Response to the locust plague in Madagascar
Campaign 2013/14

FINAL REPORT
September 2013–August 2014

Food and Agriculture Organization of the United Nations

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ABBREVIATIONS AND ACRONYMS

AGP	Plant Production and Protection Division of FAO
AGPMM	Locusts and Transboundary Plant Pests and Diseases team
CCE	*Cahier des charges environnementales*
CERF	Central Emergency Response Fund
CFSAM	Crop and Food Security Assessment Mission
CNA	*Centre national antiacridien*
CSAI	Infrastructure and Facilities Management Branch of FAO
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GIS	Geographic Information System
GPS	Global positioning system
IGR	Insect growth regulator
MARD	Ministry of Agriculture and Rural Development
PCN	*Poste de coordination national*
PGSE	*Plan de gestione sanitaire et environnementale*
PNUA	*Plan national d'urgence acridienne*
PPD	Plant Protection Directorate
PPE	Personal protective equipment
PSMS	Pesticide Stock Management System
RDRD	Regional Directorate for Rural Development
SSB	Single-sideband
TCE	Emergency and Rehabilitation Division of FAO
ULV	Ultra-low volume

EXECUTIVE SUMMARY

The plague of the Malagasy Migratory Locust began in April 2012 in Madagascar, in a context where food insecurity and malnutrition rates were already high. Given the extent of the plague, it was estimated that the food security of about 13 million people (60 percent of the population) could be affected in the absence of large-scale locust control operations. To cope with this dire situation, in December 2012, the Ministry of Agriculture and Rural Development of Madagascar and the Food and Agriculture Organization of the United Nations developed a Three-year Programme (2013–2016) in response to the locust plague.

Donor response has been timely and positive. The first locust campaign was fully funded and successfully implemented. The specific objective of the campaign, aimed at halting the dynamics of the locust plague while protecting crops and pastures, was achieved. Following surveys carried out on more than 30 million ha, the locust populations in an area exceeding 1.2 million ha were controlled, without any incident affecting human health or the environment and without causing significant damage to the major rice baskets.

These results were obtained owing to the implementation of large-scale aerial survey and control operations in the infested areas. The operations were executed from three aerial bases, which were redeployed as needed in accordance with the evolving locust situation. A total of 1 025 hours were flown for survey operations and 1 017 hours for control operations by three helicopters and one fixed-wing aircraft, which reinforced aerial control capacities for a three-month period.

The strategy adopted to tackle the locust plague in Madagascar includes the use of: conventional chemical pesticides for full cover treatments against adult locusts and late instar hopper bands; insect growth regulators (IGRs) for barrier treatments to rapidly protect large areas contaminated by hopper bands; and biopesticides to treat locations near or within environmentally sensitive areas. In total, more than 600 000 litres of IGRs and conventional pesticides and 83 kg of biopesticides were used during the first campaign to treat two-thirds of the contaminated area using full cover and barrier treatments.

The 2013/14 campaign significantly contributed to the strengthening of national capacities through the delivery of specific trainings in various technical domains. These trainings were complemented with on-site practical training sessions provided by various experts working in the field.

In order to sustain the results achieved during the first campaign, it is essential to support the decline of the locust plague during the 2014/15 campaign and return, in 2016, to a locust recession situation (overall objective of the Three-year Programme), thus putting an end to the locust crises' cycle and avoiding further deterioration of the significant food insecurity situation.

1 INTRODUCTION

1.1 Background

The plague of the Malagasy Migratory Locust began in April 2012, in a context where food insecurity and malnutrition rates were already high. Crops (mainly rice) and pastures were at risk of major damage. The plague therefore posed a considerable threat to domestic food supply and grain prices, and consequently, to the food security of about 13 million people. To cope with this situation, the Ministry of Agriculture and Rural Development (MARD) of Madagascar declared a national state of emergency on 27 November 2012. In December 2012, the MARD requested technical and financial assistance from the Food and Agriculture Organization of the United Nations (FAO) in order to tackle the locust plague and ensure resource mobilization, coordination and implementation of an emergency response.

1.2 Overview of the Three-year Programme

1.2.1 Objectives

In response to the plague, an emergency Programme for three consecutive locust campaigns (2013–2016) was jointly developed by FAO and the MARD in December 2012.

The objective of the Programme is to safeguard the food security of rural populations in Madagascar.

1.2.2 Beneficiaries

The target beneficiaries of the Programme include:

1. The Plant Protection Directorate (PPD) of the MARD, through the establishment of the Locust Watch Unit to improve the capacity to monitor and analyse the locust and anti-locust situation in the country.
2. *Centre National Antiacridien* (CNA), through the strengthening of its capacity to respond to the locust threat.
3. Approximately 13 million people in Madagascar, whose livelihoods are affected by the locust plague.

1.2.3 Components

The Three-year Programme consists of five components and numerous activities:

Table 1 – Components and Activities of the Three-year Programme			
Component		**Activities**	
1	National capacity for monitoring and analysis of the locust situation strengthened	1.1.	Strengthening of human capacities in data collection and analysis and information management
		1.2.	Support to survey operations
2	Locust control capacity strengthened	2.1.	Human capacity building for locust control
		2.2.	Support to locust control operations
3	Human health preserved and environment protected	3.1.	Strengthening of human capacities for human health preservation and protection of the environment
		3.2.	Support impact monitoring (of treatments) on human health and the environment
		3.3.	Construction of a pesticide storage facility (Toliara)
4	Implementation and coordination of the Programme	4.1.	Implementation of the National Locust Emergency Plan
		4.2.	Coordination of the Three-year Programme
5	Assessment of the effectiveness of the locust campaigns and of the impact of the locust crisis on crops and pastures	5.1.	Assessment of the effectiveness of the locust control campaign
		5.2.	Assessment of the impact of the locust crisis on crops and pastures

1.2.4 Budget

The budget was planned to be revised on an annual basis to reflect the evolution of the locust situation, the needs of each locust control campaign and the actual costs of various items and services. In June 2014, the estimated overall budget of the Three-year Programme was anticipated to have increased by 1.4 million compared to the initial estimates made in September 2013 (i.e. USD 42.9 million rather than USD 41.5 million). In December 2014, the budget was readjusted to USD 39.39 million, taking into account the actual cost of the first campaign and the estimated cost of the second campaign (see table below).

Table 2 – Overall budget of the Three-year Programme (revised December 2014)				
COMPONENT	**CAMPAIGN 1 (2013/14) USD million**	**CAMPAIGN 2 (2014/15) USD million**	**CAMPAIGN 3 (2015/16) USD million**	**TOTAL USD million**
Component 1: Capacity for monitoring and analysis of the locust situation strengthened	5.07	2.60	1.10	**8.77**
Component 2: Locust control capacity strengthened	12.13	7.42	1.80	**21.35**
Component 3: Human health preserved and environment protected	0.18	0.95	0.16	**1.29**
Component 4: Implementation and coordination of the Programme	2.78	4.20	0.80	**7.78**
Component 5: Assessment of the effectiveness of locust campaigns and the impact of the locust crisis on crops and pastures	0.05	0.10	0.05	**0.2**
TOTAL (USD million)	**20.21**	**15.27**	**3.91**	**39.39**

1.3 Donor response

Donor response has been timely and positive. A total of USD 28.2 million was provided by the Central Emergency Response Fund (CERF) of the UN Office for the Coordination of Humanitarian Affairs and the European Union (EU), in addition to the Governments of the Republic of Austria, the Kingdom of Belgium, the French Republic, the Republic of Italy, Japan, the Republic of Madagascar (through a World Bank loan), the Kingdom of Norway and the United States of America. The first locust campaign was fully funded and successfully implemented.

The actual cost of the first campaign was USD 20.21 million, out of an estimated total budget of USD 24.8 million. The remaining funds allowed FAO to launch the second campaign, and will cover aerial survey and control operations through February 2015. The second and third locust campaigns remain under-funded, although FAO has initiated negotiations with donors in order to secure the required funds.

