clarify how the different activities could be shared to improve on the articulation between the WPs.

During these days, Patrice Levang of the IRD-CIFOR and André Nso Ngang of the IRAD were met: the first to see his availabilities for supervision of the trainees and PhD students; the second as a possible candidate for the realization of field works to carry out in 2013 within the WP2 in Cameroon.

The next workshop will be held in Kenya from 21st to 25th October 2013.

Results of Scientific coordination

- Management meetings were done to launch the activities.
- Website www.afs4food.cirad.fr/en is improved and updated frequently.
- Online budget management is fully operational, allowing daily updating by users.

2.2.2. Cameroon

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WP1: Management

1.1. Identification of target farms and communities

Two localities were identified in Cameroon:

- **Bokito**: the locality is characterized by small cocoa farms managed in the forest-savannah transition area. IRAD and CIRAD have worked with cocoa farmers in this area for the last ten years in the frame of several projects. During these projects, some cocoa farmers have been encouraged to test innovative cocoa cultivation practices, based on simultaneous planting cacao with intercropped species trees, resulting in the absence of permanent shade during the ten years following planting. This practice differs from the traditional one, which is mainly based on planting cacao under the shade of older timber trees. One of the activities of the current project consists in a comparative assessment of the profitability and performances of traditional cocoa plots and of cocoa plots managed under the new practices.
- Farmers taking part to this comparative assessment have already been identified.
- **Talba**: locality characterized by the presence of large cocoa farms generally managed by employees. A field trip conducted by Philippe Pedelahore (CIRAD) and André Nso Ngang (IRAD) in October 2012, allowed to contact with local traditional and administrative authorities as well as some representatives of cocoa and food crop producers. Another field trip is scheduled in April 2013, in order to select the farmers and the plots to be included in the survey and the description of cocoa plots and to actually start the activities of WP2 and WP3.

1.2. Creation of multi-sector Advisory committees and External advisory panels

Contacts were taken with different representatives of the cocoa and agricultural sector for their inclusion in the advisory panel. This panel is now operational and is composed of:

- Two persons involved in a national program (ACEFA project). One is specialized in the financial support and advice to farmers and the other person is specialized in technical aspects aiming at improving the performances of small farms.
- One person managing a private company working on quality aspects on several crops: coffee, pepper and cocoa (AGRO PME).
- One representative of Ministry of Agriculture, who is specialized in cocoa.
- One local representative of cocoa farmers in Bokito.
- One researcher of IRAD specialized on agroforestry.
- One researcher of IRAD specialized on fruit crops.

The first meeting will be held before the end of 2013, as soon as the first results from WP2, WP3 and WP4 are available.

1.3. Scientific coordination of the funded operations and the network

Two members of A.U staff conducted a routine technical and financial monitoring of the Cameroonian component of the project. The visit took place in December 2012. The country leaders of both IRAD and CIRAD partners were able to present the project activities and organize a field trip in Bokito, including field visits and discussion with local farmers.

A 4X4 pick-up vehicle was purchased in September 2012 and is currently used for the field trips organized for the project.

1.4. Capacity building and capitalization of knowledge

The team-leaders organized the first workshop in Yaoundé in October 2012 to launch the project. Project participants from different countries were present: 6 from France, 2 from Kenya and 2 from Madagascar. This workshop was organized as follows:

- Meeting between the researchers involved in the coordination of the projects in order to organize the activities across the three countries.
- Meeting between the participants from other countries and local partners (IRAD, Ministry of Agriculture, farmers) in order to present the project in the three countries and the activities to be implemented in Cameroon. The project was presented to the Cameroonian partners at a meeting organized on October 11. The meeting was attended by representatives of farmers (cocoa farmer) and farmers (producing food) and those of Bokito ACEFA program (Improving Competitiveness of Agricultural Farms Family Cameroon).
- Field trip in Bokito to visit the trials and surveyed farms and discuss with local cocoa farmers.

Results of WP1

- Activities have started.
- Training of students will start in April 2013.
- The project was made known to the partners.
- The evaluation committees and external advisory panels are operational and a first meeting is scheduled.
- The country leaders received the visit of the A.U. technical and financial monitors.

WP2: Characterisation of farming systems and identification of long term drivers at household and landscape levels

2.1. Spatio-temporal dynamics of farming systems

2.1.1. Understand the dynamics of farming systems on the long term

A field trip was conducted by Stéphane Dupuy (CIRAD France) and Stéphane Saj (CIRAD Cameroon) in November 2012 in order to place accurate bench marks on a satellite image Worldview taken in February 2011, with a 50 cm resolution, and covering a 100 km² area in the neighbourhood of Bakoa village (near Bokito).

Bibliographic and statistics information that are useful for understanding the changes over a long period (several decades) were collected. Variables were collected at the national level and, where possible, in the studied areas. Two types of data were collected:

Macroeconomic data:

- Changes in the composition of GDP in Agriculture : tree crops GDPA / food crops GDPA);
- Compared evolution of the consumer price index and median wages of the civil service, the price of the agricultural food products (tree crops and main food crops concerned with the studied zones)
- Changes in the production of the studied perennial culture (Cocoa, coffee or clove) and in the existing main food crops in the studied zones (surfaces, tonnage, number of farmers).
- Evolution of the food imports at the national level, the level of rural and urban poverty and of the severity of malnutrition when it exists.

Demographic data:

- Evolution of the national population and the urban: rural ratio.
- Evolution of the population density in the studied zones and the ratio No men: No women in the population pyramids.
- Data on the migratory movements (rural exodus, pioneer fronts).

There is both a restructuring of the cocoa-food crop balances within the historic areas of AFS (at the farm, and at the village level) and an expansion of the area of cocoa-based AFS on the savannah areas (Bokito) and forest edge pioneer fronts (Mbam et Kim). These extensions will have a significant impact on the cocoa-food crop balances at the farm, village and agrarian regional levels.

A first characterization of dynamic of the studied AFS and first items of zoning of the studied zones was done after P. Pédelahore's mission in October 2012. Details are given in Annex.

2.1.2. Analysis of aerial imagery and Geographic Information System

S. Dupuy has achieved a field survey (26/11 to 9/12/2012) to map the plots where remote sensing analysis and altimetry measurements will be done for DTM production of the study area around Bakoa village (Bokito region), with the help of local researchers.

C. Lelong and S. Dupuy have done the preliminary processing (especially radiometric corrections and ortho-rectification) of the very high resolution WorldView2 satellite image over the area of Bakoa, at the east of Bokito, west of Guefigué, and south of Bafia. This image was already acquired ahead of the project, in February 2011, and covers a 80 sq.km rectangle comprised between (4.60°N, 11.11°E) and (4.54°N, 11.26°E). The area is mainly covered by cocoa-based AFS in traditional complex cropping system, but also has some modern systems, which include other tree crops (palm, citrus...), food crops, and savannah. They also prepared the learning data set for remote sensing analysis, collecting different sources of data from several partners and from their own field surveys for the two past years.
They began to select different attributes (from reflectance and texture indices) derived from the satellite image in 8 spectral bands, aiming at discriminating the main land covers and land uses in the mapped area, including cocoa agroforests and cocoa monocrop plantations cultivated under shading of palm, citrus, or others.

S. Dupuy has begun to identify in partnership with P. Pedelahore the survey area in Talba region for dynamics mapping, and has begun to seek for archives on available data acquired in the past over the region.

2.2. Evolution of smallholders' strategies and agricultural activities. Contribution of food crops and AFS to food security and well-being of households

2.2.1. Typology, farmers management and strategies

The activities will start in April 2013, based on the following observations on the two sites:

Bokito: Two criteria can preside over the choice of households to investigate (if new surveys are needed after reviewing the documents and already existing training course reports). The first criterion relates to the level of incomes of the various types of household of the Bokito zone (very poor, poor, average, rich). The second criterion is relating to the importance of the surfaces in savannah held by the agricultural household and, likely to carry food crops (insufficient owned savannah surfaces / sufficient surfaces in savannahs for the household manpower).

Talba: For this site the principal hypothesis to be tested concerns the possible difference of composition and structure of the AFS carried by the small (between 0.1 and 2), the medium (between 2 and 6 ha), the large (between 6 and 30 ha) and the very large cocoa growers (> 30 ha). We indeed formulated the following hypothesis: complex AFS are implemented especially by the small and medium farmers, the simple AFS, or monocrop (cacao alone) are mostly planted by large and very large farmers. The sample retained for the agricultural households or private entrepreneurs must thus cover the diversity of farm size. This is of course in direct link with the level of the incomes of these production units and thus in line with the proposal to make the level of income, the first criterion of choice of the households surveyed for the socio-economic studies of the AFS4Food project.

Farmers indicated that the cacao plantations in "full sun" are rare in the Talba zone. The small and medium farmers explain that they have no financial means (for the purchase of motor saws) and in labour to eliminate all the forest trees present on their lot. All farmers explain that cacao does not like "to be in full sun" because mortality is higher and the plantation decline more quickly. However, we have found two cases of very large plantations where farmers have made the choice to plant, in years 1975-90, full sun plantations, with in rows plantation of cacaos. These two cases are interesting to study because there is a gradual integration in these plots of shade and fruit trees. One of the two cases is particularly interesting from a socio-economic point of view because it corresponds to the "recovery" of a very large plantation by small farmers who made the simple initial AFS evolve into a complex AFS. This evolution is interesting to study because it precedes the future evolution of a part of the very large plantations which are currently developing in the Talba zone and which will be perhaps a day "taken" by the small and medium farmers.

If the full sun cacao-plantations are rare, the discussions with the farmers and a few AFS plots visited during this mission indicate a variation in the level of shading and the level of complexity of the AFS (greater or lesser presence of fruit trees, plantain banana or cocoyam …) among different farmers. First observations suggest that, as expected, this complexity is generally higher for the small and medium farmers than for the large and the

very large ones, but this rule does not always apply and we have observed that some large farmers use a lot of shade and food crops. More precise observations and measures must be made by the researchers of the WP3 to clarify these first observations.

2.2.2. Evaluation of production systems and farm activities

The activities will start in April 2013, with surveys conducted by André Nso Ngang (IRAD).

2.3. Modelling and prospecting at farms and landscape levels

This activity will start in April 2013.

Results of WP2

- Bibliography consulted.
- Sites selected for forthcoming surveys.
- Local researchers are actively working on the project activities.

WP3: Assessment of the productive and environmental performances of AFS and their synergies with food-crops at plot, farm, and landscape levels

3.1. Productive and environmental interactions between AFS and food crops at plot, farm and landscape levels (characterization)

3.1.1. Characterization of indigenous knowledge related to agronomic or environmental functions and uses of the cultivated species (mainly trees species) in a range of AFS and food crop combinations

This activity will start in April 2013.

3.1.2. Assessment of productive and environmental performance of agroforestry and food cropping systems and of their synergy

A survey was made in February 2013 in Bokito area by Hervé Todem Ngnogue (IRAD) on ten cocoa farms, five belonging to farmers using traditional cocoa cultivation practices and five using experimental ones. Data from the last two years' crop production were recorded during this survey.

3.2. Pathways to improve synergies between AFS and food crops at plot level

This activity will start in April 2013.

WP4: Characterization of the AFS main-crop quality for value addition to farmers' incomes

4.1. Characterization of the quality of AFS products at plot level

An IRAD researcher, Abeline Mbesso, was trained at CIRAD in Montpellier on the statistical analyses of cocoa sensorial samples, in September 2012.

Afterward, Abeline Mbesso conducted a three day training session to introduce cocoa liquor flavour tasting to a panel of 15 members of IRAD staff. This session was held in January 2013. The panel was trained to recognize the flavour profiles of cocoa varieties or cocoa samples from different treatments.

Particularly, the recently trained local panel had to classify two series of 16 cocoa samples which were collected by Olivier Sounigo (CIRAD Cameroon) and prepared in November and December 2012. Also, the panel had to assess the differences between flavour profiles of 14 cocoa varieties and of cocoa samples issued from the same varieties, but grown on three different types of soil.

4.2. Identification of main drivers of the quality of AFS products at plot level and at first transformation.

Two experiments were initiated by Flore Eyenga, Sali Ndindeng Atanga and Bella Manga (IRAD) in order to:

- assess the influence of fruit slices on the quality of dried safou;
- evaluate the potential use of safou flour for rice biscuit confection;

In both cases, samples were prepared and will be assessed for their rancidity and acceptability through sensory and chemical analyses.

Reason for modification for the planned activity

No modification were necessary

What is your assessment of the results of the Action so far?

So far, very few finalized results have been produced, since the undertaken actions mainly consisted in preparing the activities (contacts with farmers, identification of farms and plots adequate for the project). However, in some cases (farmer interviews, experiments on quality of the products), data and samples were collected and have been partially analysed, but final results will not be available before July 2013.

Potential risks that may have jeopardized the realisation of some activities and explain how they have been tackled

The activities were never jeopardized during the period

Activities planned but not implemented

The activity 3.2 was delayed but could start beginning of April 2013.

What is your assessment of the results of the Action so far?

The action has just started. The results are not yet available.

Updated action plan

Activities	Year 1												Implementing bodies
	1st Semester						2nd Semester						
Months	1 Apr	2 May	3 Jun	4 Jul	5 Aug	6 Sep	7 Oct	8 Nov	9 Dec	10 Jan	11 Feb	12 Mar	
1.1. Identification of study farms and communities			x	x	x								CIRAD, IRAD
1.2. Creating Eval. committees & Ext. adv. panels							x						CIRAD, IRAD
1.3. Scientific Coordination	x	x	x	x	x	x	x	x	x	x	x	x	IRAD
Workshops							c						CIRAD, IRAD
1.4. Capacity Building							x	x	x	x	x	x	CIRAD, IRAD
2.1. Spatio-temporal Dynamics							x	x	x	x	x	x	CIRAD, IRAD
3.1. Assess interactions AFS and food crops											x	x	CIRAD, IRAD
3.2. Pathways to improve synergies													CIRAD, IRAD
4.1. Characterization of SAF product quality							x	x	x	x	x	x	CIRAD, IRAD
4.2. Drivers of AFS product quality							x	x	x	x	x	x	CIRAD, IRAD
5. Dissemination of results													CIRAD, IRAD

Activity	Following years				Implementing body
	Year 2		Year 3		
Semesters	3 Apr – Sep 13	4 Oct 13 – Mar 14	5 Apr – Sep 14	6 Oct 14 – Mar 15	
1.3. Scientific coordination	x	x	x	x	All partners
1.4. Capacity building	x	x	x	x	All partners
2.2. Evolution of farmers' strategies	x	x			All partners
2.3. Modelling and forecasting			x	x	All partners
3.1. Assess interactions AFS and cash crops	x	x			All partner
3.2. Assess pathways to improve synergies	x	x	x	x	All partners
4.1. Characterization of AFS product quality	x	X	x	x	All partners
4.2. Drivers of AFS product quality	x	X	x	x	All partners
5. Dissemination of results	x	X	x	x	All partners

Reasons of changes

The months of October and November 2012 were characterized by four workshops and conferences on cocoa research held in Yaoundé, which made the researchers unavailable for implementing the project activities during this period.

3.1 has partially started but is starting at a faster pace now, since this activity is currently conducted with the help of students, who were not available before April 2013.

3.2 will start before the end of April 2013, on the same plots studied in 3.1 activities.

2.2.3. Kenya

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WP1: Management

1.1. Identification of target farms and communities

As planned, the AFS4Food team in Kenya has identified, in collaboration with local partners (i.e. ICRAF, CRF and the Union of farmers' cooperatives of Murang'a), the target farms and community in the district of Murang'a.

Criteria for selecting this target zone have been: 1) the existence a dynamic union of cooperatives with whom the AFS4Food partners have collaborated in a previous project; 2) an altitudinal range from 1200 to 1800 m asl, that allows to encompass a wide range of the agro-ecological conditions and tree-coffee-food associations; and 3) the extreme importance of coffee AFS and food crops in a landscape under high population pressure.

1.2. Creation of multi-sector Advisory committees and External advisory panels

So far, the local **steering committee** is not yet officially constituted, but farmers as well as representatives of local authorities, extension services and representatives of NGO working with local communities have been identified and exchanges of information regarding the goals of the project have been taking place in various occasions.