2 IMPLEMENTATION OF THE 2013/14 CAMPAIGN

2.1 Presentation of the first campaign

2.1.1 Objective

The specific objective of the first campaign of the Programme, implemented from September 2013 to August 2014, was to halt the plague by stemming the dynamics of the Malagasy Migratory Locust populations.

2.1.2 Strategy

The strategy implemented included identifying hotspots of locust populations (i.e. the most infested areas), regularly monitoring the dynamics of these populations in order to establish the most accurate forecasts and deploying the best available control measures in accordance with good agricultural practices and with respect to human health and the environment.

During the first anti-locust campaign, 1.5 million ha were planned to be treated in order to protect crops and pastures. This strategy aimed to reduce the threat to the livelihoods of rural populations, which are affected by the locust plague and other factors such as cyclones, drought and political instability.

2.2 Activities implemented

The campaign was officially launched on 20 September 2013. The period preceding the official launch – February to August 2013 – was mainly characterized by three activities:

1. the establishment and the maintenance of the Locust Watch Unit to gather and analyse locust, ecological and meteorological data, in addition to data on damage to crops and pastures;
2. the procurement of goods and services critical for survey and control operations (aerial services/flying hours, vehicles and pesticides and equipment for surveying, spraying, camping, communication and protecting personnel); and
3. the deployment of staff essential to the coordination and implementation of the campaign in Madagascar.

Details on activities carried out and results achieved during the 2013/14 campaign are outlined below.

2.2.1 Component 1: Strengthening of national capacities for the monitoring and analysis of the locust situation

Expected outcome: The capacities for the monitoring and analysis of the locust situation are strengthened, thus making it possible to understand the dynamics of the locust populations, to implement the locust control strategy, to make necessary tactical adjustments during the campaign and to identify the targets for large-scale control operations.

Indicators:

- 500 flying hours[1] are undertaken to complete aerial surveys from September 2013 (up to September 2014), surveying around 80 million ha in the infested areas[2].
- Spatial-temporal dynamics (both quantitative and qualitative) of the locust populations are documented: the number, size and density of hopper and adult winged populations (swarms) are identified in the infested areas; movements of the swarms are described and mapped.

Results achieved: *During the first campaign[3], a total of 1 025 hours were flown by the three helicopters for survey operations. These aerial surveys covered an estimated area of more than 30 million ha.*

Between March 2013 and August 2014, 27 ten-day and 18 monthly bulletins were produced and published on the FAO Web site dedicated to the locust emergency in Madagascar. These bulletins, produced by the Locust Watch Unit and illustrated with maps and tables, documented the spatial-temporal development of locust populations and their habitats, the means used to monitor them, details on locust control operations and agro-economic information, in addition to difficulties encountered and staff movements.

Activity 1.1.: Strengthening of human capacities in data collection and analysis and information management

Establishment and strengthening of the Locust Watch Unit

Two months after receiving the request for emergency assistance from the Government of Madagascar, FAO advanced its own emergency funds in February 2013 to establish a Locust Watch Unit within the PPD in Antananarivo. The Unit was staffed by three junior experts responsible for collecting, managing and analysing ecological, meteorological, locust, anti-locust and agro-socio-economic data. The Unit carried out seven ten-day field assessments (ground surveys) from February to September 2013 in order to collect locust information for analysis.

The timely contribution of donors to the 2013/14 campaign allowed the continuity of the Locust Watch Unit. In October 2013, the Locust Watch Unit began relying on data from the aerial bases – collected during aerial surveys and included in ground reports – in order to conduct data analysis. Five field missions were carried out for a total of four weeks in order to obtain missing data and collect and send survey forms.

That same month, the Locust Watch Unit was further strengthened through the recruitment of a national expert in Geographic Information Systems (GIS). The national GIS expert, under the supervision of the Coordinator of the Three-year Programme, was in charge of improving the mapping and visual representation of the locust survey and control operations for the ten-day and monthly bulletins, the campaign's archives, the media and the FAO Web site.

[1] Before an anti-locust campaign, it is not possible to anticipate the exact number of flying hours required to carry out the operations. FAO mentions a lump sum for both survey and control flying hours.

[2] This indicator, as outlined in the evaluation report of the first campaign prepared by Mr Ghaout, did not prove to be objectively verifiable because of the practical difficulties encountered in effectively assessing the areas surveyed by air.

[3] Although the first campaign officially ended on 31 August 2014, from an operational point of view, survey and control activities ended on 10 September 2014, the date of dissolution of the aerial base that remained operational during the winter period.

At the beginning of the campaign, the Locust Watch Unit benefited from technical support and an on-site training session provided by an international GIS expert. The training focused on: (i) the establishment and management of the GIS database; (ii) the creation of thematic maps illustrating the dynamics of locust populations, the extent of the locust infestations and weather conditions (estimated rainfall); (iii) locust forecasts; and (iv) mapping of the areas to be treated. The international GIS expert carried out a second one-month mission to Madagascar in January 2014 to: (i) reinforce the training previously provided; (ii) improve the expanding geo-referenced database of information related to meteorological conditions, locust dynamics and control operations, as well as the environmental/human health and socio-economic aspects of the locust campaign; and (iii) further strengthen the capacity of the Locust Watch Unit for mapping and forecasting. When working abroad, the international GIS expert continued to provide virtual support to the Locust Watch Unit for data management, analysis and mapping.

In June 2014, an international agronomist was deployed to Madagascar to further strengthen and support the drafting and editing of the ten-day and monthly bulletins, in addition to the data collection, management and analysis efforts of the Locust Watch Unit. The funds for the first campaign also allowed the four members of the Locust Watch Unit to benefit from a French language course held outside of working hours in order to improve their editing and writing skills.

Between March 2013 and August 2014, 27 ten-day and 18 monthly bulletins were produced and published on the FAO Web site dedicated to the locust emergency in Madagascar. These documents, illustrated with maps and tables, covered the spatial-temporal development of locust populations, their habitats, the means used to monitor them, details on locust control operations, agro-economic information, staff movement and difficulties encountered.

Throughout the campaign, the Locust Watch Unit continued to receive daily support from the FAO Response Coordinator (based in Rome) and the Senior Locust Expert (based in France), both of whom had provided initial training for the Locust Watch Unit in February 2013. The four members of the Locust Watch Unit also benefited from four on-site trainings delivered by the FAO Response Coordinator during her missions to Madagascar in September and December 2013 and in March/April and June/July 2014. An additional on-site training and refresher course was provided to the Unit on the collection, analysis and distribution of locust information by the Senior Locust Expert during his mission in August 2014.

Training of radio technicians

Between December 2013 and January 2014, two technicians from the CNA based in Betioky and Toliara were provided with training on the use of radios and the selection of frequencies. Radio operators also received on-the-job training on radio maintenance and repair during the installation of mobile radios in vehicles on site in Toliara, and during the installation of fixed radios at the base stations in Betioky and Toliara. During a security mission conducted by the United Nations Department for Safety and Security, vehicle drivers were instructed on proper radio frequency selection and use, and the importance of communicating vehicle movements/positions during survey and control operations. In July 2014, during the installation of fixed radios at the locust outposts, the two previously trained CNA technicians received a refresher course on radio use and frequency selection. These technicians were additionally trained on the installation and maintenance of the fixed radios.

Every radio operator present at the locust outposts was further trained on the use of radios and selection of frequencies.

Activity 1.2.: Support to survey operations

Procurement and delivery of vehicles and equipment required for survey operations

Following competitive procurement processes, FAO procured and delivered vehicles and the necessary equipment for the appropriate implementation of field operations. The following equipment was delivered during the 2013/14 anti-locust campaign to establish aerial bases and enable ground and aerial survey operations: survey equipment (entomological/scientific equipment); camping equipment (tents, camping beds, tables, chairs, cookware, generators, etc.); 46 radios (11 fixed radios for base stations and 35 mobile radios for vehicles); seven satellite phones; six digital cameras; 100 global positioning system (GPS) units; 15 computers and seven printers; eight motorcycles; and 27 four-wheel drive vehicles, including 25 double-cabin pick-ups and two station wagons.