It is foreseen that the first official meeting of the Kenyan steering committee will take place in April 2013, now that the election process is over after the final verdict of the Kenyan Supreme Court (March 30th 2013) and hence that now that the social and political conditions are conducive to do so. An **external advisory panel** was also foreseen and be constituted of representatives of producers, local government and public organizations (extension services and NGOs). Following discussions between partners, we feel that one body (i.e. the steering committee) appears sufficient to give advices and recommendations to the project and that some external advisors with particular insights on specific issues will be asked to join the steering committee meetings whenever necessary.

1.3. Scientific coordination of the funded operations and the network

For Kenya, a management unit has been constituted between ICRAF & CIRAD to follow up financial, technical, and administrative matters and to strengthen the local research network and communication with the coordinator in Montpellier, France, as well as partners in the 2 other countries.

1.4. Capacity building and capitalization of knowledge

The team in Kenya has helped the project management unit to organize the first international workshop that will take place in Yaoundé in October 2012. It has also facilitated the field work of a graduate student (see details below).

The Kenyan team has already started to organize the second international workshop that will take place in Murang'a in October 2013.

Results of WP 1

- Members of the local steering committee identified
- First official meeting of the local steering committee members planned for May 2013 with the Kenyan election process over in March 2013
- Management unit in place

WP2: Characterisation of farming systems and identification of long term drivers at household and landscape levels

2.1. Spatio-temporal dynamics of farming systems

2.1.1. Understand the dynamics of farming systems on the long term

Consultation of bibliographic records, and discussions with researchers based in Kenya, helped to redefine the scope of the study to assess the major types of coffee based production systems as well as some of their main characteristics and dynamic evolution.

Kenyan coffee growing has known for twenty years a decline in domestic production (from 90,000 tonnes in 1990 to 50,000 tons in 2005). This decrease was largely due to the fall in coffee price which was particularly low between 1998 and 2004.

The main production area is located North-East of Nairobi, on the slopes of Mount Kenya, between 800 and 1500 m. This densely populated area (650 to 850 inhabitants per km²) concentrated 82% of the coffee area in 1992. The Central region has a wide diversity of forms of production (involving cooperative sector smallholders / estates), of usages of coffee, all being different depending on the types of farm households and coffee based production systems. The great diversity is very instructive to identify the determinants of the dynamics at work and the development of scenarios. Due to the high diversity of situations, we decided to expand our study area. Initially limited to the Muranga District, we propose to extend it to the whole of the Central Region.

Indeed, in the situation of Kenyan coffee growing, the relationships between coffee based agroforestry systems (coffee-AFS) and food security of rural and urban households are more dependent on socio-economic reconstruction, productivity changes (of coffee or food crops) and farming techniques that occur inside the historical coffee zones and expansion of areas planted with coffee (here no pioneer fronts).

These elements have therefore led to propose the realization of a first zoning of the Central based on experts' knowledge to better characterize and locate spatially the main types of coffee based agroforestry systems. The objective will be to identify trends on the long period (one to two generations of farmers) and their impact on the relationships between coffee-based AF plantations and food security. This zoning will be based in large part on the stratification criteria that makes sense to local stakeholders (= "local experts"). But, interview guides might also recall the need to question farmers on the validity of local criteria for stratification of the Central region (altitudinal gradient, distance from Nairobi ...).

A ten days France - Kenya Mission has been scheduled during the 2nd semester of year 2 of the project, to give time to researchers based in France and Kenya to conduct all this first phase of work. This mission will be preceded by the completion of literature searches and analysis of available statistical data to inform the development of the macro-economic

framework, meso-economic (coffee and food sectors), and demographic at the national level and at the level of the Central region. It will also be preceded by a preliminary identification of local actors (= "local experts") to develop semi-directive interview guides. A Kenyan agricultural technician, paid by the AFS4Food project, will participate in the preparation and in the execution of this mission, and will be responsible for continuing the work initiated in this context.

The results of this zoning will help selecting, in a consistent manner, the different types of coffee-based AFS to be studied, and will give a first estimate of their importance in terms of population, cultivated area and agricultural production (coffee and food crops). These elements are essential to generalise our results to all the Central Region and to support the construction of scenarios (Task 3 of WP2).

2.1.2. Analysis of aerial imagery and Geographic Information System

C. Lelong has identified with the help of P. Vaast, project leader in Kenya, and F. Pinard, the study area where remote sensing images will be used, as a 157 sq.km rectangle comprised between (0.694°S, 36.92°E) and (0.765°S, 37.10°E). It corresponds to the lands south to Kangema, east to Murandia, and West to Muranga, in the Aberdare province. It is mainly covered by coffee plantations in diverse levels of agroforestry associations and complexity.

A very high spatial resolution Worldview2 satellite image was ordered, but not yet acquired. C. Lelong's mission in Kenya for the training of mapping survey researchers is scheduled in June 2013. This activity will be continued during the first half of year 2 of the project and will continue during year 3.

2.2. Evolution of smallholders' strategies and agricultural activities

This activity has for objective to assess the contribution of food crops and AFS to food security and well-being of households.

In preparation to the visit of a socio-economic expert in December (3rd to 12th), the local team has gathered information on the diversity of farms and cropping systems, and identified the main strategies regarding tree crop management, animal husbandry and food-crops systems at farm level in the target zone.

2.2.1. Typology, farmers management and strategies

The first bibliographic readings and initial discussions with researchers based in Kenya helped providing the first elements on the evolution of strategies of farm households and highlighting the need to define before the start of the investigation, the unit of observation relevant to remember.

Approximately 60% of Kenya coffee is produced by 600,000 smallholders grouped in cooperatives. The relative weight of these smallholders in the Kenyan coffee production is decreasing compared to that of large coffee estates. In 1992, the smallholders represented 65% of the national coffee production. Initial analyses suggest that the decline in coffee production by smallholders is not due to a decrease in their number, but rather to a decrease in the areas under cultivation (coffee is replaced by food crops and livestock) and the decrease in yields per hectare due to less intensive crop management, inputs and labour. Although uprooting of coffee has been forbidden for a long time by the "coffee act", it is now well established among smallholders. They have changed from pure coffee plantations to the establishment of production systems that combine coffee with shade trees, fruit trees, food

crops (banana, potato, bean, corn ...) and in some areas cattle for milk production. The coffee areas represent not more than 1,600 m² of the utilized agricultural land in farm of 1-2 ha size. Nowadays, coffee represents only around 15% of farm income in the household. Another noteworthy fact: the average age of smallholders is 61 in the Central region. Due to the degradation of farm and farm size, the younger generation has largely invested in non-agricultural activities: driver, supermarket employees, tourist guide.

Therefore, the question of the future of the coffee-AFS and their role in Kenyan household food security appears largely based on the life strategies of this new generation. Will the young people replace their old farmer fathers? What will be the functions that they will assign to these land areas (heritage identity and family self-sufficiency, source of cash income ...)? The answer to these questions depends on the strength of the scenarios that we will be able to establish.

These considerations suggest that the observation unit to adopt for socio-economic surveys probably cannot be limited to solely household members permanently living in the farms and agricultural activities.

The second part of the France / Kenya mission was used to specify the agricultural production units, consumption, acquisition and management of cash income (farm and nonfarm) and accumulation capital, households in the Central region. Here also, we will rely on the semi-structured interviews conducted with a first sample of households selected according to the results of earlier zoning and the age of the farmer (young / old). Therefore, this sample will concern different types of smallholders and families or entrepreneurs who own the large coffee estates and operate currently in major coffee production areas (average size of coffee estates = 34 ha / estate). These interviews will also seek to identify the first elements of strategies and outlook of these production units and agricultural characteristics (complexity levels of coffee-AFS, cash-crop association, level of technical intensification ...), and their results (agricultural productions, cash income ...). This second part of the mission will be preceded by some bibliographical synthesis of work already done on the characterization of agricultural farms in the Central Region and in particular on the analysis of the results of surveys already carried out within the framework of the CAFNET project, by the Kenyan partner, among 50 farmers in the Muranga area. These factors should enable us to precisely define the observation units to be used for future surveys and to specify the variables to use. The Kenyan agricultural technician will participate in the preparation and execution of this mission and will be responsible for the implementation of semi-structured interviews to further achieve this early knowledge. A Cameroonian student will start working in May 2013 with the technician in charge on upcoming surveys (semester 1 of year 2 of the project).

2.2.2. Evaluation of production systems and farm activities

This part of the activity should start in the 2nd semester of year 2 of the project or the 1st semester of year 3.

2.3. Modelling and prospecting at farms and landscape levels

No activity has been done during this semester.

Results of WP 2:

- Sites selected for forthcoming surveys.
- Data set on main features for around 60 households.
- Typology of coffee AFS farms in progress

WP3: Assessment of the productive and environmental performances of AFS and their synergies with food-crops at plot, farm, and landscape levels

3.1. Productive and environmental interactions between AFS and food crops at plot, farm and landscape levels (characterization)

3.1.1. Characterization of indigenous knowledge related to agronomic or environmental functions and uses of the cultivated species (mainly trees species) in a range of AFS and food crop combinations

The characterization of local knowledge on agroforestry practices and key attributes of trees associated to coffee and, to a lesser extent, associated food crops has already been intensively undertaken in the target zone by a previous project. ICRAF is currently working on a publication (expected end of 2013) in that respect. They are also refining the tool to select trees according to their desirable attributes for a beneficial association with coffee and food crops and in accordance to farmers' needs.

3.1.2. Assessment of productive and environmental performance of agroforestry and food cropping systems and of their synergy

For 5 months (April to August 2012), a MSc student from Morocco, has conducted interviews of farmers on their household strategies, collected information on the various cropping systems (coffee and food crops) and their management in a series of 50 farms, registered basic information on the main productions in each farm, and completed an inventory of trees species and their position with respect to cropping systems and farm boundaries.

From September to December 2012, an ICRAF technician has completed this work with an extra 15 farms so that a total of 65 farms is fully documented, including GPS. This will greatly facilitate the remote sensing work, based on very high resolution satellite images, that is planned for mid-2013.

Furthermore, soil sampling and analyses have been undertaken in all the target farms which allow the assessment of carbon sequestration in the various cropping systems, as well as providing baseline information on soil fertility on all the reference farms.

Coffee pathology:

It is currently plan to initiate the coffee plant pathology activities by the first week of May with the onset of main rainy season in Central Kenya. Principal objectives include:

- Monitoring Coffee Berry Disease, Coffee Berry Borers and Leaf Rust on coffee in specific locations.
- Data analysis in relation to climate data and shade plot characteristics.

During the last trimester, preliminary activities include site selection, contacts and discussion with Coffee Research Foundation to construct research collaboration on the subject and student interview/selection for short-term recruitment.

Currently:

- Collaboration with the plant pathology unit from CRF has been initiated for joint implementation of field activities;
- One student in plant pathology from AGRO-ParisTech (France) is recruited, expected to arrive in Kenya by the 20th of April.

- One site selected in Muthiti (Muranga District) to host the experiment; the site characterization is initiated and the farm has already been equipped with 10 automatic climate data loggers.

Expected results:
Although the complete set of observation is planned for the period from April 2013 to June 2014, preliminary results should be available by the end of September 2013.

3.2. Pathways to improve synergies between AFS and food crops at plot level

Farmers' interviews already undertaken (see details above) are the first step in the assessment at plot level of the trade-offs and synergies of AFS containing food crops in terms of productivity and services. Clearly, this particular sub-activity will go on during the full duration of the project. A graduate student from Cameroon will be arriving in Kenya late April 2013 to contribute partially to understand better framers' strategies and constraints.

Results of WP 3:

Species inventory and measurement of all trees present in 65 farms.

- Description of the various cropping systems (coffee monoculture, coffee associated with trees, coffee and food crops, mixed food crops)
- Description of the traditional tree management
- Description of the traditional cow manure production and timing of organic amendment in coffee and food crop plots
- Database on soil characteristics of all target farms.
- Soil samples collected in all the cropping systems of these farms and soil analysis (carbon & nitrogen) undertaken for 188 soil samples.

WP4: Characterization of the AFS main-crop quality for value addition to farmers' incomes

4.1. Characterization of the quality of AFS products at plot level

In Kenya, project partners have already initiated discussion on the sampling strategies to be implemented over the coming harvesting seasons in order to assess the effects of

- altitude (along an altitudinal gradient going from 1200-1800 masl),
- shade (composition & intensity),
- soil types
- and coffee genotypes (traditional cultivars versus improved ones recently released)

on coffee quality and some biochemical compounds (mainly chlorogenic acid, caffeine ...).

Early January 2013, the workpackage leader came for a 5-day visit to Kenya in order to develop protocols on this aspect and plan the field activities for the coffee harvest of 2013. Plot selection is foreseen in May 2013.

4.2. Drivers of the quality of AFS products at plot level and at first transformation

In Kenya, the main objective will be to assess the influence of the post-harvest process in determining the best coffee quality. Project partners have already identified their strategy towards this objective, namely to take coffee samples in the different coffee processing units that are located at various altitudes in the coffee landscape. Processing units will be selected in June-July 2013 once the plot selection is completed in May (see above).

Reason for modification for the planned activity

Clearly, the official constitution and the first meeting of the steering committee, originally planned for December 2012, have been postponed by several months due to the fact that the election campaign and process over the last 4 months have created in the project target zone social conditions that were not favourable.

What is your assessment of the results of the Action so far?

Partners are collaborating fully and farmers' representatives and local authorities are also keen to participate and share their views. Clearly, there is already from a previous project (CAFNET: Connecting, enhancing and sustaining environmental services and market values of coffee agroforestry in Central America, East Africa and India) many valuable information that have allowed the Kenyan team to select and work (see detailed below) on target farms.

Potential risks that may have jeopardized the realisation of some activities and explain how they have been tackled

So far, no major problem has been encountered in the target zone. As pointed out above, there was a risk of possible civilian unrest due to the fact that Kenya went through general elections, including presidential election, in March 2013. As we anticipated, fieldworks and meetings with local stakeholders were stopped during the first months of 2013. Nonetheless, intensive field activities and meetings had already undertaken from May to December 2012 in terms of farm selection and characterisation (see details below) and socio-economic surveys in November-December 2012. With the election process over late March 2013, field activities and interactions with local stakeholders will resume fully during the month of April 2013 (see below).

Activities planned but not implemented

None

What is your assessment of the results of the Action so far?

Farmers are fully collaborating and providing ample information on their management strategies and constraints during interviews while often helping to take soil samples in their various cropping systems.

Due to possible civilian unrest due general election in Kenya in March 2013, the fieldwork was halted from January to late March 2013 as mentioned above.

Updated action plan

Activities	Year 1												Implementing bodies
	1st Semester						2nd Semester						
Months	1 Apr	2 May	3 Jun	4 Jul	5 Aug	6 Sep	7 Oct	8 Nov	9 Dec	10 Jan	11 Feb	12 Mar	
1.1. Identification of study farms and communities			X	x	x								CIRAD, ICRAF
1.2. Creating Eval. committees & Ext. adv. panels				x	x				x	x			CIRAD, ICRAF
1.3. Scientific Coordination	x	x	X	x	x	x	x	x	x	x	x	x	ICRAF
1.4. Capacity Building							x	x	x	x	x	x	CIRAD, ICRAF
2.1. Spatio-temporal Dynamics							x	x	x	x	x	x	CIRAD, ICRAF
2.2. Evolution of farmers' strategies							x	x	x	x	x	x	All partners
3.1. Assess interactions AFS and food crops													All partners
3.2. Pathways to improve synergies													All partners
4.1. Characterization of SAF product quality									x	x	x	x	All partners
4.2. Drivers of AFS product quality									x	x	x	x	All partners
5. Dissemination of results							x	x	x	x	x	x	All partners

Activity	Following years				Implementing body
	Year 2		Year 3		
Semesters	3 Apr – Sep 13	4 Oct 13 – Mar 14	5 Apr – Sep 14	6 Oct 14 – Mar 15	
1.3. Scientific coordination	X	x	x	x	All partners
Workshop		x			
1.4. Capacity building	X	x	x	x	All partners
2.2. Evolution of farmers' strategies	X	x			All partners
2.3. Modelling and forecasting			x	x	All partners
3.1. Assess interactions AFS and cash crops	X	x			All partner
3.2. Assess pathways to improve synergies	X	x	x	x	All partners
4.1. Characterization of AFS product quality	X	X	x	x	All partners
4.2. Drivers of AFS product quality	X	X	x	x	All partners
5. Dissemination of results	X	X	x	x	All partners

Reasons of change

1.2. The core of the evaluation and advisory committees is created, but the members might still change depending on the possible evolutions of the project. A meeting is scheduled for May 2013.

2.2. This activity can be started together with 2.1. It has been added to the first year timetable. A French mission was done in December 2012 to supervise the technician's activity.

3.1. This activity started in April 2013. It was delayed due to presidential elections.

3.2. This activity will start after activity 3.1; i.e. in year 3 (end 2013).

4.1. This activity started in December 2012.

2.2.4. Madagascar

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WP1: Management

1.1. Identification of target farms and communities

Two sites were identified: Fénérive East (main site) and Ile Sainte Marie (limited actions). Features: A large number of on-going works supported by other funding need to be exploited before starting WP2 activities. In addition, it is important to take into account the dynamic variations between Fénérive and Sainte Marie.

The selected areas are mapped in annex 5.2.3.

1.2. Creation of multi-sector Advisory committees and External advisory panels

The composition is as follows:

- Regional Director of CIRAD in Madagascar,
- President CTHT and Executive Director of CTHT,
- Regional Director of Rural Development for the Province of Toamasina,
- Representative of ESSA conference (University of Antananarivo),
- Exporters of clove oil and nails (SCIM and Wu Chao Ying),
- 1 representative of clove farmers.

1.3. Scientific coordination of the funded operations and the network

The local management is organized and is fully functional.

1.4. Capacity building and capitalization of knowledge

See below.

Results of WP 1

- Members of the local advisory committee identified
- Producers and producers' groups of nails and oil
- NGOs and support structures
- Exporters and importers

WP2: Characterisation of farming systems and identification of long term drivers at household and landscape levels

2-1: Spatio-temporal dynamics of farming systems

2.1.1. Understand the dynamics of farming systems on the long term

This activity is pending receipt of thematic maps, aerial photos and satellite images in order to perform the analysis of the physical environment.

Study on the history of clove production

A historical study on the evolution of the clove sector was conducted by a trainee of ESSA on the analysis of the existing bibliography at Antanarivo. This study caused a report of end of study and a working paper: "historical evolution, and inventory of the clove sector in Madagascar". This work is supplemented by an analysis of the databases in France and will lead to the drafting of an article which will be subjected to a review with impact factor.

In addition, a first student training course on farmers' strategies on clove-based agroforestry systems and associated crops in both Sainte-Marie island and the east coast of Madagascar carried out by CIRAD in 2010, raised many questions on the clove sector and its evolution since the introduction of the plant in the XIX th century. The current cultivation systems vary between the pure plantation, the agroforestry systems and in very high proportion the sparse systems containing cloves derived from the old mono-specific plantations of clove and which now are much diversified. The resource giroflière is growing old and only some cases isolated from replanting were noticed. However Madagascar holds an important place in the international market of the clove because it appears among the main producers and exporters of nails and petrol of leaves. A historical study of the conditions of establishment was necessary not only to understand how the sector but especially for better distinguishing evolved the points of rupture which led to the current situation.

This study mainly consisted in analysing the existing data bases. The first data obtained allowed to recall the history of clove in Madagascar since its introduction until nowadays to then determine the constraints and opportunities as well as the main economic issues.

A scientific synthetic article is in progress. The title will be: The Clove in Madagascar: history of a "success story".

2.1.2. Analysis of aerial imagery and Geographic Information System

C. Lelong and A. Desbrosses have worked to decipher the scientific questions addressed by the partners in Madagascar, and to locate the study area, which happened to be more or less focused in the Fénérive district. A first rough delimitation was rendered possible, with the help of C. Cornu and M. Jahiel.

A. Desbrosses organized a cooperation contract between P. Danthu (regional director of CIRAD in Madagascar), P. Tessier (responsible of the SEAS-OI station in La Réunion), and the CTHT, in order to benefit from free acquisitions of SPOT imagery. She also analysed the potential of already acquired Quickbird data over the area of interest, but found that they are only a pan-sharpened "true-colour" image without the infrared band neither the original radiometric values, so it is far from exploitable. Thus, she analyses the possibility (technical

and financial) to acquire a new, and complete data set, most probably “Pleiades” imagery due to its lower price. The area to be covered is still under discussion among the team.

As originally planned, this activity will be followed by a Master 2 trainee on Remote sensing, which will be launched on the first half of the year 3 of the project (April 2014).

The land use in the cloves production area and structuration of various production systems (monocrop plantations and more or less complex agroforestry systems) and dynamics will be addressed through the following themes:

1. A study of the history of the production of cloves in Madagascar (nail and oil)
2. A study on the dynamics of land use and the development of clove trees population in relation to climate risks by mapping analysis at different times (aerial photographs, satellite images).
3. A field survey to validate and supplement the information obtained previously to assess the resilience of different systems and the potential for development of production in the study area.

A study on the occupation of space dynamics and on the evolution of the clove population in relation to the climatic risks by mapping analysis at various periods (aerial photographs, satellite images) has started in Fénérive in the framework of a master 2 on remote sensing, funded by University of La Réunion. The main results are described in annex.

2-2: Evolution of smallholders’ strategies and agricultural activities

2.2.1. Typology, farmers management and strategies

This theme was studied through students training courses:

- A first study carried out in 2010 (Study of forest and agroforestry systems and country strategies associated in Sainte Marie island and on the east coast of Madagascar, 2010) financed by CIFOR.
- Two studies carried out in 2012 on Sainte Marie island (where clove was firstly introduced in Madagascar), financed by CIRAD. These studies were carried out from April to August 2012 by two students of SUPAGRO/IRC, Montpellier. The first study (5-months duration) focused on the characterisation of clove farms. A typology of the situation and modelling of the main types of farms was done, but it did not show the share of income resulting from clove (i.e. other spices, agricultural and extra off-farm activities). Two study zones were selected in the North and the Centre of the island corresponding to contrasted situations. This study emphasised the complexity of relations between the owners of different the types of rights: right on land, right on the tree, and right on use of clove nails or leaves. This study was carried out by a of SUPAGRO/IRC student. The second study (2.5-months duration) focused on the characterisation of the various clove-based cultivation systems and on the typology of the systems formerly identified in 2010. About thirty plots were studied on different East-West transects in the island in the two same villages selected for the first study. The results showed a very great variability of the systems and the importance of the crops associated with clove, even though clove remains the first source of income, as vanilla and some off-farm activities (fishing, and other activities linked with tourism). Both studies finished end of August 2012.

The reports and associated working papers are available and the results are summarised in annex.

These studies were supplemented by a third study which included two more villages on Sainte Marie, making it possible to comprehend the whole of this island's problems. The study focused more specifically on certain methods which were insufficiently studied by the two previous studies. The training course was carried out from September to January 2013. The main results are described in a pre-report entitled "Analysis of the clove based production systems in Sainte Marie island- Madagascar", and the results are summarised in annex.

2.2.2. Evaluation of production systems and farm activities

This work will be done in the zone of East Fénérive, where the clove culture is concentrated and located on larger areas. The forthcoming surveys started in April 2013 with a trainee from IRC.

2.3. Modelling and prospecting at farms and landscape levels

Not yet started.
This theme will start when the preceding topics are completely treated.

Results of WP 2:

- Bibliography consulted.
- Typologies of the farming systems on Ste Marie island are described.
- Students' reports are available.

WP3: Assessment of the productive and environmental performances of AFS and their synergies with food-crops at plot, farm, and landscape levels

3.1. Characterization of productive and environmental interactions between AFS and food crops at plot, farm and landscape levels

3.1.1. Database of knowledge of farmers regarding the use and physical characteristics of tree species in each project site

The first inventories of the woody species composing the various clove based agroforestry systems began at the time of the surveys conducted within the framework of the studies conducted to St Marie and Fénérive (typology).

3.1.2. Typology of clove producers in relation to the diversity of production systems

The typology of the clove producers in the regions of Fénérive and Sainte Marie was carried out within the framework of two training courses.

Training course 1 - Region of Sainte Marie: Description of East-West transects in the island, and description of the cultivation systems for 30 clove plots representative of the typology of the cultivation systems.

The study was done in the framework of a training course done last year (June to September), under the supervision of local CIRAD researchers. The objective was to identify the plots variability: types of crop associations and an estimate of clove yields. Expected results are two reports describing the clove plots and transects in two selected villages.

Training course 2 - Region of Fénérive: Typology of the practices in the producing farms. It was carried out in the scope of an engineer training course in Madagascar under the supervision of the CTHT executives.

Further investigations were conducted in order to refine the diagnostic already done. It was in particular a question of assessing the diversity of the clove-based cropping systems, sometimes observed at the level of the same farm, but not taken into account in the first analysis. In the same way, it was a question of refining the knowledge on the incomes and strategies of the producers in order to better know the place of the clove in the households' economy. It was finally a question of refining the knowledge of the practices at the plot level, in particular by characterizing best the composition of the agroforests and their uses.

Field surveys were conducted during the second half-year of the project, and the analysis of the raw data was carried out. One Cirad researcher from La Réunion carried out a mission at the end of 2012 to help analysing the raw data and write the progress report, particularly to validate a certain number of assumptions arising from the expertise acquired by the investigator during her field work.

These assumptions will guide the phase of analysis. Among the points raised at the time of this mission, it appeared necessary to supplement the number of farms to study in order to include the farms currently setting up new plantations in the analysis. The survey phase is now finished. On the whole, 93 plots and 73 exploitations were surveyed. The analysis of the results will be carried out using statistical tools for multivariate analysis (software R, modules ADE4) during the second year of the project.

3.2. Pathways to improve synergies between AFS and food crops at plot level

This activity has three objectives:

1. Agro-economic performance of the AFS and appreciation of their contribution to the food safety and the farmers' means of subsistence of (combination of products, source of food, annual distribution of the products, etc.).
2. Impact of pests and diseases on the production in the plots available, in relation to the trees diversity and the layout and the microclimatic conditions
3. Effects of the trees and the food crops on the soils fertility maintenance of the AFS.

These activities have not been initiated because they are following the typology of producers and production systems.

However, a first characterisation of the clove plots was carried out for the Island Sainte Marie in 2012 by a trainee of the IRC. Two reports of the description of the plots were returned in August 2012.

Results of WP 3:

- Typology realized
- Students reports available

WP4: Characterization of the AFS main-crop quality for value addition to farmers' incomes

4.1. Characterization of the quality of AFS products at plot level

4.1.1. Comparison of Malagasy species with species from other major producing countries (Indonesia, Tanzania)

The objective of this work is to compare the composition of oils in bud, leaf and stem of *Syzygium aromaticum* and then to evaluate the correlation of anatomic and geographic origins of the oil.

Experimental trial:

The clove oils of *Syzygium aromaticum* used in this work were commercial samples provided by either industrial exporting companies in Madagascar (94 samples), compared to samples from Indonesia (12 samples), and Zanzibar (15 samples). The oil was obtained by a steam-distillation method using an industrial type distiller for 12 hours. The oil samples were dried through anhydrous sodium sulphate (Na_2SO_4) and stored in a cool and dark room until their analysis by Gas Chromatography (GC).

Results:

The oil samples analysed by GC contained up to ten components. The major component found in the bud, leaf and stem oils was eugenol, with increasing percentages from bud (72.08 - 82.36%), then leaf (75.04 - 83.58%) and stem (87.52 - 96.65%). In the clove bud, the second major component in oil is eugenyl acetate (8.6 - 21.3%). It was detected in considerably lower amount in the leaf (0 - 1.45%) and in stem (0.07 - 2.53%). In leaf oil, the second main components were β-caryophyllene (11.65 - 19.53%) and α-humulene (1.38 - 2.17%). They were less represented in bud oils (2.76 - 8.64% and 0.34 - 1.04% respectively) and in stem oils (1.66 - 9.7% and 0.22 - 1.31% respectively).

For each plant material, variation in the percentage of the main components was observed according to the geographic origin of the samples. In fact, in all oils, eugenol was the main component, with decreasing percentages from Madagascar (93.91%), then Indonesia (89.02%) then Zanzibar (88.46%). This component is followed by β-caryophyllene with increasing contents (3.38, 7.58 to 8.27 % respectively). Out of these two components, a significant difference was also observed with respect to eugenyl acetate and could be used to discriminate the three origins. The results will be available in an article titled: **"Bud, leaf and stem oil composition of clove (*Syzygium aromaticum* L.) from Indonesia, Madagascar and Zanzibar."** This article will be submitted at *Natural Product communications*.

4.1.2. Determination of quality oils and nail sheet in relation to the complexity of the structure (AFS monoculture agro-forest simple and complex) and seasonality of production

The overall objective of this study is to evaluate the sources of variability determining the quality of clove nails, the chemical composition of oils in nail, leaf and stem to understand their origins to optimize the conditions of clove oil production that meet the quality criteria

sought on the international market: a highest possible content in eugenol, and β-caryophyllene eugenyl acetate.

The scientific question that this study seeks to answer is "What are the determinants of the variability of the quality of the nails, yields and chemical composition of oils of nails, leaves and stems of cloves?

This variability may have multiple origins (non-exhaustive list):

- Individual (difference between individual trees or age-related),
- Climatic (seasonal effects, rainfall ...),
- Inter-annual and geographical (topographical orientation),
- Environmental (types of farming systems, and agroforestry),
- Farming practices (trees collection management),
- Post-harvest treatment (storage durations, distillation methods and durations).

To answer the question and unlike numerous works (the vast majority) addressing the issue of the variability of oils, the procedure that we developed in this study was based on two innovative principles that we believe relevant: (i) develop a traceability method from the harvest of nails and oil in plant materials collected on each identified tree until analysis, (ii) take into account both climatic factors and factors modulated by cultural practices to assess the individual variability of the main clove products.

To achieve these targets, three training courses were conducted.

Work 1:

Title: Oil composition of *Syzygium aromaticum* buds from Madagascar: Effect of harvesting date on the oil composition

Objective:

The Objective of this work is to characterize *Syzygium aromaticum* buds through its oil at different growing stages to determine the optimal accumulation period of desirable compounds.

Materials and methods:

Cloves buds of *Syzygium aromaticum* were monthly collected at different harvesting periods from three individual trees grown in the region Atsinanana of Madagascar, fokontany Analamalotra (S 18°05’28 / E 049°21’41). Harvesting period was extended from July 2012 (formation of cloves buds: young buds) to end of February 2013, (fruiting, ripe fruits).

Approximately 100 g of fresh clove buds from each tree were submitted to hydro-distillation during 4 hours using a Clevenger apparatus. The oils obtained were separated from water by decantation, dried over anhydrous sodium sulphate (Na_2SO_4) and the yields evaluated (%, v/w of dry weight). Moisture was determined using the thermo-scale type Sartorius MA 45, at 130 °C temperature and of 4 mg weight loss per 24 sec. The extracted oils were stored at 4 °C until required for analysis by Gas Chromatography (GC).

Results:

The oil composition of *Syzygium aromaticum* bud during its different growing stages was determined. The effects of harvesting dates were significant on some physical properties of *Syzygium aromaticum* bud, weight, length and diameter. The increase of clove buds weight (13 to 531 mg per bud) was strongly positively correlated with diameter (3.to 11 mm per bud) and length (5.8 to 25.9 mm per bud) during the eight harvesting time. Oil yields varied from 17.5 to 2.5 %, reaching a maximum in September (17.9 %). After that, it rapidly decreased. The decrease of oil yields was strongly negatively correlated with moisture content from 47.6 to 79.6 % (R^2 = – 0.7212) during all stage. GC analysis of cloves buds oil composition allowed identifying four components (eugenol, eugenyl acetate, β-caryophyllene and caryophyllene oxide). The cloves buds oil composition was characterized by high levels of eugenol and eugenyl acetate; these two components had a contrasting evolution during all harvesting date. When eugenyl acetate reached its highest percentages in July (57.0 %) and in August (55.7 %), eugenol reached the lowest ones with, respectively, 40.4 % and 39.8 %, but when the eugenol reached a maximum percentage in January and February with 95.3% and 94.5 %, respectively, eugenyl acetate reached a minimum of 2.5 % and 2.0 %. The PCA and ACH made it possible to distribute the 24 samples analysed into two chemical patterns. This first chemical pattern, characterized by lower percentage of eugenol (45.5 %) and high content of eugenyl acetate (51.3 %), is constituted by samples of clove buds oil harvested from July to October (budding stage). The second, characterized by high eugenol content (92.8 %) and lower percentage of eugenyl acetate (11.7 %), is constituted by samples collected in full budding (November) to end of fruiting (February).