National logistics expertise ensured

Two national Logisticians were recruited in October 2013 to assist in receiving equipment at various air and sea ports, clearing customs formalities and distributing the equipment to different locations (warehouses, aerial bases, etc.). They continued to provide their services in accordance with the needs identified by the Campaign Coordinator based in Madagascar, in collaboration with the Locust Team at the FAO Representation in Antananarivo and the FAO Response Coordinator in Rome.

Given the high number of purchases made during the campaign, the importance of the vehicle fleet and the high mobility of the aerial bases, it was considered necessary to strengthen the Programme management team in Madagascar through the recruitment of two national Logisticians. Thus, a vehicle manager joined the team to ensure the monitoring of the fleet and the maintenance and management of the vehicles in terms of security and fuel consumption. The second Logistician contributed to the strengthening of capacities through improving the monitoring of imports, deliveries, distribution of equipment in the field and payment of the teams.

Establishment of three aerial bases

Following a competitive tender process, FAO procured the services of an experienced contractor to provide helicopters, skilled pilots and related logistics services for aerial operations in Madagascar.

The first helicopter arrived in Madagascar on 15 September 2013. On 20 September, the 2013/14 campaign was officially launched in the presence of the Minister for Agriculture, the FAO Representative for Madagascar and donors. Aerial survey operations began on 26 September in western Madagascar.

Following the arrival of the second helicopter on 10 October 2013, two aerial bases were established in the west (Tsiroanomandidy) and the south (Ihosy). The second helicopter was used to begin survey operations on 4 November 2013. A third helicopter, received on 2 February 2014, further reinforced aerial survey and control capacity. The helicopter was operational from 6 February at the third aerial base, initially deployed in Toliara.

Each aerial base was equipped with one helicopter and staffed with a team responsible for the daily management of the base, in addition to a team responsible for data collection. The locations of the aerial bases changed in accordance with the evolving locust situation and security constraints in the country.

In November 2013, the Campaign Coordinator and two Locust Experts (one national and one international) carried out a mission in Toliara to train CNA staff and aerial base personnel, surveyors, ground control teams and helicopter crews on locust survey operations and the transmission of locust, anti-locust and environmental data. More specifically, this training focused on: the objectives of the survey operations (data collection and transmission); the preparation of the teams; the planning and implementation of both extensive and intensive aerial and ground surveys; evaluation methods concerning locust, vegetation, soil moisture and meteorological conditions; and how to complete and transmit the survey forms.

By the end of June 2014 (the beginning of the winter season), two out of the three aerial bases were demobilized as a result of significantly reduced locust activity; only one base was necessary. CNA staff were dismissed and charged for the cleaning, maintenance, repair and storage of the equipment used during the first anti-locust campaign in order to keep them operational for use during the second campaign.

During the winter period, from early July to 10 September 2014, one mobile aerial base was maintained in order to evaluate the importance, location and characteristics of residual locust populations, either scattered or in groups, and to conduct the necessary control operations.

Locust expertise ensured

International and national locust expertise was ensured throughout the first campaign. A national Locust Expert worked in close collaboration with the Campaign Coordinator and the Response Coordinator in order to support the supervision of day-to-day activities of the anti-locust campaign. At the beginning of the campaign, an international Locust Expert was present for a two-month period in order to participate in the launch of activities and extensive surveys.

Two junior Locust Experts from the National Anti-Locust Centre of the Kingdom of Morocco were recruited to support field operations from January to April and June 2014, respectively. These experts, who can master new technologies and possess excellent technical knowledge and writing skills, were ideal to support surveyors and aerial base managers. The managers have the required field experience but are not always able to report appropriately (accurate, concise and almost in real time) on the locust and anti-locust situations and eventual incidents. In August 2014, the national Locust Expert planned and participated in the aerial and ground survey activities undertaken in Malagasy Migratory Locust outbreak and invasion areas in order to evaluate the locust situation at the end of the campaign.

The need for a permanent presence of FAO experts on each aerial base became evident during the first campaign. This presence is necessary in order to ensure the smooth implementation of all operations, the immediate reporting of any incident and the daily transmission of all information regarding the locust situation and related treatments.

Aerial surveys

There are two types of aerial surveys: extensive and intensive. The purpose of the extensive aerial surveys carried out at the beginning of the campaign was twofold: (i) to assess the nature (i.e. number, size and density) and the phase characteristics of the previous generation of adult locusts that survived through the end of the dry and cool season (the unfavourable season for locusts, during which they exist as mobile winged locusts usually unable to breed); and (ii) to locate the hotspots of locust populations (thus mapping the most infested areas) in order to determine where to deploy the aerial bases from which aerial surveys would be organized and eventually complemented through ground surveys, and from which the locust control operations would be implemented.

During the campaign, extensive aerial surveys managed to provide a synoptic overview of the locust situation at key periods and in areas essential to the bioecology of the insect pest, providing indications of where the aerial bases should be redeployed (if needed). The extensive surveys carried out at the end of the campaign allowed the national Locust Expert to assess the locust situation, develop accurate appraisals regarding the dynamics of the residual populations and predict the future evolution of the situation in order to adjust the anti-locust strategy in view of the preparation and implementation of the second anti-locust campaign.

Alternatively, the intensive surveys assisted in identifying and delimiting the blocks to be treated in all of the areas where Malagasy Migratory Locusts were developing and multiplying, while overcoming the topographic constraints that may sometimes hamper ground surveys.

The three helicopters flew 1 025 hours (well over the 500 flying hours estimated in the Programme document[4]) to survey infested and at-risk areas. These aerial surveys covered an estimated area of more than 30 million ha, although it is difficult to be precise considering the different nature of the targets (hopper bands and groups moving through vegetation, groups of winged locusts or flying swarms, etc.) and the distances from which they can be observed.

Ground surveys

Ground surveys are sometimes required to complement aerial surveys, particularly in areas close to the bases or to prepare for ground treatments. These are carried out by CNA staff of the ground teams at the bases. The operating costs of these teams (fuel, vehicle maintenance, daily subsistence allowance for team members mobilized by the CNA, etc.) were covered by campaign funds.

Following each survey, either ground or aerial (intensive or extensive), a scout is required to complete a form that requests the following information: when and where (name of the closest locality and precise GPS coordinates) a locust observation was observed; the

[4] The highest concentrations of locust infestations (i.e. what are usually referred to as "locust hotspots" and which represent the basis for the deployment of the aerial bases) have been identified in much more remote areas than were expected, and therefore had to be detected and localized in the absence of any reporting by the rural population.

development stage (hopper instar, maturity, number of eggs laid for the winged locusts, etc.) and phasal state of the locust populations; and characteristics of soil and vegetation.

The CNA has locust outposts located throughout the outbreak area. Each outpost chief carried out ground surveys and transmitted information on the locust situation to the Locust Watch Unit, regardless of the presence or absence of hoppers or adults. However, the Locust Watch Unit received the information on an irregular basis, and the information transmitted was often imprecise and incomplete, making it difficult to use. To overcome the lack of information, a team of five scouts equipped with motorcycles is planned to be established in the outbreak area during the second campaign.

2.2.2 Component 2: Strengthening of national locust control capacities

Expected outcome: The Migratory Locust populations are reduced during the 2013/14 campaign in infested areas, and damage to crops and pastures due to the locust plague is limited.

Indicators:

- 1.5 million ha are treated or protected[5].
- Locust mortality rate in the treated areas.
- Number, size and density of swarms leaving the infested areas.

Results achieved: *From 5 November 2013 to 10 September 2014, a total area of 1 218 353 ha was treated or protected.*

The use of insect growth regulators (IGRs) on an area of 742 930 ha resulted in a mortality rate of up to 85 percent, while the use of conventional pesticides on an area of 473 763 ha resulted in a mortality rate of about 90 percent. An additional 1 660 ha were treated using the biopesticide Green Muscle®, but the assessment of the mortality rate was carried out over a limited period of time, hindering the ability to draw meaningful conclusions.

<u>Activity 2.1.</u>: Human capacity building for locust control

Inputs and supplies management

A software tool to assist in the management of inputs/supplies (inventory of the number and types of inputs acquired, manufacturer, date of acquisition, delivery, redistribution and use, routine checks/quality control [if necessary], replenishment, etc.) was adapted from a management tool currently used by the National Anti-Locust Centre in Morocco to be installed in the CNA office in Toliara. From 27 October to 3 November 2013, the Campaign Coordinator trained CNA staff in Toliara on the use of the software. CNA staff additionally received training on the importance of, and methods for, managing the vehicle fleet and equipment (GPS, radios, etc.) that were procured to meet the complex logistical needs of the 2013/14 campaign. This equipment was vital to the campaign, especially as the activities were being implemented from multiple mobile aerial bases. The CNA staff responsible for the use of the software benefited from further on-the-job training delivered by the Campaign Coordinator during his mission to Madagascar from mid-May to late June 2014.

[5] This is an assumption that was made before the launch of the Three-year Programme based on field information available at that time. To halt the plague and thus achieve the purpose of the first anti-locust campaign, it was necessary to control locust populations in an area of just over 1.2 million ha.

Training on aerial base management and security-related aspects

In October 2013, the international Logistician/Security Advisor trained CNA staff – aerial base personnel, surveyors, ground control teams and helicopter crews – on the organization, management and security-related aspects of an aerial base. This training focused on: human and material resources of an aerial base; the responsibilities of the base manager and his staff; the location of the fueling point of the helicopter; the characteristics of the airstrips for the fixed-wing aircraft; the handling and storage of pesticides and fuel; pesticide leakage response and the minimum equipment required for this task; the maneuvering area of the aircraft; the management of pesticide stocks and empty drums; and the proper filling and transmission of the daily flight report forms to the Locust Watch Unit.

In order to ensure the safety of ground teams assigned to the bases, as well as the effectiveness of survey and control operations (on rough ground, in remote areas and sometimes for extended periods away from bases), the Logistician/Security Advisor trained drivers on: the use of vehicle logbooks; how to perform a daily check of the vehicles; the use of single-sideband (SSB) radios; safe transportation by road; and the delivery of camping, survey and protection equipment to the warehouses, aerial bases and field teams.

Calibration of the helicopters' spraying systems

In November 2013, the Campaign Coordinator provided practical training to the teams from the aerial bases on the calibration of the helicopter-mounted Micronair sprayers, which were to be used for aerial control operations. On-the-job training and technical advice on calibration continued to be provided by the Campaign Coordinator and the Aircraft Logistician throughout the duration of spraying operations.

Training on the mounting and calibration of the vehicle mounted sprayer

In February 2014, an international consultant/specialist in spraying techniques installed the AU 8115 Micronair sprayer on the platform of a pick-up truck and provided training on the mounting and calibration of the sprayer to three CNA agents. The training focused on the basic principles of ultra-low volume (ULV) spraying, the functioning and maintenance of the spraying equipment, quality control of the spraying, the respect of technical parameters (speed progress, swath width, dosage and spraying height), appropriate weather conditions, protection of the control team members (wearing personal protective equipment [PPE]) and preservation of the environment (respect of exclusion and buffer zones).

Training on biopesticides

An international Biopesticide Expert carried out a one-month mission to Madagascar in March 2014 to provide a technical on-the-job training session/refresher course to CNA and *Poste de coordination national* (PCN) staff on the use of the biopesticide Green Muscle®, which is formulated with conidia of the entomopathogenic fungus *Metarhizium acridum*. This training, which was delivered with the assistance of a national Biopesticide Expert, focused on all practical and theoretical aspects of the use of biopesticides for both aerial and ground treatments: preparation and calibration of the spraying equipment, storage and preparation of the spray mixture prior to application, proper spraying, cleaning of spraying equipment after use, techniques for monitoring post-treatment efficacy and data collection and analysis.

Activity 2.2.: Support to locust control operations

Procurement and 'triangulation' of pesticides

The strategy adopted to respond to the locust plague in Madagascar includes the use of conventional chemical pesticides for full cover treatments against adult locusts and late instar hopper bands, IGRs for barrier treatments to rapidly protect large areas contaminated by hopper groups and bands[6] and biopesticides to treat locations surrounding and within environmentally sensitive areas. FAO used competitive tender processes to commercially procure 288 000 litres of conventional pesticides (Chlorpyrifos 240 ULV) and 200 000 litres of IGRs[7] (Teflubenzuron), along with a total of 1 500 kg of biopesticides (Green Muscle®) from its sole supplier.

The remaining quantity of conventional pesticides (229 600 litres) was donated by the Governments of Morocco (199 600 litres) and the Islamic Republic of Mauritania (30 000 litres) from their stocks through a process known as pesticide 'triangulation'. By making use of readily available pesticide stocks located in other countries – the effectiveness of which is verified and confirmed on a regular basis – the triangulation process reduces the global production of chemical pesticides, thereby limiting the environmental risks associated with their prolonged storage (e.g. leakage) and eventual disposal, if not used prior to becoming obsolete. Programme funds allowed FAO to transport these pesticides from Northwest Africa to Madagascar by air and sea.

The quantities of pesticides (litres or kgs) delivered and used during the 2013/14 campaign are provided in **Table 3**.

Table 3 – Quantities of pesticides required, procured or triangulated and used during the 2013/14 Campaign

Pesticides (litres except where indicated)	Quantity required for Campaign 1	Quantity procured	Quantity delivered	Quantity used
Conventional pesticides	550 000	*517 600	*517 600	473 931
IGRs	200 000	200 000	200 000	142 450
Biopesticides (kg)	1 500	1 500	**1 500	***83

** This figure includes the pesticides purchased as well as those 'triangulated' from Mauritania (30 000 litres) and Morocco (199 600 litres).*

*** This figure includes 500 kg (delivered in two batches of 250 kg) on 2 and 4 September 2014.*

[6] A hopper, or nymph, is a wingless locust not yet able to fly and breed. The hoppers of the Malagasy Migratory Locust develop in five successive hopper instars, each of which has a total duration of 30 days during the rainy season, and up to 60 days during the dry season (should breeding occur during that period). The last moulting corresponds with the fledging, which allows the emergence of the winged adult, still immature.

[7] The external skeleton of locusts is composed of chitin, which increases strength and is produced at each moult during the hopper development (until the locust is winged). Insect growth regulators disrupt chitin synthesis; the affected hoppers become soft and unable to move and feed usually after two successive moults. Therefore, it is not possible to use insect growth regulators against late instar hoppers.

**** Biopesticide treatments were initiated from the end of March after biopesticide team members were trained on its use. It must be noted that, once the biopesticide team became operational, very few targets were located within or near protected areas.*

Procurement and delivery of equipment

The equipment listed under Activity 1.2 (vehicles, radios, GPS, etc.) was purchased in order to be used during both survey and control operations. In addition to the aforementioned equipment, the following were procured and delivered for use by control teams: two single-cabin vehicles; four 10-tonne trucks; PPE such as gloves, boots, goggles, overalls and aprons; 242 sprayers (90 backpack sprayers, 150 hand-held sprayers and two vehicle-mounted sprayers); and 27 pesticide pumps (22 chemical pesticide pumps and six biopesticide pumps).

Aerial and ground control operations

Locust control operations were launched on 5 November 2013, approximately one month after survey operations began. By 10 September 2014, the three helicopters had flown approximately 668 hours[8] for treatment and nearly 371 hours for the deployment of the helicopters to and between the aerial bases.

Following a competitive tendering process, FAO contracted a second service provider in order to procure a fixed-wing control aircraft, along with qualified pilots and logistics services to further strengthen control operations. This fourth aircraft arrived on 3 March. By 3 June 2014, the aircraft had completed nearly 349 flying hours for treatment and 20 flying hours for deployment.