Conclusions:

The results reported on the oil of the clove buds at different development stages revealed great differences. It may be suggested that these differences could be due to the harvesting time effect as well as the environmental conditions. The most significant differences between the eight harvesting date were the changes in oil yield and in the percentages of its main compounds (eugenol and eugenyl acetate).

Work 2:

Title: Chemical Composition of Volatile Oil from Intact and Fallen Leaves of *Syzygium aromaticum.*

Objective:

A work was therefore undertaken to explore the variability in the content and chemical constituents of the volatile oil of *Syzygium aromaticum* leaves at different stages, *i.e.* intact (juvenile and adult leaves) and brown leaf litter.

Materials and methods:

Five individual trees of *S. aromaticum* growing in the region Analanjirofo, east of Madagascar, fokontany Ambatombary (S 17°20’14 / E 49°21’07) were selected for collection of plant material used in the present study. Juvenile (rose in colour) and adult (dark green in colour) intact leaves were taken from the trees, and leaf litter (brown coloured non-decayed leaves) was collected on the soil under the tree. Oil was obtained from all the three leaf types by hydro-distillation in a Clevenger’s apparatus over 4 h. The oils obtained were separated from water by decantation, dried over anhydrous sodium sulphate (Na_2SO_4) and the yields evaluated (%, v/w of dry weight). Water content was determined using the thermo-scale type Sartorius MA 45, whit temperature at 130°C and weight loss of 4mg per 24 sec. The extracted oils were stored at 4°C until required for analysis by Gas Chromatography (GC).

Results:

The amount of volatile oil of *S. aromaticum* was found to be maximum in the juvenile leaves (5.05±0.43) followed by adult leaves (3.48±0.33) and leaf litter (2.35±0.18). The greater amount of oil in juvenile leaves the maximum amount could be attributed to a higher rate of biosynthetic activity. The increase of amount of volatile oil was strongly positively correlated ($R^2 = 0.9237$) with that of water content from 51.30 % ± 1.00 to 10.89 % ± 0.35 following the three types of leaves.

GC Analysis of three types of *S. aromaticum* leaves oil composition showed four identified compounds: eugenol, β-caryophyllene, eugenyl acetate, and caryophyllene oxide (Table 2). In all the three types of foliage eugenol (49.86 – 89.08 %) was identified to be the major compounds followed by eugenyl acetate (0.20 – 36.46 %). The content of the eugenol was also nearly same in adult and litter leaves being nearly 89.08 and 84.17 %, respectively. However, it was only 49.86 % in Juvenile leaves. In contrast to eugenol, the amount of eugenyl acetate was maximum in Juvenile leaves (36.46%) and almost similar (0.75 %) in adult and litter leaves (0.20%). The amount of β-caryophyllene (11.54%) and caryophyllene oxide (1.50%) was highest in juvenile followed by litter leaves, 9.14 and 1.20 % respectively to reach minimum in adult leaves, 7.05 and 0.91 % respectively. The variations in the constituents and their respective amounts in the three types of leaf oils could be due to the difference in the metabolic stage of leaves.

Conclusion:

It is thus evident from the above results that although the oil composition from different leaves of *S. aromaticum* was more or less the same, yet there was a great variation in the relative amount of major constituents. The litter leaves with a relatively higher amount of eugenol (84.17%) could serve as an important source for commercial exploitation.

Work 3:

Title: Effect of drying on yield and chemical composition of *Syzygium aromaticum* leaves

Objective:

The objective of this work was to evaluate the effect of drying on yield and chemical composition of *Syzygium aromaticum* leaves to optimize the production of their oil.

Materials and methods:

The adult leaves of *Syzygium aromaticum* used in this study were collected in Analanjirofo region, east of Madagascar (17 ° 20 ' 14 / E 049 ° 21 ' 07) in December 2012 on ten trees taken at random. Leaves of these ten trees were bulk brewed. The shade drying of leaves was done during 15 days. The raw material was spread in fine layers and turned frequently. The temperature varied 25 in 38 °C during the period of the drying. The oil extraction was realized every day by hydro-distillation of three samples of 400 g stemming of “bulk” in Clevenger apparatus over 4 h. The oils obtained were separated from water by decantation, dried over anhydrous sodium sulphate (Na2SO4) and the yields evaluated (%, v/w of dry weight). Water content was determined using the thermo-scale type Sartorius MA 45, at 130 °C temperature and of 4 mg weight loss per 24 sec. The extracted oils were stored at 4 °C until required for analysis by Gas Chromatography (GC).

Results:
During the drying period, the moisture content decreases gradually then becomes more or less constant. So it evaluate from 54.78 % to 11.42 %.

The oil yield increases according to the drying period, and then falls to tend to stabilize from eighth day of drying. The increase of oil content during the first days of drying is proportional in the decrease of moisture content. The maximum of oil content is obtained in the sixth day (5.58 ml by 100g of DW).

Analyses on GC of 75 samples of Syzygium aromaticum leaves allowed identifying four components: eugenol, β-caryophyllene, eugenyl acetate and caryophyllene oxide. The content in eugenol, β-caryophyllene and eugenyl acetate, with P value calculated respectively by 0.768; 0.501 and 0.114; in the threshold alpha □0.05, do not vary significantly with the duration of drying period. On the other hand, an irregular variation of caryophyllene oxide is noticed with P value calculated by 0.001.

Conclusion:
This work showed that the oil yield of Syzygium aromaticum leaves varies significantly whit the drying period. The best yield, 5.58 ml by 100g of DW, is obtained in the sixth day of drying. In the same condition, the chemical composition is not affected considerably.

For an industrial undertaking concern, it is thus advisable to extract the oil of Syzygium aromaticum leaves approximately one week after their harvest, because the content in oil would be for its maximum. Beyond this period, leaves lose quantitatively and qualitatively their oil.

4.1.3. Influence of tree crop productivity on the final product quality

This topic is currently studied through three student training courses.

Work 1:

Title: Development of clove performance in Madagascar: the effect of endogenous and environmental factors

The study was started during last semester through a training course done in the framework of a DEA at University of Antananarivo.

Objective:
The objective of this work is to provide the first knowledge basis about the factors influencing the flowering of clove, and therefore the development of nail performance. This work will follow several cycles of nails production to quantify the yields fluctuation. We are interested in the flowering of a point of view of yield and for its development over time (more or less synchronized within the trees and between the trees: effect on the maturity and nails quality, many harvest rounds). Given the current knowledge on clove and more generally on tree flowering, and field observations done in December 2011, three assumptions are made about the nature of these factors:

- Factors specific to the species: flowering is related to architectural development in terms of structural and temporal, of the tree;
- Environmental factors: temperature, rainfall, soil type, water supply ...;
- Farming practices: particularly severe pruning of trees for distillation can affect flowering.

This year was devoted to the implementation of monitoring the phenology and climate in the areas of Tamatave and Fénérive and periodic monitoring of the occurrence of different plant (buds, branches, leaves) and reproductive (inflorescences drafts , claws and nails) organs.

Preliminary results:

The observations related to 32 trees (20 in Tamatave area and 12 in Fénérive area) showed that cloves are distributed on tanety (hillsides) and lowland. The trees in Tamatave areas were differentiated according to whether they are pruned or not pruned. The results of the observations done since March 2012 showed a very weak flowering. On the 640 axes studied at the beginning, only about ten gave well differentiated inflorescence in June. These floriferous axes are gathered on same trees which in majority are located on lowland. From the architectural point of view, they are also characterised by a former flowering. The easier access to water and the climatic conditions can explain why only certain trees flowered on the same site. The trees located on tanety for Tamatave, having been pruned, did not flower and present branches which dried out in the course of time. The evolution of floral buttons is not synchronous with the floriferous branches. Deeper observations in time are necessary to specify the factors producing clove. These will be continued during year 2 of the project. At present, the sampling is initiated to map the oil quality in relation with the production system. Two students (University of Antananarivo, Ecole Supérieure des Sciences Agronomiques) were appointed to realize a study on the quality evaluation in the relation with the distillation system and to have information about the best conditions to obtain oil with high content of eugenol. They are working on these topics during three months (12 February to 12 May 2013).

Work 2

Title: Effects of the distillation parameters on the quality of oil of *Syzygium aromaticum* leaves: Studies of the functioning of traditional “alambic” in the district of Ambatoharanana, region of d' Analanjirofo east of Madagascar

Objective:

The objective of this work is to study the yield and the chemical composition of clove leaves oil according to the species, and how to improve distillation to optimize the conditions of production oil.

Expected results:

The study should bring actualized information as for the impact of the methods and the handling of distillation on the yield and the quality of clove leaves oil, collected in the Malagasy context so that these products correspond to the international standards.

Work 3

Title: Chemical characterization of the *Syzygium aromaticum* leaves oil from Madagascar: Influence of treatments and state of leaves on the quality of oil.

Objective:
The objective of this work is to evaluate the sources of yield variability and the oil chemical composition of Syzygium aromaticum leaves to understand their origins and to optimize the production conditions.

Expected results:
The study should bring information objectified as for the methods impact and the conduct of distillation on the yield and the quality of clove leaves oil, collected in the Malagasy context so that these products correspond to the international standards.

4.2. Drivers of the quality of AFS products at plot level and at first transformation
This activity will be initiated during the second year.

Results of WP 4:
- Students' works have started giving interesting preliminary results.
- Competitiveness of clove oil from Madagascar will help Malagasy farmers to compete other origins.

Reason for modification for the planned activity
None

What is your assessment of the results of the Action so far?
Partners are collaborating fully and farmers' representatives and local authorities are also keen to participate and share their views.

Farmers are fully collaborating and providing ample information on their management strategies and constraints during interviews while often helping to take soil samples in their various cropping systems.

Potential risks that may have jeopardized the realisation of some activities and explain how they have been tackled
None

Activities planned but not implemented
None

What is your assessment of the results of the Action so far?

The action has just started. The results are not yet available.

Updated action plan

Activities	Year 1												Implementing bodies
	1st Semester						2nd Semester						
Months	1 Apr	2 May	3 Jun	4 Jul	5 Aug	6 Sep	7 Oct	8 Nov	9 Dec	10 Jan	11 Feb	12 Mar	
1.1. Identification of study farms and communities			x	x	x	x	x	x	x				CIRAD, CTHT
1.2. Creating Eval. committees & Ext. adv. panels				x	x				x	x			CIRAD, CTHT
1.3. Scientific Coordination	x	x	x	x	x	x	x	x	x	x	x	x	CTHT
1.4. Capacity Building							x	x	x	x	x	x	CIRAD, CTHT
2.1. Spatio-temporal Dynamics							x	x	x	x	x	x	CIRAD, CTHT
2.2. Evolution of farmers' strategies										x	x	x	All partners
3.1. Assess interactions AFS and food crops										x	x	x	All partners
3.2. Pathways to improve synergies													All partners
4.1. Characterization of SAF product quality							x	x	x	x	x	x	All partners
4.2. Drivers of AFS product quality							x	x	x	x	x	x	All partners
5. Dissemination of results									x	x	x	x	All partners

Activity	Following years				Implementing body
	Year 2		Year 3		
Semesters	3 Apr – Sep 13	4 Oct 13 – Mar 14	5 Apr – Sep 14	6 Oct 14 – Mar 15	
1.3. Scientific coordination	x	x	x	x	All partners
Workshop				x	
1.4. Capacity building	x	x	x	x	All partners
2.2. Evolution of farmers' strategies	x	x			All partners
2.3. Modelling and forecasting			x	x	All partners
3.1. Assess interactions AFS and cash crops	x	x			All partner
3.2. Assess pathways to improve synergies	x	x	x	x	All partners
4.1. Characterization of AFS product quality	x	X	x	x	All partners
4.2. Drivers of AFS product quality	x	X	x	x	All partners
5. Dissemination of results	x	X	x	x	All partners

Reasons of change

1.1 Extend until December because of the difficulties to get the farmers' association on board. These types of associations are not common.
1.2 The core members of the committees are selected. But some adjustments must be made, and the setting up of the committees shall be specified in December (or January).
2.2. The activity will start earlier than scheduled through an internship with ENSIAA.
3.1. The activity will not start before January. The results of the current studies in Sainte Marie Island must be awaited before starting this activity.
3.2. The activity will start after 3.1, therefore it will not start before year 3.

3. Partners and other Co-operation

3.1. Cameroon

3.1.1. How do you assess the relationship between the formal partners of this Action

Links with IRAD are very close as both CIRAD and IRAD researchers based in Cameroon are involved in the project. Moreover, they are already working together for several years on the research station near IRAD Yaoundé.

Partnership with IRAD as regarding the implementation of administrative and financial procedures and scientific programming takes place quite satisfactory.

3.1.2. How would you assess the relationship between your organisation and State authorities in the Action countries?

CIRAD has good relations with the Cameroonian authorities and a framework agreement was signed between CIRAD and the French Ministry of Research (MINRESI).

3.1.3. Describe your relationship with any other organisations involved in implementing the Action

Links with cocoa farmers in the region of Bokito existed for over ten years through various research activities conducted by IRAD and CIRAD.

Links with Agro-PME (member of the Advisory panel) have recently resulted in the collaboration on cocoa improved variety release in the South west region of Cameroon.

3.1.4. Outline any links and synergies you have developed with other actions

Contact has been established with the representative of the Improvement Programme Competitiveness family-run farms (ACEFA). At first, this program was conducted in two regions of Cameroon; its activities will soon be developed in the same areas than those of the project.

The project will also be complementary of the CORAF project. The main difference between both projects is that the CORAF project is working on the trade-offs in AFS. They mainly study the agronomic trade-offs, while the AFS4Food project, on top of that, also assesses the socio-economic and technologic aspects.

The project will benefit from the French C2D (Contrat Désengagement de la Dette) project which will develop extension work activities. The project has a small research component.

3.2. Kenya

3.2.1. How do you assess the relationship between the formal partners of this Action

• Partner

ICRAF is clearly collaborating enthusiastically and see this project as a great opportunity to refine the tool aimed at selecting the most suitable tree species and identifying the best composition and management options in AFS plots to enhance farmers' food security and income generation according to the specific context of each study site.

Once the development of the toolbox in Kenya is achieved and tested, ICRAF is keen to develop a survey methodology for collecting farmers' knowledge in the 2 other project sites (Cameroon and Madagascar) and train partners in these countries on the use of the toolbox.

• Associate

CRF is fully collaborating on:

WP1: One researcher participated to the 1st international meeting of AFS4Food in Yaoundé in October 2012. Researchers attend preriodic meetings that have taken place during visits of CIRAD researchers (December 2012 and January 2013). CRF is keen to help with the organization of the next international meeting of the project that will take place in October 2013 in the target zone.

WP2: One research is involved in the direct selection and supervision of a Kenyan graduate student that will conduct socio-economic surveys starting late April 2013. This researcher will also co-tutor in the field a graduate student from Cameroon conducting surveys in the Kenyan target zone.

WP3: One researcher is collaborating with the CIRAD phytopathologist on protocol to assess the effect of coffee management and shade provided by associate trees on the incidence of the key coffee fungal disease (*Hemileia vastatrix*) that greatly affects coffee production in the target zone.

WP4: One researcher has greatly contributing to the development of the study on coffee quality and has already provided valuable ideas to develop protocols to be implemented during the next coffee harvesting and processing seasons. This researcher will be in charge to select farms and processing units in May-June 2013.

3.2.2. How would you assess the relationship between your organisation and State authorities in the Action countries?

Exchange of ideas and experience with other third parties involved (including other donors, other government agencies or local government units, NGOs, etc.) has already taken place between AFS4Food partners and other NGOs promoting indigenous tree planting in farms in neighbouring districts.