Overall, about 77 percent of the 1 825 flying hours initially planned (i.e. 1 408 hours for the four aircraft) were used – 56 percent of which (almost 1 017 hours) were used for treatments and 21 percent for the deployment (to, from and between the aerial bases).

These operations were carried out from successively deployed aerial bases in order to be as close to the locust hotspots as possible[9]. Locust hotspots were determined according to the outcomes of the extensive surveys, additionally taking into account logistics and security constraints[10].

Aerial control operations undertaken by the four aircraft were complemented by localized ground treatments as needed. Each aerial base, equipped with at least one helicopter, was staffed with mobile ground control teams and other teams responsible for the management of empty pesticide drums. From the first quarter of 2014 to the end of July, a mobile ground

[8] This includes the time spent on spraying in addition to the filling of the tank and reaching the block to be treated.

[9] The locations of the hotspots change throughout the rainy season, including during exceptional events such as cyclones, which may have a significant influence on the distribution and dynamics of the locust populations. In 2014, these included the passage of Cyclone Hellen and the violent winds that swept the swarms present in the Mid-West to the Highlands. In 2013, Cyclone Haruna created prolonged optimal conditions for the development of Migratory Locusts.

[10] Security constraints inhibit the establishment of temporary filling (for pesticides) or refueling stations, and therefore prevent additional flights beyond surveys and treatments. In addition, helicopters, as well as aerial bases, need some motorized ground support in order to operate properly (all-terrain vehicles for movement of personnel and to ensure ground surveys, treatments and trucks for supplying kerosene and pesticides, etc.). Aerial surveys additionally cannot reach locust hotspots because of the complex topography of Madagascar, the inaccessibility of some airstrips during the rainy season, the lack of airstrips in some areas and insecurity.

control team, equipped with a vehicle-mounted sprayer, was deployed in the outbreak area. The team consisted of three field staff – a team leader, an operator and a driver – and was trained by an international specialist in spraying techniques. From 10 April to 4 July 2014, another mobile team devoted to spraying biopesticides (Green Muscle®) was deployed, also consisting of three field staff. By 10 September, the ground control teams had treated more than 12 600 ha with conventional pesticides and biopesticides.

The total area treated by air and ground control operations was 1 218 353 ha. **Table 4** provides a breakdown of the area treated/protected during the first campaign.

Table 4 – Area treated (in ha) during the 2013/14 campaign from 5 November 2013 to 10 September 2014

Pesticides/type of treatment	Assumption: ha to be treated from September 2013 to August 2014	Aerial treatments in ha (full cover and barrier treatments)			Ground treatments (in ha)	TOTAL ha treated
		Base 1	Base 2	Base 3		
Conventional pesticides (full cover treatment)	550 000	273 561	97 830	91 430	10 942	**473 763**
IGRs (barrier treatment)	900 000	654 150	60 280	28 500		**742 930**
Biopesticides (full cover)	30 000	0	0	0	1 660	**1 660**
Total	**1 480 000**	927 711	158 110	119 930	12 602	**1 218 353**

According to the estimates made for the first campaign, a total surface area of 1.5 million ha was expected to be treated – 37 percent of which was planned to be treated with conventional pesticides and 60 percent with IGRs. As of 10 September 2014, 1 218 353 ha had been treated in similar proportions to those initially planned, as 39 percent of the surface area was treated using the full cover technique (conventional pesticides and biopesticides) and 61 percent was treated using the barrier technique. These treatments were in line with the strategy of the Three-year Programme, which prioritizes control operations against hopper bands.

2.2.3 Component 3: Preservation of human health preserved and protection of the environment

Expected outcome: No incident affecting human health during the aerial control operations or the handling of pesticides is reported; the impact on the environment from the control operations is limited.

Indicators:

- Number of incidents reported affecting human health during aerial control operations or the handling of pesticides.
- Severity of the impact of control operations on the environment.

Results achieved: *Human health and environmental monitoring is carried out on a regular basis, resulting in monthly reports.*

Out of almost 1 300 pesticide drums handled, two pesticide drums leaked during transport between the port of arrival and the pesticide warehouse. However, the pesticides were safely transferred to secure empty containers and precautions were taken to load/unload pesticide drums with more care.

Only one incident affecting the environment was recorded during the first campaign, without consequences for human health: due to a technical problem with the spraying kit, 400 litres of conventional pesticides spilled over an area of about 5 ha, resulting in the death of a bird, two snakes and a few beetles. Pesticide burns on the leaves of crops and pastures were also observed.

<u>Activity 3.1.</u>: Strengthening of human capacity for human health preservation and protection of the environment

Awareness and prevention/mitigation of risks

In October 2013, the Logistics/Security Advisor organized an awareness raising session on the risks related to operations at aerial bases for the staff of the bases, ground control teams mobilized by FAO and the CNA and helicopter crews. The session was held in order to inform participants about measures to prevent and mitigate health and environmental risks, covering topics such as: safe movement around a helicopter; fire hazards; information on handling of fire extinguishers; risks related to the use and temporary storage of pesticides; importance of wearing PPE (overalls, gloves, boots, masks and aprons) while handling pesticides; emergency measures in case of contact with pesticides; presence of atropine kits on the bases; risks associated with large herds passing near the camps; and problems related to potential alcoholism on the bases.

Pesticide management

The Pesticide Stock Management System (PSMS) is an online database that was developed by FAO in 2004/05 at the end of the last Desert Locust upsurge in the Sahel (western Africa). The database was designed to help countries better manage their pesticide stocks and ensure traceability of pesticide drums, thus minimizing the risk of surpassing pesticide shelflife and necessitating the destruction of obsolete stocks. This database provides an updated inventory of the pesticides and allows users to monitor their use from acquisition to disposal of empty containers through an automated and simplified management system that assigns unique barcodes to each pesticide drum.

An international expert provided technical assistance and training on the PSMS database to staff of CNA and the PPD from 9 to 15 November 2013. The training was organized in two phases: (i) trainings on labelling (barcodes) and inventory techniques took place at three warehouses in Toliara, Sakaraha and Ihosy; and (ii) sessions were delivered on entry of data related to pesticide type, manufacturer, active ingredient, stocks, location, movement (within Madagascar and abroad), sampling for routine quality control tests, loss or damage,

pesticide use (sprayed quantity, site locations, dose rates, spraying equipment, etc.), disposal of empty containers and rinsing solvents.

In addition to this database, FAO established an internal monitoring system for all pesticides delivered to and stored in the various warehouses in Madagascar in order to monitor pesticide use and the location of empty drums.

Human health and environmental management

Two Environmentalists were among the first international experts fielded to Madagascar in August 2013. These consultants developed the Plan de gestion sanitaire et environnementale (PGSE) in close collaboration with the CNA, the PCN and the PPD. The Plan: summarizes the Government of Madagascar's environmental policy; provides an evaluation of the risks posed by the different control techniques employed by the locust campaigns; lists measures to be respected and implemented to reduce the negative impacts of large-scale control operations on human health and the environment; and provides the tools (forms) necessary for proper monitoring. The Plan is accompanied by an action plan for sensitizing communities living in locust-infested areas to the risks associated with locust control operations, and clarifies the responsibilities of the team in charge of health and environmental monitoring during the campaign. Based on feedback received from the World Bank, FAO adjusted the PGSE in April 2014; the final version was submitted to the World Bank on 30 April. The measures outlined in the PGSE were applied throughout the first campaign and before the launch of initial control operations (i.e. tests to determine the level of acetylcholinesterase in the blood of control workers) in order to reduce the negative impact of locust control operations on human health and the environment.