3.2.3. Describe your relationship with any other organisations involved in implementing the Action

• Final Beneficiaries and Target groups

Farmers are showing interests for the project and the Union of Cooperatives of Murang'a is very much impatient to put into practice some of the results of the project (i.e. promotion of selected trees to improve soil fertility and diversify farmers' revenues, improved management of coffee processing unit for coffee quality).

Other third parties involved (including other donors, other government agencies or local government units, NGOs, etc.)

Exchange of ideas and experience has already taken place between AFS4Food partners and other NGOs promoting indigenous tree planting in farms in neighbouring districts.

3.2.4. Outline any links and synergies you have developed with other actions

The CAFNET project (Connecting, enhancing and sustaining environmental services and market values of coffee agroforestry in Central America, East Africa and India, financed by EuropeAid/121998/C/G - Programme on Environment in Developing Countries) was undertaken in Kenya from 2007 to 2011. This has greatly helped to identify the target zone, local partners (particularly farmers' cooperatives) as well as key stakeholders to involve in AFS4Food. Furthermore, experience and tool (i.e. the tool aimed at selecting the most suitable tree species and best composition and management options in AFS plots) will benefit not only to Kenya but the 2 others countries as well.

3.3. Madagascar

3.3.1. How do you assess the relationship between the formal partners of this Action

Where applicable, describe your relationship with any other organisations involved in implementing the Action:

CTHT is the body responsible for the implementation of actions in Madagascar. It works closely with the University of Antananarivo (Graduate School of Agricultural Sciences), with private sector (exporters and importers).

Furthermore, in order to facilitate exchanges with the administration and stakeholders in the clove sector, the project has requested the involvement of CIRAD in Madagascar, CTHT, Rural development department, ESSA (University of Tananarive), exporters of clove and oil, and farmers associations.

3.3.2. How would you assess the relationship between your organisation and State authorities in the Action countries?

CTHT and CIRAD are working closely with the regional director of rural development in the province of Toamasina.

3.3.3. Describe your relationship with any other organisations involved in implementing the Action

CTHT and CIRAD are doing research activities and surveys in the area with the support of farmers' organisations, and particularly with clove producers. Moreover, farmers are keen to participate with project partners, and we can assess that relations are good, which will help the project.

The relation with university of Tananarivo is also good, and the project partners are already hosting many students from the university.

3.3.4. Outline any links and synergies you have developed with other actions

The project has benefited from previous projects and we were able to build on existing activities, either because they produced results from which we could build our own most recent activities, or because this project will be able to complement the activities that started in the previous project but should be continued in this project to bring significant results that will match our needs.

4. Visibility

4.1. Website

To ensure the visibility of the project, we have created a Web site, available at: http://afs4food.cirad.fr/en.

The website is also advertised in other partners' websites; and particularly on the website of Cirad in East Africa.

4.2. Advertisement

International Agricultural Fair

The project leader participated at the Salon International de l'Agriculture in Paris (February 2013) in the framework of a public debate on Agroforestry Systems in Europe and other regions. On this occasion, he could communicate on the project.

The European Commission may wish to publicise the results of Actions. Do you have any objection to this report being published on EuropeAid Co-operation Office website? If so, please state your objections here.
I have no objections

Name of the contact person for the Action: Didier SNOECK

Signature: 

Location: CIRAD
TA B34 / 02
Avenue Agropolis
34398 Montpellier Cedex 5
FRANCE

Date report due:

Date report sent: 17 May 2013

5. Annexes

5.1. Students' reports summaries

5.1.1. Madagascar

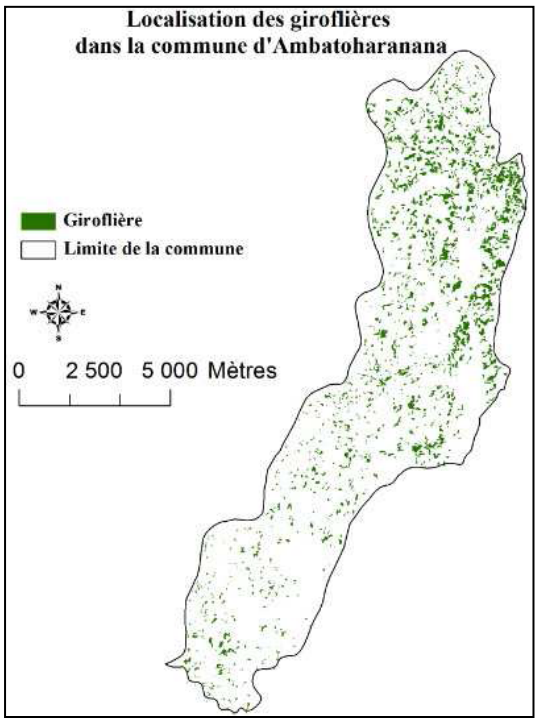
Study on the dynamics of occupation of space and on the evolution of the clove population in relation to the climatic risks by mapping analysis at various periods (aerial photographs, satellite images)

This theme initially started in the scope training course of Master degree II in remote sensing and Risks Natural had as a subject: Dynamics of the landscapes of the production zone of the clove (Fénérive East): comparison with the cyclonic risks and the strategies of occupation of space.

This first approach will be supplemented by work to come on a greater scale by mobilizing lately acquired images SPOT.

Main results concerning the commune of Ambatoharana
After vectorization of clove farms use in the commune of Ambatoharanana, their entire area was evaluated at 8.77 km². Generally, a strong concentration of cloves is found in the Northern part of the commune. On the other hand, the Southern part seems slightly covered (figure 1).

Figure 1: Localisation of clove plots



Approach used to define the cyclonic risk
The cyclonic risk introduced into this work is defined by the way in how the various zones receive the cyclonic winds. The zones at risk are those touched by the winds not crossing an obstacle. In this work, it is considered that a zone is at risk when it is directed against the wind. Conversely, a zone directed under the wind will undergo month the effect of the wind. We thus regard it as favourable to the culture of clove, a tree very sensitive to strong winds.

Historically, the cyclones pass in or near the studied zone with an East to West direction and, then turn towards the South [30] [39] [47]. One deduces from this history that the zones at risk (i.e. directed against the wind) are those exposed East, North-East and South-East, and that the relatively protected zones are those exposed West, South-west and North-West.

Histograms Analyses

In this chapter, we will present the distribution of cloves in the commune of Ambatoharanana following three selected variables (altitude, slope and exposition).

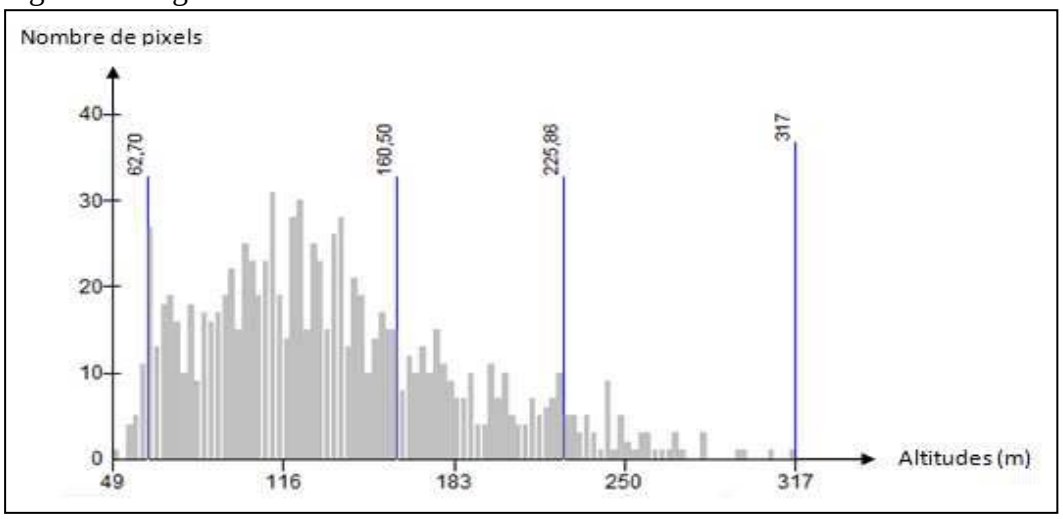
Histogram of altitudes

It informs about the presence of clove related to altitudes. The value of altitudes is in X-coordinate; the number of pixels of the digital terrain is in ordinate.

This histogram confirms that cloves do not support high altitudes. After analysis, the ideal conditions of its culture are between 62.7 and 160.5 m. asl. At these altitudes, the plantations cover a surface of 6.34 km², representing 72% of the plantations in the commune.

The assertion on the clove requirement for altitude (mentioned in part 1) is thus checked.

Figure: Histogram of altitudes



Histogram of slopes

This histogram shows the presence of clove according to slopes. Values of the slopes are in X-coordinate, and the number of pixel of the raster image corresponding to the slopes is in ordinate.

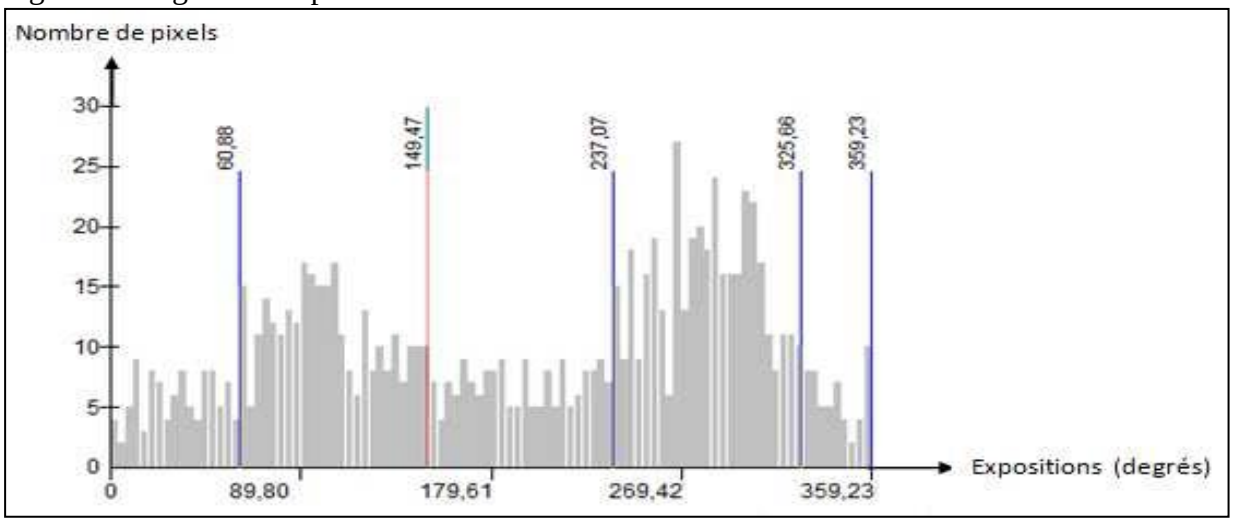
Statistically, the cloves of the commune of Ambatoharanana grow preferentially on slightly tilted fields (0 – 2.3°); these areas are evaluated to be 4,658 hectares. Between 2.3° to 8.4° slope, the fields are fairly favourable; this corresponds to about 2,849 hectares.

The cloves do not grow on the strong slopes (> 23°), this corresponds to about 64 hectares. One can thus affirm that the commune of Ambatoharanana has a great range of fields with slopes favourable to cloves.

Histogram of expositions

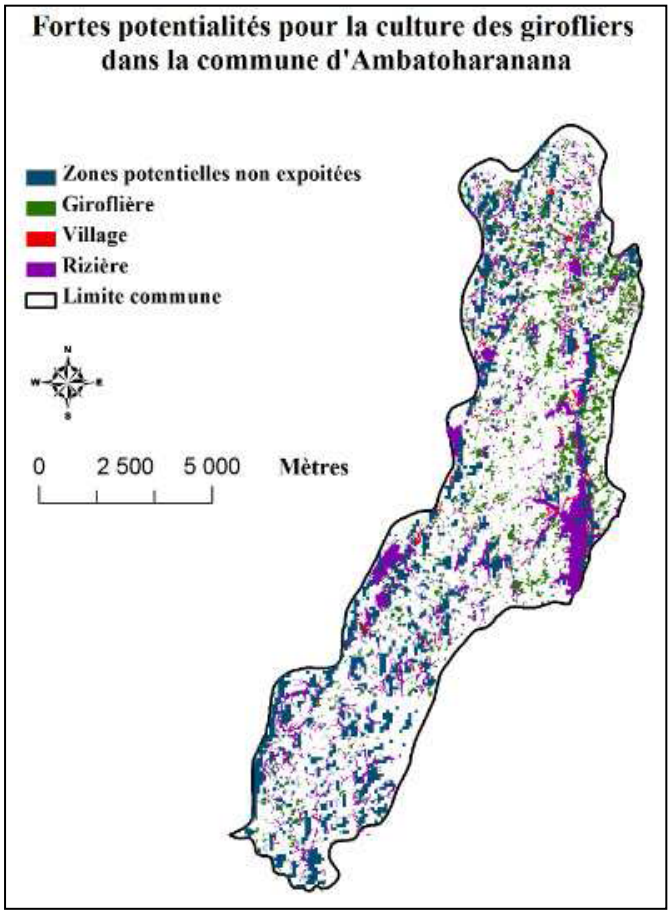
The values of the very favourable expositions to cloves cultivation are between 237.1° and 325.7°. This corresponds to the Western, South-western and North-western expositions previously described to be theoretical favourable. Values of expositions between 0° and 60° and 325° and 360° are corresponding to the unfavourable North and North-East expositions. These statistics thus confirm that zones under the wind constitute favourable areas for clove cultivation.

Figure: Histogram of expositions



Zones potentially favourable for clove cultivation taking into account the cyclonic risk
The map of zones with high growing potentialities taking into account the cyclonic risk is obtained by combination of the three environmental variables.

Figure 4 zones with strong potentialities for the clove cultivation



We considered as favourable only the pixels for which the combination of the three variables was optimal, therefore equal to 27 (3×3×3).

The results show that most of the fields with strong potentialities are in the Southern part of the commune.

To refine this work, it will be necessary to take into account the current soil occupation of these areas, because all are not suitable (villages, rice plantation, other crops).

CONCLUSION

The main aim of this study consisted in the determination of the zones favourable to cloves cultivation, taking into account the cyclonic risks of the zone. To answer it, we chose an approach by satellite imagery. An object-directed classification was used to locate and map the clove trees. In spite of many tests using various parameters, it was not possible to obtain satisfactory results. Thus, the automatic recognition of cloves on THRS images appears difficult. An approach by phyto-interpretation seems to be more adapted because the observer has more parameters to localise the cloves, of which certain are complex, than the automatic method tested can integrate (object-directed classification).

Among the factors at the origin of the difficulties encountered to extract in an automatic way the cloves objects appears a strong variability of the size, colour, and a complex texture. Nevertheless, the use of topological rules, such as the proximity, would have reinforced the quality of the treatment, because one of the important criteria of identification of cloves is that they are grouped in groves.

We finally adopted a phyto-interpretation approach to map the cloves in one of the three communes of the study, Ambatoharanana.

This work will be supplemented by the study of two other communes for which we have HTRS images.

Analysis of clove-based production systems in Sainte Marie island

Introduction

On Sainte Marie island, we could observe a typology of the cultivation systems based on three distinct clove-based cultivation systems: I) A system in mono-specific plantation, II) a complex agroforestry system and III) a system of parks planted with trees. The agroforestry system is often a combination of fruit trees associated with clove. The agroforestry system is often a combination of fruit trees associated with the clove. The other productions, primarily cassava, sweet potato, fruits and breadfruit tree, feed subsistence farming and ensure the food safety of the households.

The study relates to the place of clove in the farms, its role in the total impact strength of the farm vis-a-vis the natural risks, and the complementary role of clove on the food safety of the households. Following a first study of discovery of the area in 2010, followed by another study to characterise the farms growing clove in 2011 in 2 villages in the north and the centre, this survey, realized in 2012-2013, supplemented the previous works. The study relates to a third zone, near to Ambodifotatra. On Sainte Marie island, the main zones of clove cultivation were located, and three areas were selected:

- Western north represented by Ambatoroa and Ifotatra.
- Centre represented by Ambohitra and a zone north of Lonkinsty.
- Centre-south in the neighbourhoods of Ambodifotatra, represented by three colonial clove plantations.

The first two villages, Ambatoroa in north and Ambohitra in the centre, are representative of a situation where the family farms prevail. The third zone includes three old colonial, typical plantations of a situation of residual farms, and no replanting of the clove resource.

Sainte Marie was the largest producer of clove in the years 1930, after the district of Mananara. Many factors generated the fall of clove productivity: loss of renewal, no labour, effect of cyclones, diseases, no maintenance, leaves harvest. Price-cutting in the years 1990 involved a Net drop of the production. Following the degradation of the clove resource, other species were planted in between: vanilla, cinnamon… The clove monocrop system evolved into agroforestry system mainly, but also in system of parks planted with trees.

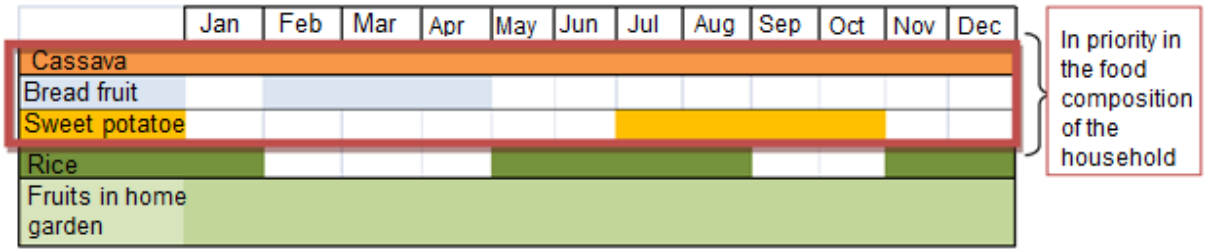
Results

Household food security

Malagasy agriculture is characterised by a multitude of the smallholdings (average cultivated areas = 1.2 hectares) which associate several activities (cultivation and breeding) and whose products are mainly directed towards subsistence farming. Rice is the main food of the Malagasy population except in Sainte Marie. If the level of productivity of irrigated rice is stationary to approximately 2 tonnes/ha on the large Island, it is approximately 500 kg/ha on Sainte Marie island.

Irrigated rice, or more exactly the more or less flooded rice in lowland, is thus far from productive and completely extensive. The farmers' first strategy is to ensure the household food safety. The surveys allowed making a synthetic calendar of the food household consumption. The family nourishes mainly from cassava (available throughout the year), fruit of the breadfruit tree (from February to April), sweet potato (from July to October) and, when harvest was good, from rice (Figure 1).

Figure1: Synthesis of farms food consumption (Levasseur, Penot, Danthu, Michel, 2012)



Ensure the minimal expenditure of the household

The farms food activity on Sainte Marie island is mainly used to ensure food safety and does not bring a monetary contribution for the household, including for the rice mainly self-consumed (but which, potentially, can be sold if necessary).

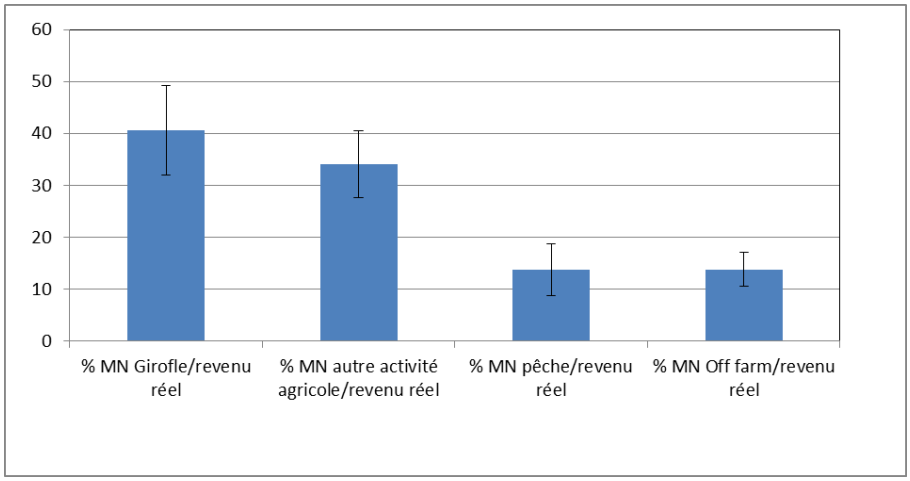
The households are not self-sufficient in rice and buy rice, but are self-sufficient in cassava, sweet potato and breadfruit which constitute the basics of food. In certain households, rice is an important part in the family budget. In parallel, another significant portion is the share of the FNP (First Need Products) which includes the expenditure of oil, salt, sugar and other by-products. This consumable expenditure is the main private expenditure of a local farm on Sainte Marie island. Thus, it is necessary to find other monetary resources for the non-consumable expenditures (schooling, clothing, health, and exceptional expenditure, such as a birth, or a death…).

The food products are not sold but are not self-consume. The monetarisation of the farmers relates to other agricultural activities (breeding, produced revenue like the clove), and of nonagricultural activities (fishing and other off-farm activities). It is thus essential measure the contribution of the clove activity within the agricultural income of a Malagasy farm on the Sainte Marie island.

Share of clove in the average income of the farms of the Sainte Marie island

In figure 2, above, one can note that, in spite of a diversification towards other agricultural activities and off-farm activities, the share of the clove activity is majority for most of the surveyed farmers.

Figure 2: Histogram of the average of the shares of each activity in the real income of the farms on Sainte Marie



Clove significantly contributes to the strength impact of local farms in spite of certain constraints: the inter-annual irregularity of the production, land pressure due to the division of the rights on the clove production. But, the renewal of this problematic resource is different depending on the situations. The other economic resources are honey, fishing and the off-farm activities which develop within the farms of the island. In a total way, food safety is ensured by the local food productions; namely: the cassava; the sweet potato and the breadfruit, and to a lesser extent: rice (rain and irrigated). All the family farms are self-sufficient. Clove contributes for 15 to 40% of the monetary income according to the types of farm.

Food production is for self-consumption and very little is sold. The local market for such productions is very little and remains limited to supplying the city and possibly the hotels (but they consume very little cassava, sweet potato and breadfruit). If food safety is ensured by these food products, in no case they can constitute a potential source of monetary income.

The study was to assess the impact of clove and diversification of activities to establish the functioning of the local farms income. Our main assumption was that clove contributes significantly to the total income of the farms whereas the resource is growing old and little is renewed in a context of important climatic cyclonic risks. The problem of the renewal of this resource and replanting is thus discussed.

The typology made in 2012 will be re-examined in 2013 (1 farm per type and per village). The later analyses will be done considering both the nails and oil in the creation of the agricultural income of the farms. In 2013 the vulnerability and the impact strength of the operating systems and the contribution of clove will be measured. Finally we will assess the conditions of current partial replacement of this resource and the major social constraints.

The problem of plantations renewal is related to that of the juxtaposition of the rights on the old plots

At present, it is mainly the 3rd generation which has the management of the concessions and the farms of village, and in a short future, the 4th generation will take over the management. One could notice, during surveys, a will on behalf of the children generation to want to bequeath a new clove cultivation system to their descendants. This is supported by a rising of the prices of cloves which can explain the renewed interest for its cultivation by the current descendants. The recent renewal of this resource thus follows mainly a patrimonial reason. One assists, as a majority, to a change of generation for the owners of villages. The following generation will take again the management of the farm and will thus inherit young cultivations of clove in order to be able to exploit this resource. If it is not about a patrimonial reason, these young owners of 3rd generation replant because they see a bright future of the cultivation of clove whose value does not cease increasing since 2004.

The collective plots are regarded as a non-divisible patrimonial asset, thus there is joint possession of the field. It is noted that between descendants, which inherited the same plot, an agreement was established on the rights on harvest. The production of the old inherited cloves is divided between all. But the production of the young clove returns to that which planted it. An arrangement by amicable agreement of the field that the descendents can occupy to replant young cloves allows a greater manoeuvre margin for clove replanting. And the loss of interest for this resource by the old generation allowed to reduce the number of owners working on the inherited plots and to increase the replanting areas for each descendant.

The first cause of non-renewal of this resource is the land pressure. Through the historical surveys, three generations of growers were identified: the grand-parents (generation 1), the parents (generation 2) and children, current adults (generation 3), i.e. current farmers. These three generations explained many divisions made between the sons and the grandsons. There are plots in villages which are divided between cousins, uncles and aunts, each one having the same rights: right of the soil, the tree and the division of harvest. Most heirs do not work on the plot and, for the majority, were installed on the large lands. They return for harvesting the cloves, when this one is profitable. During the year, the heirs remained present to maintain the plot and if they want it, replant young cloves. But the production of these young cloves will be shared between all the heirs if replanting is made on the older plots, even if the latter did not take part in the plantation of the young cloves. This situation of division of the plots without "balancing" the rights is a brake for replanting of this resource, at least on the old plots. Replanting is thus done on new plots free from external rights.

The second cause is the fall in the price of cloves around the years 1990 (figure 2). These price drops were accompanied by losses due to the cyclones justifying an abandonment of this resource by the 2nd generation. In parallel, the generation of parents decided to diversify and do other agricultural activities or off-farm activities to provide for the need for their household. The current generation 3, which takes again the farm, continues this diversification of agricultural activities (figure 5). Thanks to the various sources of income, these owners of the 3rd generation do not renew the clove on the old inherited plots. This decision not to renew the resource is also due in particular to the vulnerability of the cloves vis-a-vis the cyclones including the recent one, cyclone Ivan in 2008, which destroyed a great number of trees.

Thus, the devastating cyclones, price-cutting in the years 1990 involving a diversification of the activities by the grand-parents were not favourable to a renewal of clove cultivation by the current owners. In the same way, the division of plots from generation to generation leaves a low manoeuvre margin for the owners who want to replant, forcing them to replant on new areas, if available.

Conclusion

At present, the purpose of the clove monocrop system set up by young peasants on the island is to make denser cultivation of clove to maximise the incomes related to its cultivation. The planting of plots in agroforest allows maximizing the cultivations on a reduced space. The installation of annual associated crops makes it possible to combine maintenance for the cloves and works related to the associated crops. The installation of an agroforestry system brings a diversification of the incomes, resources of food, but also a source of wood of heating and construction. The systems of park, mainly observed in the colonial concessions result from non-maintenance from the plot and non-renewal from the cultivation from clove. But it was noted a certain dynamics of replanting of new feet of cloves in the surveyed producers due to the raising of prices of the clove since 2004 (figure 4). This recent renewal follows in particular a patrimonial logic.

Therefore, the place of the clove activity in the income of the farms of Sainte Marie remains majority in comparison with the off-farm activities. The income resulting from the farm of the cloves, nails and oil, is intended for the purchase of PPN, schooling and clothing.

History and trajectory of 3 colonial concessions in Sainte Marie, Madagascar

The clove, native to Amboine island into the Moluccas archipelago, was introduced on Sainte Marie island in 1822 by the Albran-Carayon-Hugot company (R. Dufournet). In the years 1856, the agricultural wealth of the island was only subsistence farming with some rare rice fields, but especially potato and cassava. Some efforts of large scale cultivation by settlers succeeded, in particular for the clove. Harvests were lost fault of labour to collect them and means of transport to export them in the 19th century (M. Tizon, 1853 - 1871).Again, around the years 1900 - 1920, some settlers settled on the island to acquire field. These fields were mainly intended for clove cultivation. At present, the south of the island belongs to the direct or indirect descendants of the families of settlers which registered and fenced their field. The north, which is cultivated since generations by the indigenous Malagasy of the island, very quickly copied the colonial system at the beginning of the 20th century. This land division is at the origin of various management methods of clove cultivation on this island with renewal or not of this resource according to the situations, thus explaining a very great disparity of the cases encountered on the island.

This study mainly focused on the history and the current management of the three old concessions located in periphery of Ambodifotatra, the capital of the island (map of the three concessions). These three concessions belong to three colonial large families, the family Joseph, of Indian origin, the Maximin family and the family Jacobo of French origin.

The main objective of this study is to include the evolution and the trajectory of these concessions and to answer the following question: Is there renewal of the cultivation of clove in these three colonial concessions? Our main assumption is that there is no or little renewal of clove cultivation in the great colonial concessions.

The colonists who settled on the Sainte Marie island to acquire fields at the beginning of the 20th century, donated respectively to their children and grandchildren clove monocrop fields. This monocrop system was transformed little by little into agroforestry system and orchards. This transformation was caused by the passage of devastating cyclones, in particular those of 1956 and 2008, and by the progressive loss of interest for clove cultivation, because of a low price value of clove in the years 1990, which involved a diversification of the agricultural activities carried out by the descendants of the concessions.

At present, in the Maximin and Jacobo families' concessions, the descendants do not renew or little the clove plantations which they inherited. They have a principal activity in parallel which enables them to live not needing to deal with their clove plantation. In spite of the raising of clove prices since a few years, these descendants have given up for the majority the agricultural activities and are not any more interested by developing an agricultural activity around the clove. As it is necessary to wait a minimum of 7 years to start producing nails, the repercussions are not direct and these descendants are not sure and cannot forecast the trend of medium-term prices. And its vulnerability vis-a-vis the climatic risks also slows down the investment of time and money in the renewal of this resource. This situation explains why the main trajectory, for these two concessions, is the abandonment of clove cultivation.

For the Joseph family's plantation, there is a partial replacement of clove on this plantation. This renewal is mainly due to the raising of cloves prices since 2004 (EU, 2011). The five descendants inherited of one of the most important concessions of clove monocrop of the island. They are very attached to the financial assets and want to preserve the heritage that

their parents and grandparents bequeathed to them to be able to bequeath it to their children. The recent renewal of this resource within the Joseph's concession follows a patrimonial logic and was started by the raising of clove prices. This situation is found in particular in the farms of village of Sainte Marie cultivated by the indigenous Malagasy of the Sainte Marie island.

Map of the 3 colonial farms

Conclusion

This survey shows the ultimate stage of the concessions and plantations of colonial age which are not taken again and on which the juxtaposition of the multiple rights of the various having rights blocked any replanting and any inclination of renewal of the resource. If the young people of the 4th generation had not planted on new fields, virgin of rights, the resource would be in a deplorable state and the production would have fallen considerably. The analysis shows clearly that replanting cannot be done on the historical plots, which poses two significant issues: the availability of lands and the access to land for the young people.