Review of the environmental guidelines (Cahier des charges environnementales [CCE])

Terms of reference were developed and included in the PGSE for the revision of the *Cahier des charges environnementales* (CCE), in line with the environmental protection frameworks and safeguard measures of the World Bank, FAO and the Government of Madagascar. The CCE should be revised under the leadership of relevant national stakeholders based on the gaps and inconsistencies identified by the PGSE between the existing CCE and the above-mentioned frameworks and safeguard measures. The application of this recommendation remains the responsibility of the national actors in charge of the implementation of the PGSE. To date, no consultant has been identified.

Monitoring the impact of treatments on human health and the environment

In February 2014, an Environmental Expert carried out a one-month mission to Madagascar to deliver refresher courses to CNA and PCN staff on evaluating the environmental impact of locust control operations. The training covered topics including: methods for monitoring and evaluating the impact of control operations on terrestrial and aquatic wildlife; collection and preparation of soil, vegetation and water samples for pesticide residue analysis; and assessment of environmental incidents caused by locust control operations. The Expert also developed a Practical Guide for Environmental Monitoring Procedures by adapting the guide prepared by the FAO Commission for Controlling the Desert Locust in the Western Region to the situation in Madagascar.

<u>Activity 3.2.</u>: Support impact monitoring (of treatment) on human health and the environment

Provision of equipment

Monitoring supplies and equipment such as cholinesterase kits[11] were delivered at the start of the campaign in September 2013. The kits provided do not require specific training for their use and allow users to monitor possible acetycholinesterase inhibition by measuring the blood cholinesterase levels of personnel involved in control operations during each phase of the campaign. If a worker presented symptoms of cholinesterase inhibition, he was required to be immediately removed either temporarily or permanently from control operations and from the vicinity of pesticides. In case of high intoxication, atropine acts as an antidote; therefore, 50 atropine (injection) kits were delivered to Madagascar and strategically stored in medical centres with qualified medical staff.

Establishment of teams for health/environmental monitoring and pesticide drum management

During the first campaign, two teams were established: one team to monitor the impact of the locust control operations on human health and the environment and a second team responsible for the management of empty pesticide drums. Programme funds covered the teams' operational costs (fuel, vehicle repairs, daily subsistence allowance for team members mobilized by CNA, salaries of drivers, etc.).

From September 2013 onwards, the health and environmental monitoring team carried out blood tests to establish individual baseline levels of cholinesterase for each person involved in operations. Knowledge of these levels was necessary in order to be able to subsequently monitor pesticide exposure in concerned personnel. During the first campaign, 441 tests were performed on 136 workers involved in locust control operations, including 105 tests to determine baseline levels. In March 2014, cholinesterase inhibition was detected in three personnel. They were excluded from control operations for one month, until their cholinesterase levels returned to normal, and were advised to comply with precautionary measures (e.g. hygiene) during and after handling pesticides.

During treatments carried out on 30 August against fragments of a swarm that had flown over Antananarivo two days prior, a technical incident occurred: 400 litres of conventional pesticides (Chlorpyrifos 240 ULV) present in a helicopter tank spilled at the entry of a block owing to the bursting of pipes, which were not properly secured. The incident occurred near Ankadivory, Morarano rural town, Arivonimamo District. A volume of pesticides 80 times greater than that applied during ULV locust control operations (1 litre per ha) spilled over 5 ha of land. FAO immediately mobilized the CNA environmental and human health monitoring team to assess the potential damage and prepare a detailed report. The results of this assessment revealed that the spillage caused the death of one bird, two snakes and a few beetles. Pesticide burns on plant leaves in fields and pastures were also observed. However, no individuals in the village displayed signs of intoxication. The team in charge of the assessment notified neighbouring populations on the need to avoid this area, as well as to avoid grazing their animals there for six days (the duration necessary for the pesticide to break down below the residue limit).

[11]Cholinesterase is a blood enzyme required for the functioning of the nervous system; however, its function can be hampered by chemicals such as pesticides, which can have severe consequences for individuals.

The pesticide drum management team was responsible for monitoring and coordinating the movements of containers and updating the state of pesticide stocks through the PSMS database and the internal monitoring system. All empty pesticide drums were collected and stored either in the central CNA warehouse in Toliara or in the Regional Directorate for Rural Development (RDRD) warehouses. A pesticide storage facility was planned to be constructed in Toliara for the future storage of these drums. Empty drums will later be rinsed and crushed after the installation of a drum crusher in the central warehouse and the training of CNA staff on its use. This will assist in avoiding any future risks to human health and the environment.

Activity 3.3.: Construction of a pesticide storage facility

The tender process for the construction of the pesticide storage facility in Toliara was initiated in October 2013, following the launch of the campaign. The process included the recruitment of an international architect, who had already worked with FAO on various construction projects in Africa, including on the finalization, in 2011, of a preliminary plan for the construction of the pesticide warehouse.

The international architect worked under the technical supervision of the FAO Infrastructure and Facilities Management Branch (CSAI), and was supported by a national engineer made available to FAO Madagascar through the United Nations Educational, Scientific and Cultural Organization national office.

From October 2013 to February 2014, the international architect worked closely with the national engineer, FAO Representation, the CSAI and the Plant Production and Protection Division (AGP) on the review and technical validation of the documentation required for the tender launch, such as drawings, technical specifications, quotations and an estimated work plan.

The international tender was launched in March 2014 and closed on 28 April. Out of six offers received, only four were valid.

Meanwhile, FAO hired the services of two national experts (a geological engineer and a geometer) to perform geological and topographical studies of the site. The studies, funded by FAO, were completed and disseminated to potential contractors.

The supplier that submitted the lowest bid, which also met technical specifications, was identified in May 2014, and the contract including the payment of value added tax was finalized in early July. Construction is expected to last 10 months, starting from the date of issuance of the purchase order.

The warehouse, once completed, will be able to store up to 40 000 litres of pesticides (200 drums of 200 litres each), making it the largest pesticide warehouse facility in Madagascar to fit national standards adopted by the Government and international standards set by FAO (currently, none of the nine larger warehouses in Madagascar – with capacities ranging from 14 000 to 150 000 litres – meet the international standards required for that type of facility). While the construction of the warehouse is underway, full and empty drums have been stored on pallets in temporary premises.

Training on the use of the drum crusher

This activity will be carried out once the drum crusher is installed in the central pesticide warehouse in Toliara. An international expert was identified to provide training in

Madagascar, but it was deemed essential to postpone the training until the skills learned can be applied on the job. This will additionally eliminate the need for a refresher course, which would have been necessary if the training was provided in September 2013 as originally planned.

2.2.4 Component 4: Implementation and coordination of the Programme

Expected outcome: The supervision and technical and operational coordination of the Programme, as well as those of the field operations, are performed and the expected outcomes are achieved.

Indicators:

- The supervision and coordination mechanism is set up, effective and efficient.
- The locust control campaign is implemented as planned.
- The operation shows overall positive outcomes.

Results achieved*: AGP and the Emergency and Rehabilitation Division (TCE) (based in Rome), in close collaboration with FAO Representation in Madagascar (based in Antananarivo), ensured the supervision, coordination and implementation of the Programme throughout the first campaign.*

Activity 4.1.: Implementation of the National Locust Emergency Plan

As part of the implementation of the *Plan national d'urgence acridienne* (PNUA), approved on 25 September 2013, the Government established the PCN within the MARD in September 2013. This Unit was created as a means of ensuring national coordination of locust control activities and facilitating the management of the campaign, and shall contribute to the transfer of skills for the coordination of large-scale locust control in the country.

During the first campaign, the Three-year Programme provided assistance for the establishment and functioning of the PCN. This included, in particular:

- the renovation of the premises occupied by the PCN;
- the supply of information technology and office equipment (details in **Annex 5**);
- technical assistance in September 2013 for the establishment of the PCN in the framework of the PNUA through the mission of a Risk Management Expert;
- technical support from the Campaign Coordinator and the Emergency Response Coordinator, whenever requested by the PCN, in addition to participation in weekly and ad hoc meetings; and
- a financial contribution of up to 140 days of mission for the PCN members (in six trips outside the capital).

Activity 4.2.: Coordination of the Programme

To coordinate and implement the Three-year Programme, FAO established teams in Rome and Madagascar, with the following main tasks:

- carry out the procurement of inputs and services;
- ensure their timely delivery, including the deployment of specialized expertise to Madagascar;

- provide training and technical advice to national partners (e.g. CNA, PPD) and field teams;
- ensure that data collection on locust and anti-locust situations, the use of pesticides, flying hours and health and environmental issues is properly conducted;
- supervise the analysis of these data and the dissemination of the resulting information;
- maintain the smooth functioning of survey and control operations; and
- manage the funds received in support of the Three-year Programme.

Technical supervision as well as coordination and monitoring of the Three-year Programme are handled by AGP of FAO in Rome and, more specifically, by the Locusts and Transboundary Plant Pests and Diseases team (AGPMM). The AGPMM's tasks include: making the required adjustments to previously established locust strategies; selecting and defining the profiles and terms of reference of international consultants; ensuring their direct supervision and review of their reports; preparing technical specifications of inputs to be provided, including their suitability to the context and their appropriate use; technical analysis and validation of bids; monitoring of all technical activities; and support for the preparation of ten-day and monthly bulletins and briefing notes.

The implementation of the Programme – including the procurement of inputs, the issuance of contracts, pesticide 'triangulation', management of staff and operational and budgetary issues and the monitoring of activities and related expenditures – is undertaken by TCE.

AGPMM and TCE work closely with the FAO Representation in Madagascar, based in Antananarivo. A Deputy Representative and an Operations Coordinator from FAO in Madagascar are in charge of the administrative, financial and operational supervision of the Programme. Assisted by a Programme Officer, they pursue resource mobilization efforts at the national level and maintain close liaison with all stakeholders involved in the management of the locust plague (ministries, technical and financial partners present in Madagascar, field experts, etc.). An Operations Officer ensures the monitoring of the operations in close collaboration with FAO headquarters and consultants in the field (pre-positioning of all inputs, support to the international technical experts, etc.). Finally, national experts provide support to the operational, administrative, logistic and financial management of field operations.

Resource mobilization and preparation of documents (writing, editing and approval) are jointly undertaken by the three above-mentioned entities.

In Madagascar, the implementation of the campaign (in the capital and at the aerial bases) and day-to-day activities were overseen by an international Campaign Coordinator, supported by a national Locust Expert until the end of June 2014. During the months of July and August 2014 (the winter period), the national Locust Expert ensured the coordination of the campaign.

Three international Logisticians and one Logistician/Security Advisor were recruited to oversee the management of aerial bases, aircraft and vehicles as well as to provide advice on management and security issues related to aerial and ground operations; they carried out missions in Madagascar from early September to late August 2014. In September and October 2013, the Logistician/Security Advisor trained CNA staff (personnel of the aerial base, scouts and ground control teams) and helicopter crews on the organization, management and security aspects of an aerial base. He carried out a second mission from

January to March 2014 to assist in the establishment of a third aerial base. From September to December 2013, and from February 2014 onwards, logistical supervision on the three aerial bases was permanently ensured by an Aircraft Logistician. From May to July 2014, the Aircraft Logistician was assisted by another Logistician in charge of overseeing the smooth logistical implementation of anti-locust operations. In addition, an Aircraft Logistician was present from March to April 2014, upon the arrival of the fixed-wing aircraft, which was intended to strengthen control efforts, and during the subsequent reconfiguration of the aerial bases.

Weekly and ad hoc teleconferences were held between Rome (AGPMM and TCE) and the FAO Representation in Madagascar to discuss solutions to problems arising during campaign implementation and to provide updates on the latest resource mobilization efforts. Moreover, operational and technical support missions were organized during these teleconferences.

A Web site devoted to the locust crisis in Madagascar was launched on 21 March 2013 in both English and French, with direct access from the FAO in Emergencies Web site. The following documents are published on the site: all Programme reference documents, situation updates, ten-day and monthly bulletins prepared by the Locust Watch Unit, international press releases made at key moments of the Programme or major events or by the Communication Office of the FAO Representation, interim and final reports of the locust campaign and photo galleries and audio-visual material documenting field activities.

At national level, during major Programme events (such as the launching ceremony of the first campaign and a meeting on its achievements) and at the end of each mission of the Campaign Coordinator and of the Response Coordinator, debriefing meetings were organized with financial partners, donors and national institutions and authorities. Meetings were held also regularly with the *Le Groupe des Bailleurs de Fonds – Développement Rural* in order to keep donors and financial partners informed on the progress of the activities of the Three-year Programme. Finally, multiple bilateral meetings were held with each financial partner in order to discuss details of the signed agreements and to provide specific information on the first anti-locust campaign.

With regard to the media, in addition to answers given by FAO at the request of journalists, many articles have been published in the national media, national press releases were issued and field trips were organized for journalists. Meetings with journalists – called "press brunches" – were also held at the FAO Representation to provide more details on issues related to the Programme's implementation and to improve journalists' understanding of locust control operations, thereby improving the general public's understanding. Since April 2014, a section called "Questions & Answers" has been regularly published in the national press to address the most common questions regarding the Three-year Programme in Madagascar.

In June 2014, the FAO Representation began publishing newsletters to the attention of donors to further provide them with information on the Three-year Programme. To date, two newsletters have been published.

2.2.5 Component 5: Assessment of the effectiveness of the locust campaign and the impact of the locust crisis on crops and pastures

Expected outcome: The results of the assessment of the locust campaign's effectiveness and of the impact assessment of the locust crisis on crops and pastures are available to all stakeholders.

Indicators:

- Results of the assessment of the locust campaign's effectiveness are disseminated.
- Results of the impact assessment of the locust crisis on crops and pastures are disseminated.

Results Achieved:

- *Preliminary results of the assessment of the locust campaign's effectiveness were presented at the debriefing meeting held on 27 June 2014 in Antananarivo.*
- *The assessment report on the locust campaign's effectiveness was distributed to technical and financial partners on 8 September 2014.*
- *The Crop and Food Security Assessment Mission (CFSAM) report was released on 21 October 2014.*

Activity 5.1.: Assessment of the effectiveness of the locust control campaign

The assessment mission of the first locust campaign (2013/14) was conducted from 10 to 29 June 2014 by Mr S. Ghaout, Locust Expert and Director of the National Anti-Locust Centre of Morocco. The preliminary findings of the mission were presented to the Government, technical and financial partners and donors at the debriefing of the first campaign, held at the FAO Representation office in Antananarivo on 27 June 2014. The assessment report was distributed to all financial and technical partners on 8 September 2014. In the report, which is available here, the evaluator indicates that the Three-year Programme's strategy was well-conceived and that the results of the first campaign were generally satisfactory. The specific objective of the campaign, aimed at halting the dynamics of the locust plague while protecting crops and pastures, has been achieved. The locust populations covering an area exceeding 1.2 million ha have been controlled, without any incident affecting human health or the environment and without causing significant damage to the major rice baskets.

Activity 5.2.: Assessment of the impact of the locust crisis on crops and pastures

The CFSAM was carried out from late June to mid-July 2014 by FAO and the World Food Programme in collaboration with the MARD. As planned in the Programme document of the first campaign, the mission paid particular attention to assessing the damages caused by locusts to crops and pastures. The report of this mission was submitted to the Government on 17 July 2014 in Antananarivo and was released on 21 October 2014. The report, available through this link, indicates that the first campaign managed to significantly reduce the size and activity of locust populations and to halt the geographical spread of the plague. The campaign additionally succeeded in limiting damages to crops and pastures. The results of this mission also indicate that national rice production increased in 2014; however, in some regions of the south, it is expected that agricultural production, especially that of maize, will face a decrease compared to 2013, primarily due to limited rainfall.

2.3 Method of work

2.3.1 Implementation arrangements

FAO is responsible for the implementation of the Three-year Programme in close collaboration with the MARD.