5.2. Interim financial report

AFS4FOOD - Contract n° AURG/031/2012

Interim financial report for the period:

04/04/2012 to 03/04/2013

Expenditures	Budget as per contract/rider				Reallocation	Per currency EUR Exchange rate for the period: 1.000000			
	Unit	# Units (a)	Unit cost (in EUR) (b)	Costs (in EUR) (a)*(b)	allowed reallocation	# Units (d_1)	Unit cost (in EUR) (e_1)	Total cost (in EUR) (f_1) = (d_1)*(e_1)	Total cost (in EUR) (g_1)= (f_1)*(Fx-rate$_1$)
1. Human Resources									
1.1 Salaries (gross salaries including social security charges and other related costs, local staff)									
1.1.1. Technical staff Cameroon	Per month	96	115	11 040		0.0	115	0	0
1.1.1. Technical staff Kenya	Per month	31	695	21 750		0.0	695	0	0
1.1.1. Technical staff Madagascar	Per month	43	259	11 254		0.0	259	0	0
1.1.1. Technical staffs France	Per month	3	4 380	13 140		0.0	4 380	0	0
1.1.2. Administrative/ support staff Cameroon	Per month	36	200	7 200		0.0	200	0	0
1.1.2. Administrative/ support staff Kenya	Per month	36	200	7 200		0.0	490	0	0
1.1.2. Administrative/ support staff Madagascar	Per month	36	200	7 200		0.0	0	0	0
1.1.3. Student training Cameroon	Per month	23	46	1 062		0.0	46	0	0
1.1.3. Student training Kenya	Per month	40	420	16 620		2.3	420	969	969
1.1.3. Student training Madagascar	Per month	73	199	14 555		0.0	149	0	0
1.1.4. Researcher Cameroon	Per month	75	460	34 500		0.0	0	0	0
1.1.4. Researcher Kenya	Per month	8	4 500	36 000		0.0	4 500	0	0
1.1.4. Researcher Madagascar	Per month	90	296	26 640		0.0	0	0	0
1.1.4. Researchers France	Per month	33	12 000	396 000		9.5	12 000	113 796	113 796
1.2 Salaries (gross salaries including social security charges and other related costs, expat/int. staff)									
1.2.1. Administrative/ support staff Cirad France	Per month	6	5 000	30 000		2.2	5 000	10 877	10 877
1.2.2. Student trained in France	Per month	41	420	17 220		8.5	420	3 576	3 576
1.2.3. Researcher Cirad France	Per month	27	6 800	183 600		5.4	6 800	36 788	36 788
1.2.4. Coordinator Cirad France	Per month	5	9 700	48 500		2.0	9 700	19 350	19 350
1.3 Per diems for missions/travel									0
1.3.1. Abroad staff assigned to the Action Cameroon	Per diem	128	132	16 941		81.0	132	10 687	10 687
1.3.1. Abroad staff assigned to the Action Kenya	Per diem	159	144	22 830		14.8	144	2 130	2 130
1.3.1. Abroad staff assigned to the Action Madagascar	Per diem	209	97	20 258		10.1	97	982	982
1.3.1. Abroad staff assigned to the Actions Ethiopia	Per diem	14	180	2 520		0.0	180	0	0
1.3.2. Local staff assigned to the Action Cameroon	Per diem	1 874	22	41 313		108.6	22	2 390	2 390
1.3.2. Local staff assigned to the Action Kenya	Per diem	200	35	7 020		0.0	263	0	0
1.3.2. Local staff assigned to the Action Madagascar	Per diem	30	19	560		0.0	19	0	0
1.3.3. Seminar/conference participants Cameroon	Per diem	120	20	2 400		91.0	20	1 819	1 819
1.3.3. Seminar/conference participants Kenya	Per diem	120	20	2 400		0.0	20	0	0
1.3.3. Seminar/conference participants Madagascar	Per diem	120	20	2 400		0.0	20	0	0
Subtotal Human Resources			***46 579***	***1 002 123***				**203 364**	***203 364***
2. Travel									
2.1 International travel									
2.1.1. International travel Cameroon	Per flight	14	1 200	16 800		4.6	1 200	5 520	5 520
2.1.2. International travel Kenya	Per flight	14	1 200	16 600		2.5	1 200	3 002	3 002
2.1.3. International travel Madagascar	Per flight	12	1 383	16 600		2.5	1 383	3 427	3 427
2.1.4. International travel Ethiopia	Per flight	4	1 500	6 000		0.0	1 500	0	0
2.1.5. International Travel across Africa	Per flight	18	1 500	27 000		4.2	1 500	6 334	6 334
2.2 Local transportation									0
2.2.1. Local transportation Cameroon	Per month	36	180	6 480		1.5	180	265	265
2.2.2. Local transportation Kenya	Per month	36	424	15 250		2.0	424	861	861
2.2.3. Local transportation Madagascar	Per month	36	709	25 533		1.0	709	733	733
Subtotal Travel				***130 263***				**20 142**	***20 142***
3. Equipment and supplies									
3.1. Purchase or rent of vehicles Cameroon	Per vehicle	1	28 000	28 000		1.0	28 000	27 898	27 898
3.2. Furniture, computer equipment	per unit	5	988	4 940		0.0	988	0	0
3.3. Machines, tools	per unit	13	918	11 930		0.0	918	0	0
3.4. Spare parts/equipment				0		0.0	0	0	0
3.5. Other (please specify)	per unit	7	1 300	9 100		0.0	1 300	0	0
Subtotal Equipment and supplies				***53 970***				27 898	***27 898***
4. Local office									
4.1. Vehicle costs	Per week	212	40	8 480		31.2	40	1 247	1 247
4.2. Office rent	Per month			0		0.0	0	0	0
4.3. Consumables - office supplies	Per month	180	374	67 280		2.0	374	750	750
4.4. Other services	Per month	180	31	5 580		0.0	31	0	0
Subtotal Local office				***81 340***				**1 997**	***1 997***

AFS4FOOD - Contract n° AURG/031/2012
Interim financial report for the period:

04/04/2012 to 03/04/2013

Expenditures	Budget as per contract/rider				Reallocation	Per currency EUR Exchange rate for the period: 1.000000			
	Unit	# Units (a)	Unit cost (in EUR) (b)	Costs (in EUR) (a)*(b)	allowed reallocation	# Units (d_1)	Unit cost (in EUR) (e_1)	Total cost (in EUR) (f_1) = (d_1)*(e_1)	Total cost (in EUR) (g_1)= (f_1)*(Fx-rate$_1$)
5. Other costs, services									
5.1. Publications	per unit	27	160	4 320		14.1	160	2 250	2 250
5.2. Studies, research	per unit	75	154	11 575		0.5	154	82	82
5.3. Expenditure verification	per unit	12	1 725	20 700		0.0	1 725	0	0
5.4. Evaluation costs	per unit			0		0.0	0	0	0
5.5. Translation, interpreter	per unit			0		0.0	0	0	0
5.6. Financial services (bank guarantee costs etc.	per unit	108	50	5 400		0.0	50	0	0
5.7. Costs of conferences/seminars	per unit	3	1 820	5 460		0.3	1 820	574	574
5.8. Visibility actions	per unit	1	260	260		1.2	260	316	316
Subtotal Other costs, services				***47 715***				**3 222**	***3 222***
6. Other									
6.1. Material for laboratory trials Cameroon	per unit	50	411	20 550		2.4	411	995	995
6.1. Material for laboratory trials Kenya	per unit	3	1 000	3 000		0.0	1 000	0	0
6.1. Material for laboratory trials Madagascar	per unit	6	1 000	6 000		0.0	0	0	0
6.2. Quality analysis Cameroon	per unit	60	125	7 500		0.0	125	0	0
6.2. Quality analysis Kenya	per unit	200	68	13 500		0.0	68	0	0
6.2. Quality analysis Madagascar	per unit	40	838	33 500		0.0	838	0	0
Subtotal Other				***84 050***			*#REF!*		***995***
7. Subtotal direct eligible costs of the Action (1-6) (excluding taxes)				**1 399 461**				**256 623**	**257 618**
8.1. Contingency reserve				0				361	361
9. Total direct eligible costs of the Action (7+ 8) (excluding taxes)				**1 399 461**				256 984	257 979
A.1. Administrative Costs				97 962				18 060	18 060
11. Total eligible costs (9+10) (excluding taxes)				***1 497 423***				275 044	276 039
12. Taxes[11]									
13. Total eligible/accepted[12] costs of the Action (11+12)				***1 497 423***					276 039

UA FINANCE 50 %	***748 711***

AFS4FOOD - Contract n° AURG/031/2012
Interim financial report for the period:

04/04/2012 to 03/04/2013

Expenditures	Expenditures incurred								
	Per currency KES				Per currency MGA				
	Exchange rate for the period:			0.009109	Exchange rate for the period:			0.000352	Exchang
	# Units (d_2)	Unit cost (in KES) (e_2)	Total cost (in KES) ($f_2 = d_2*e_2$)	Total cost (in EUR) ($g_2 = f_2*(Fx\text{-}rate_2)$)	# Units (d_3)	Unit cost (in MGA) (e_3)	Total cost (in MGA) ($f_3 = d_3*e_3$)	Total cost (in EUR) ($g_3 = f_3*(Fx\text{-}rate_3)$)	# Units (d_4)
1. Human Resources									
1.1 Salaries (gross salaries including social security charges and other related costs, local staff)									
1.1.1. Technical staff Cameroon	0.0	0	0	0	0.0	0	0	0	10.7
1.1.1. Technical staff Kenya	0.0	76 302	0	0	0.0	0	0	0	0.0
1.1.1. Technical staff Madagascar	0.0	0	0	0	5.2	735 335	3 840 662	1 353	0.0
1.1.1. Technical staffs France	0.0	0	0	0	0.0	0	0	0	0.0
1.1.2. Administrative/ support staff Cameroon	0.0	0	0	0	0.0	0	0	0	0.0
1.1.2. Administrative/ support staff Kenya	0.0	21 957	0	0	0.0	0	0	0	0.0
1.1.2. Administrative/ support staff Madagascar	0.0	0	0	0	10.5	567 826	5 940 000	2 092	0.0
1.1.3. Student training Cameroon	0.0	0	0	0	0.0	0	0	0	0.0
1.1.3. Student training Kenya	0.0	46 111	0	0	0.0	0	0	0	0.0
1.1.3. Student training Madagascar	0.0	0	0	0	3.6	564 987	2 031 613	716	0.0
1.1.4. Researcher Cameroon	0.0	0	0	0	0.0	0	0	0	13.4
1.1.4. Researcher Kenya	0.0	494 043	0	0	0.0	0	0	0	0.0
1.1.4. Researcher Madagascar	0.0	0	0	0	27.4	840 382	22 997 592	8 100	0.0
1.1.4. Researchers France	0.0	0	0	0	0.0	0	0	0	0.0
1.2 Salaries (gross salaries including social security charges and other related costs, expat/int. staff)									
1.2.1. Administrative/ support staff Cirad France	0.0	0	0	0	0.0	0	0	0	0.0
1.2.2. Student trained in France	0.0	0	0	0	0.0	0	0	0	0.0
1.2.3. Researcher Cirad France	0.0	0	0	0	0.0	0	0	0	0.0
1.2.4. Coordinator Cirad France	0.0	0	0	0	0.0	0	0	0	0.0
1.3 Per diems for missions/travel				0				0	
1.3.1. Abroad staff assigned to the Action Cameroon	0.0	0	0	0	0.0	0	0	0	0.0
1.3.1. Abroad staff assigned to the Action Kenya	0.0	0	0	0	0.0	0	0	0	0.0
1.3.1. Abroad staff assigned to the Action Madagascar	0.0	0	0	0	0.0	0	0	0	0.0
1.3.1. Abroad staff assigned to the Actions Ethiopia	0.0	0	0	0	0.0	0	0	0	0.0
1.3.2. Local staff assigned to the Action Cameroon	0.0	0	0	0	0.0	0	0	0	0.0
1.3.2. Local staff assigned to the Action Kenya	0.0	3 843	0	0	0.0	0	0	0	0.0
1.3.2. Local staff assigned to the Action Madagascar	0.0	0	0	0	24.1	53 943	1 300 000	458	0.0
1.3.3. Seminar/conference participants Cameroon	0.0	0	0	0	0.0	0	0	0	0.0
1.3.3. Seminar/conference participants Kenya	0.0	0	0	0	0.0	0	0	0	0.0
1.3.3. Seminar/conference participants Madagascar	0.0	0	0	0	0.0	0	0	0	0.0
Subtotal Human Resources			0	***0***			**36 109 867**	***12 719***	
2. Travel									
2.1 International travel									
2.1.1. International travel Cameroon	0.0	0	0	0	0.0	0	0	0	0.0
2.1.2. International travel Kenya	0.0	0	0	0	0.0	0	0	0	0.0
2.1.3. International travel Madagascar	0.0	0	0	0	0.0	0	0	0	0.0
2.1.4. International travel Ethiopia	0.0	0	0	0	0.0	0	0	0	0.0
2.1.5. International Travel across Africa	0.0	0	0	0	0.0	0	0	0	0.0
2.2 Local transportation				0				0	
2.2.1. Local transportation Cameroon	0.0	0	0	0	0.0	0	0	0	0.0
2.2.2. Local transportation Kenya	0.0	46 550	0	0	0.0	0	0	0	0.0
2.2.3. Local transportation Madagascar	0.0	0	0	0	0.3	2 012 943	620 000	218	0.0
Subtotal Travel			0	***0***			**620 000**	***218***	
3. Equipment and supplies									
3.1. Purchase or rent of vehicles Cameroon	0.0	0	0	0	0.0	0	0	0	0.0
3.2. Furniture, computer equipment	0.0	108 470	0	0	0.9	2 805 060	2 620 000	923	0.3
3.3. Machines, tools	0.0	100 785	0	0	0.0	0	0	0	0.5
3.4. Spare parts/equipment	0.0	0	0	0	0.0	0	0	0	0.0
3.5. Other (please specify)	0.0	0	0	0	0.0	0	0	0	0.0
Subtotal Equipment and supplies			0	***0***			2 620 000	***923***	
4. Local office									
4.1. Vehicle costs	0.0	0	0	0	0.0	0	0	0	7.9
4.2. Office rent	0.0	0	0	0	0.0	0	0	0	0.0
4.3. Consumables - office supplies	0.0	41 060	0	0	0.7	1 061 835	723 400	255	3.3
4.4. Other services	0.0	3 403	0	0	0.0	88 013	0	0	6.1
Subtotal Local office			0	***0***			**723 400**	***255***	

AFS4FOOD - Contract n° AURG/031/2012
Interim financial report for the period:

04/04/2012 to 03/04/2013

Expenditures	Expenditures incurred								
	Per currency KES				Per currency MGA				
	Exchange rate for the period:			0.009109	Exchange rate for the period:			0.000352	Exchang
	# Units	Unit cost (in KES)	Total cost (in KES)	Total cost (in EUR)	# Units	Unit cost (in MGA)	Total cost (in MGA)	Total cost (in EUR)	# Units
	(d_2)	(e_2)	(f_2) = (d_2)*(e_2)	(g_2)= (f_2)*(Fx-rate$_2$)	(d_3)	(e_3)	(f_3) = (d_3)*(e_3)	(g_3)= (f_3)*(Fx-rate$_3$)	(d_4)
5. Other costs, services									
5.1. Publications	0.0	0	0	0	0.0	0	0	0	0.0
5.2. Studies, research	0.0	0	0	0	0.0	0	0	0	0.0
5.3. Expenditure verification	0.0	189 383	0	0	0.0	4 897 499	0	0	0.0
5.4. Evaluation costs	0.0	0	0	0	0.0	0	0	0	0.0
5.5. Translation, interpreter	0.0	0	0	0	0.0	0	0	0	0.0
5.6. Financial services (bank guarantee costs etc.	0.0	5 489	0	0	0.0	141 957	0	0	0.0
5.7. Costs of conferences/seminars	0.0	0	0	0	0.0	0	0	0	0.0
5.8. Visibility actions	0.0	28 545	0	0	0.0	738 174	0	0	0.0
Subtotal Other costs, services			0	***0***			**0**	***0***	
6. Other									
6.1. Material for laboratory trials Cameroon	0.0	0	0	0	0.0	0	0	0	0.0
6.1. Material for laboratory trials Kenya	0.0	0	0	0	0.0	0	0	0	0.0
6.1. Material for laboratory trials Madagascar	0.0	0	0	0	1.7	2 839 130	4 893 620	1 724	0.0
6.2. Quality analysis Cameroon	0.0	0	0	0	0.0	0	0	0	0.0
6.2. Quality analysis Kenya	0.0	0	0	0	0.0	0	0	0	0.0
6.2. Quality analysis Madagascar	0.0	0	0	0	4.9	2 379 191	11 618 554	4 092	0.0
Subtotal Other				***0***			***16 512 174***	***5 816***	
7. Subtotal direct eligible costs of the Action (1-6) (excludir			**0**	**0**			**56 585 441**	**19 931**	
8.1. Contingency reserve				0			0	0	
9. Total direct eligible costs of the Action (7+ 8) (excluding t			0	0			56 585 441	19 931	
A.1. Administrative Costs			0	0			1 395	1 395	
11. Total eligible costs (9+10) (excluding taxes)			0	0			56 586 836	21 326	
12. Taxes[11]									
13. Total eligible/accepted[12] costs of the Action (11+12)				0				21 326	

UA FINANCE 50 %

AFS4FOOD - Contract n° AURG/031/2012
Interim financial report for the period:

04/04/2012 to 03/04/2013

Expenditures	Per currency XAF			Total for the period in EUR		Cumulated costs (before current report) (in EUR)	Cumulated costs (from start of implementation to present report included) (in EUR)
	e rate for the period:		0.001524				
	Unit cost (in XAF)	Total cost (in XAF)	Total cost (in EUR)	Total # units for all currencies	Total cost of the period (in EUR)		
	(e_4)	(f_4) = (d_4)*(e_4)	(g_4)= (f_4)*(Fx-rate$_4$)	Sum (d_1→d_4)	(h)= Sum (g_1→g_4)	(i)	(h)+(i)
1. Human Resources							
1.1 Salaries (gross salaries including social security charges and other related costs, local staff)							
1.1.1. Technical staff Cameroon	75 435	805 000	1 227	10.7	1 227		1 227
1.1.1. Technical staff Kenya	0	0	0	0.0	0		0
1.1.1. Technical staff Madagascar	0	0	0	5.2	1 353		1 353
1.1.1. Technical staffs France	0	0	0	0.0	0		0
1.1.2. Administrative/ support staff Cameroon	131 191	0	0	0.0	0		0
1.1.2. Administrative/ support staff Kenya	0	0	0	0.0	0		0
1.1.2. Administrative/ support staff Madagascar	0	0	0	10.5	2 092		2 092
1.1.3. Student training Cameroon	0	0	0	0.0	0		0
1.1.3. Student training Kenya	0	0	0	2.3	969		969
1.1.3. Student training Madagascar	0	0	0	3.6	716		716
1.1.4. Researcher Cameroon	301 740	4 036 704	6 154	13.4	6 154		6 154
1.1.4. Researcher Kenya	0	0	0	0.0	0		0
1.1.4. Researcher Madagascar	0	0	0	27.4	8 100		8 100
1.1.4. Researchers France	0	0	0	9.5	113 796		113 796
1.2 Salaries (gross salaries including social security charges and other related costs, expat/int. staff)							
1.2.1. Administrative/ support staff Cirad France	0	0	0	2.2	10 877		10 877
1.2.2. Student trained in France	0	0	0	8.5	3 576		3 576
1.2.3. Researcher Cirad France	0	0	0	5.4	36 788		36 788
1.2.4. Coordinator Cirad France	0	0	0	2.0	19 350		19 350
1.3 Per diems for missions/travel			0	0.0			0
1.3.1. Abroad staff assigned to the Action Cameroon	0	0	0	81.0	10 687		10 687
1.3.1. Abroad staff assigned to the Action Kenya	0	0	0	14.8	2 130		2 130
1.3.1. Abroad staff assigned to the Action Madagascar	0	0	0	10.1	982		982
1.3.1. Abroad staff assigned to the Actions Ethiopia	0	0	0	0.0	0		0
1.3.2. Local staff assigned to the Action Cameroon	14 431	0	0	108.6	2 390		2 390
1.3.2. Local staff assigned to the Action Kenya	0	0	0	0.0	0		0
1.3.2. Local staff assigned to the Action Madagascar	0	0	0	24.1	458		458
1.3.3. Seminar/conference participants Cameroon	0	0	0	91.0	1 819		1 819
1.3.3. Seminar/conference participants Kenya	0	0	0	0.0	0		0
1.3.3. Seminar/conference participants Madagascar	0	0	0	0.0	0		0
Subtotal Human Resources		***4 841 704***	***7 381***		***223 464***		*223 464*
2. Travel							
2.1 International travel							
2.1.1. International travel Cameroon	0	0	0	4.6	5 520		5 520
2.1.2. International travel Kenya	0	0	0	2.5	3 002		3 002
2.1.3. International travel Madagascar	0	0	0	2.5	3 427		3 427
2.1.4. International travel Ethiopia	0	0	0	0.0	0		0
2.1.5. International Travel across Africa	0	0	0	4.2	6 334		6 334
2.2 Local transportation			0	0.0	0		0
2.2.1. Local transportation Cameroon	0	0	0	1.5	265		265
2.2.2. Local transportation Kenya	0	0	0	2.0	861		861
2.2.3. Local transportation Madagascar	0	0	0	1.3	951		951
Subtotal Travel		***0***	***0***		***20 360***		*20 360*
3. Equipment and supplies							
3.1. Purchase or rent of vehicles Cameroon	0	0	0	1.0	27 898		27 898
3.2. Furniture, computer equipment	648 086	175 000	267	1.2	1 190		1 190
3.3. Machines, tools	602 169	309 000	471	0.5	471		471
3.4. Spare parts/equipment	0	0	0	0.0	0		0
3.5. Other (please specify)	0	0	0	0.0	0		0
Subtotal Equipment and supplies		***484 000***	***738***		***29 559***		*29 559*
4. Local office							
4.1. Vehicle costs	26 238	206 000	314	39.0	1 561		1 561
4.2. Office rent	0	0	0	0.0	0		0
4.3. Consumables - office supplies	245 328	815 460	1 243	6.0	2 248		2 248
4.4. Other services	20 335	124 000	189	6.1	189		189
Subtotal Local office		***1 145 460***	***1 746***		***3 998***		*3 998*

AFS4FOOD - Contract n° AURG/031/2012
Interim financial report for the period:

04/04/2012 to 03/04/2013

Expenditures	Per currency XAF Unit cost (in XAF) (e_4)	Per currency XAF Total cost (in XAF) (f_4) = (d_4)*(e_4)	Total for the period in EUR Total cost (in EUR) (g_4)= (f_4)*(Fx-rate$_4$)	Total for the period in EUR Total # units for all currencies Sum (d_1→d_4)	Total for the period in EUR Total cost of the period (in EUR) (h)= Sum (g_1→g_4)	Cumulated costs (before current report) (in EUR) (i)	Cumulated costs (from start of implementation to present report included) (in EUR) (h)+(i)
Exchange rate for the period:			0.001524				
5. Other costs, services							
5.1. Publications	0	0	0	14.1	2 250		2 250
5.2. Studies, research	0	0	0	0.5	82		82
5.3. Expenditure verification	0	0	0	0.0	0		0
5.4. Evaluation costs	0	0	0	0.0	0		0
5.5. Translation, interpreter	0	0	0	0.0	0		0
5.6. Financial services (bank guarantee costs etc.	32 798	0	0	0.0	0		0
5.7. Costs of conferences/seminars	0	0	0	0.3	574		574
5.8. Visibility actions	0	0	0	1.2	316		316
Subtotal Other costs, services		***0***	***0***		***3 222***		*3 222*
6. Other							0
6.1. Material for laboratory trials Cameroon	269 598	0	0	2.4	995		995
6.1. Material for laboratory trials Kenya	0	0	0	0.0	0		0
6.1. Material for laboratory trials Madagascar	0	0	0	1.7	1 724		1 724
6.2. Quality analysis Cameroon	0	0	0	0.0	0		0
6.2. Quality analysis Kenya	0	0	0	0.0	0		0
6.2. Quality analysis Madagascar	0	0	0	4.9	4 092		4 092
Subtotal Other		***0***	***0***		***6 811***		***6 811***
7. Subtotal direct eligible costs of the Action (1-6) (excludin		**6 471 164**	**9 865**		**287 414**		**287 414**
8.1. Contingency reserve		0	0		361		361
9. Total direct eligible costs of the Action (7+ 8) (excluding t		6 471 164	9 865		287 775		287 775
A.1. Administrative Costs		691	691		20 146		20 146
11. Total eligible costs (9+10) (excluding taxes)		6 471 855	10 556		307 921		307 921
12. Taxes[11]							0
13. Total eligible/accepted[12] costs of the Action (11+12)			10 556		307 921		307 921

UA FINANCE 50 %

AFS4FOOD - Contract n° AURG/031/2012

Implementation period of the contract : 04/04/2012 to 03/04/2015

Forecast budget and follow-up		Previous period (04/04/2012 to 03/04/2013)			Actual previous period (04/04/2012 to 03/04/2013)		Following period (04/04/13 to 03/04/14)		
	Unit	# of units	Unit rate (in EUR)	Costs (in EUR)	# of units	Costs (in EUR)	# of units	Unit rate (in EUR)	Costs (in EUR)
1. Human Resources									
1.1 Salaries (gross salaries including social security charges and other related costs, local staff)[4]									
1.1.1 Technical Cameroon	Per month	32	115	3 680	10.7	1 227	43	115	4 906
1.1.1 Technical Kenya	Per month	10	695	7 250	0.0	0	16	695	10 875
1.1.1 Technical Madagascar	Per month	14	259	3 751	5.2	1 353	19	259	4 925
1.1.1 Technical Cirad	Per month	1	4 380	4 380	0.0	0	2	4 380	6 570
1.1.2 Administrative/ support staff Cameroon	Per month	12	200	2 400	0.0	0	18	200	3 600
1.1.2 Administrative/ support staff Kenya	Per month	12	200	2 400	0.0	0	18	200	3 600
1.1.2 Administrative/ support staff Madagascar	Per month	12	200	2 400	10.5	2 092	13	200	2 514
1.1.3 Student training : Cameroon	Per month	8	46	354	0.0	0	12	46	531
1.1.3 Student training : Kenya	Per month	13	420	5 540	2.3	969	19	420	7 826
1.1.3 Student training : Madagascar	Per month	24	199	4 852	3.6	716	35	199	6 905
1.1.4 Researcher Cameroun	Per month	3	460	12 000	13.4	6 154	31	460	14 171
1.1.4 Researcher Kenya	Per month	25	4 500	11 500	0.0	0	4	4 500	18 000
1.1.4 Researcher Madagascar	Per month	30	296	8 880	27.4	8 100	31	296	9 114
1.1.4 Researcher Cirad (expatriates)	Per month	11	12 000	132 000	9.5	113 796	12	12 000	141 102
1.2 Salaries (gross salaries including social security charges and other related costs, expat/int. staff)							0		0
1.1.2 Administrative/ support staff Cirad	Per month	2	5 000	10 000	2.2	10 877	2	5 000	9 562
1.2.2 Student trained in France	Per month	14	420	5 740	8.5	3 576	16	420	6 822
1.2.2 Researcher Cirad (France)	Per month	9	6 800	61 200	5.4	36 788	11	6 800	73 406
1.2.3 Coordinator Cirad	Per month	2	9 700	16 167	2.0	19 350	2	9 700	14 575
1.3 Per diems for missions/travel[5]					0.0	0	0		0
1.3.1 Abroad (staff assigned to the Action) Cameroon	Per diem	43	132	840	81.0	10 687	24	132	3 113
1.3.1 Abroad (staff assigned to the Action) Kenya	Per diem	53	144	5 647	14.8	2 130	72	144	10 353
1.3.1 Abroad (staff assigned to the Action) Madagascar	Per diem	70	97	7 610	10.1	982	99	97	9 638
1.3.1 Abroad (staff assigned to the Action) Ethiopia	Per diem	5	180	6 753	0.0	0	7	180	1 260
1.3.2 Local (staff assigned to the Action) Cameroon	Per diem	625	22	13 771	108.6	2 390	883	22	19 459
1.3.2 Local (staff assigned to the Action) Kenya	Per diem	67	35	2 340	0.0	0	100	35	3 510
1.3.2 Local (staff assigned to the Action) Madagascar	Per diem	10	19	187	24.1	458	2	19	46
1.3.3 Seminar/conference participants Cameroon	Per diem	40	20	800	91.0	1 819	15	20	291
1.3.3 Seminar/conference participants Kenya	Per diem	40	20	800	0.0	0	60	20	1 200
1.3.3 Seminar/conference participants Madagascar	Per diem	40	20	800	0.0	0	60	20	1 200
Subtotal Human Resources				**334 041**		**223 464**			**389 073**
2. Travel[6]									
2.1 International travel									
2.1.1 International travel Cameroon	Per flight	5	1 200	5 600	4.6	5 520	5	1 200	5 640
2.1.2 International travel Kenya	Per flight	5	1 200	5 533	2.5	3 002	6	1 200	6 799
2.1.3 International travel Madagascar	Per flight	4	1 383	5 533	2.5	3 427	5	1 383	6 586
2.1.4 International travel Ethiopia	Per flight	1	1 500	2 000	0.0	0	2	1 500	3 000
2.1.5 International travel across Africa	Per flight	6	1 500	9 000	4.2	6 334	7	1 500	10 333
2.2 Local transportation		0		0	0.0	0	0		0
2.2.1 Local transportation Cameroon	Per month	12	180	2 160	1.5	265	17	180	3 108
2.2.2 Local transportation Kenya	Per month	12	424	5 083	2.0	861	17	424	7 195
2.2.3 Local transportation Madagascar	Per month	12	709	8 511	1.3	951	17	709	12 286
Subtotal Travel				**43 421**		***20 360***			**54 947**
3. Equipment and supplies[7]									
3.1 Purchase or rent of vehicles	Per vehicle	1	28 000	28 000	1.0	27 898	0	28 000	0
3.2 Furniture, computer equipment	per unit	2	988	1 647	1.2	1 190	4	988	3 715
3.3 Machines, tools…	per unit	4	918	3 977	0.5	471	12	918	11 459
3.4 Spare parts/equipment for machines, tools				0	0.0	0	0		0
3.5 Other (please specify)	per unit	2	1 300	3 033	0.0	0	7	1 300	9 100
Subtotal Equipment and supplies				**36 657**		***29 559***			**24 274**
4. Local office									
4.1 Vehicle costs	Per week	71	40	2 827	39.0	1 561	86	40	3 459
4.2 Office rent	Per month				0.0	0	0		0
4.3 Consumables - office supplies	Per month	60	374	22 427	6.0	2 248	87	374	32 511
4.4 Other services (tel/fax, electricity/heating, maintenance)	Per month	60	31	1 860	6.1	189	87	31	2 695
Subtotal Local office				**27 113**		*3 998*			**38 666**

AFS4FOOD - Contract n° AURG/031/2012

Implementation period of the contract : 04/04/2012 to 03/04/2015

Forecast budget and follow-up		Previous period (04/04/2012 to 03/04/2013)			Actual previous period (04/04/2012 to 03/04/2013)		Following period (04/04/13 to 03/04/14)		
	Unit	# of units	Unit rate (in EUR)	Costs (in EUR)	# of units	Costs (in EUR)	# of units	Unit rate (in EUR)	Costs (in EUR)
5. Other costs, services[8]									
5.1 Publications	per unit	9	160	1 440	14.1	2 250	6	160	1 035
5.2 Studies, research[9]	per unit	25	154	3 858	0.5	82	37	154	5 746
5.3 Expenditure verification	per unit	4	1 725	6 900	0.0	0	6	1 725	10 350
5.4 Evaluation costs	per unit	0		0	0.0	0	0		0
5.5 Translation, interpreters	per unit	0		0	0.0	0	0		0
5.6 Financial services (bank guarantee costs etc.)	per unit	36	50	1 800	0.0	0	54	50	2 700
5.7 Costs of conferences/seminars[9]	per unit	1	1 820	1 820	0.3	574	1	1 820	2 443
5.8. Visibility actions[10]	per unit	0	260	87	1.2	316	0	260	0
Subtotal Other costs, services				**15 905**		***3 222***			**22 274**
6. Other									
6.1. Material for laboratory trials Cameroon	per unit	*17*	*411*	6 850	*2.4*	*995*	24	*411*	9 778
6.1. Material for laboratory trials Kenya	per unit	*1*	*1 000*	1 000	*0.0*	*0*	2	*1 000*	1 500
6.1. Material for laboratory trials Madagascar	per unit	*2*	*1 000*	2 000	*1.7*	*1 724*	2	*1 000*	2 105
6.2. Quality analysis Cameroon	per unit	*20*	*125*	2 500	*0.0*	*0*	30	*125*	3 750
6.2. Quality analysis Kenya	per unit	*67*	*68*	4 500	*0.0*	*0*	100	*68*	6 750
6.2. Quality analysis Madagascar	per unit	*13*	*838*	11 167	*4.9*	*4 092*	17	*838*	14 626
							0		
Subtotal Other				**28 017**		***6 811***			**38 509**
7. Subtotal direct eligible costs of the Action (1-6) (excluding taxes)				**485 154**		287 414			**567 742**
8. Provision for contingency reserve (maximum 5% of 7, subtotal of direct eligible costs of the Action) (excluding taxes)						361			0
9. Total direct eligible costs of the Action (7+ 8) (excluding taxes)				**485 154**		***287 775***			**567 742**
10. Administrative costs (maximum 7% of 9, total direct eligible costs of the Action) (excluding taxes)				**33 961**		20 146			**39 742**
11. Total eligible costs (9+10) (excluding taxes)				**519 114**		***307 921***			**607 484**
12. Taxes[11]									
13. Total eligible/accepted[12] costs of the Action (11+12)				**519 114**		***307 921***			**607 484**