The implementation of activities is supervised and coordinated by FAO experts and carried out with the support of CNA staff in the outbreak area of the Malagasy Migratory Locust, as well as the staff of PPD and RDRD in the invasion area. The PCN, which was established within the MARD under the framework of the PNUA, also contributes to the Programme's coordination.

2.3.2 Reports, communication and visibility

During the first campaign, the following documents/reports were produced and published on the FAO Web site dedicated to the locust plague in Madagascar:

- all Programme reference documents (Three-year, first and second campaign Programme documents);
- 27 ten-day bulletins and 18 monthly bulletins on the locust and anti-locust situations;
- 11 situation updates on the locust crisis in Madagascar to keep the technical and financial partners regularly informed on progress made in the implementation of the campaign;
- the Human Health and Environmental Management Plan;
- an interim report covering the period from September 2013 to February 2014; and
- the assessment report of the 2013/14 campaign.

In addition to these reports, financial and narrative reports were regularly provided to each donor regarding their specific contributions (if foreseen in the respective agreements and according to the modalities stated in these agreements).

Mission reports were regularly prepared by all international consultants deployed in Madagascar.

The website also features a media library regularly updated with the publication of photo galleries and audio-visual material documenting field activities. In February 2014, FAO contracted a videographer to create a video *reportage* of the operations carried out within the framework of the locust campaign. Following this mission, two videos were produced (one short and one long, each available in both French and English) and published on the Web site in March.

2.4 Difficulties encountered

During the first campaign, the difficulties encountered and actions taken to resolve them included the following:

- Lack of locust data for the southwest, which covers the Migratory Locust outbreak area: The efforts made to improve the exchange/flow of information between national stakeholders (CNA, PCN and RDRD) only resulted in the exchange of the minimum necessary information.

- Control operations in remote or difficult to access areas: A fixed-winged aircraft was deployed in March 2014, which proved to be effective in rapidly treating large areas where hopper bands (barrier treatments) or swarms (full cover treatments) were present. The aircraft additionally covered areas that were out of reach for the helicopters, which have a more limited range of action (and even more limited when filled with pesticides). The reinforcement of the aircraft fleet was crucial to the success of the campaign, as asserted in the assessment report (Ghaout, 2014).
- Delays in the delivery of personal protective and camping equipment: Although suppliers are selected based on technical compliance, the most competitive price and expected delivery time, some suppliers did not comply with the promised delivery dates, causing goods to reach Madagascar later than expected. Penalties were applied on a case-by-case basis and alternative suppliers were identified by FAO's Procurement Service in order to purchase additional equipment as required.
- Some components such as the hoses of the first pumps purchased, which were used to transfer pesticides from drums to the helicopter-mounted tank, proved to be irresistant to the corrosiveness of some chemical pesticides. Alternative solutions were identified and a new set of pumps was delivered.
- Following an accident on 17 November 2013, one of the double-cabin Toyota vehicles purchased by the Programme was severely damaged. As the damages did not allow for repairs, another double-cab vehicle was purchased.
- The metal drums of a batch of conventional pesticides proved to be too fragile for Malagasy field conditions, and were thus damaged during transportation and handling operations (loading and unloading). The content of the damaged drums was transferred into more resistant drums. More detailed technical specifications for drums have been elaborated and will be included in future tenders for the provision of pesticides.
- Problems of insecurity due to local conflicts or political events (e.g. elections) occasionally limited aerial operations. Such security concerns were sometimes overstated and exploited by the helicopter crews to redeploy their aircraft to Morondava and Toliara, far from treatment targets. This resulted in additional flying hours. Two security agents were paid by FAO to ensure safety on the bases. The situation changed in March 2014 when the fixed-wing aircraft was deployed in Betioky (previously considered a high-risk area). This created a certain competition between the two types of aircraft, which resulted in improved performance of the helicopter services. In addition, FAO decided that one FAO expert would be permanently present on each aerial base to provide support to the base manager and facilitate a number of operations. This decision became effective as of February 2014. The proven effectiveness of this approach led to the decision to replicate it during the second campaign.
- Some batches of Teflubenzuron purchased from one of the two suppliers during the first campaign caused corrosion problems to the spraying system and to the fixed-wing aircraft tank. Therefore, FAO discontinued the use of this product. The Procurement Service contacted the supplier in order to verify the level of corrosiveness of the product.
- The success of the 2013/14 campaign was not always recognized by some farmers in the south, who lost much of their crops, and by some partners and media, often due

to a lack of knowledge regarding locust control. Communication efforts have therefore been reinforced by FAO to address this issue.

3 IMPACT OF THE 2013/14 CAMPAIGN

3.1 Appraisal of the locust and anti-locust situation

Ecological and weather conditions were generally suitable for Migratory Locusts throughout the campaign, especially the prolonged rainfall at the campaign's end.

The significant control efforts made during the first campaign contributed to a significant decrease in locust populations – of their density and of the overall level of infestation – without major incidents related to human health or the environment. Locust infestations in the Betsiboka plain in the north invasion area and in Ankay in the east invasion area were halted, blocking the migration of the swarm towards the north and preventing the geographical extension of the plague. The spread of the plague was thus not only avoided, but continued to decline during the winter period.

The gregarious populations were eliminated in the central invasion area and in the outbreak area, with some exceptions. At the end of August 2014, the residual populations in these areas were composed of the following:

- Low populations of gregarious immature adults (winged locusts) to be eradicated; and
- *Transiens degregans*[12], or immature adult populations, which do not present a major risk in the central invasion area; however, these populations could pose a major risk of a new upsurge in the outbreak area if their development is not adequately controlled during the next campaign. In late August 2014, these locust populations were well-distributed throughout the transitory outbreak area and the initial multiplication area; they were abundant in numbers and with relatively high densities. These populations were set to become targets in the beginning of the rainy season following maturation and the laying of eggs, which would result in hatching and the development of hoppers.

These locust populations were mostly localized in the outbreak area. Major efforts to monitor and treat them were carried out by the FAO teams whenever possible, as the next generation could result in a new plague. The second and third locust campaigns must be completed to sustain the achievements of the first campaign. This will allow for a return to a locust recession period, as envisaged by the Three-year Programme, contributing to the protection of food security for rural populations.

3.2 Impact of the locust crises on crops and pasture

According to the 2014 CFSAM, cereal crops incurred the greatest losses from the locust plague, as the Migratory Locust is graminivorous and cereal shoots are more productive than the rapidly drying pastures. On average, it is estimated that cropping areas lost as a result of the locusts varied between 8 and 37 percent in the 14 regions where investigations were conducted. Maize cultivation recorded the highest losses (37 percent), followed by rice

[12] *Transiens degregans* populations: locust populations undergoing degregarization, between the gregarious and solitary phases, which characterizes a declining plague or a major upsurge.

(about 20 percent) and cassava (around 7 percent). In terms of the geographical distribution of losses, the most significant damages – reaching up to 80 percent for maize and rice crops – were observed in the southwestern part of the country and in the Melaky Region. In general, pastures and livestock were less affected by the locust plague.

The effectiveness of large-scale aerial treatments implemented by FAO helped to halt the progression of the locust plague towards the major rice producing areas, thus preventing the country from facing a serious food crisis. Without these treatments, crops would have been destroyed by locusts.

4 CONCLUSION AND RECOMMENDATIONS

The concerted efforts of the FAO teams in Madagascar and Rome, supported by specialist teams in the field, enabled the successful implementation of the first anti-locust campaign of the Three-year Programme. The locust populations in an area exceeding 1.2 million ha were controlled, without any incident affecting human health or the environment and without causing significant damage to the major rice baskets. The specific objective of the campaign, aimed at halting the dynamics of the locust plague while protecting crops and pastures, was achieved.

These results were attained owing to the deployment of four aircraft, three of which carried out both survey and control operations. It is to be noted that large-scale treatment, which is required for halting a plague, could not have been completed without being preceded by aerial surveys. Aerial bases were redeployed as many times as necessary and as close as possible to locust hotspots. The locations of these areas evolved constantly throughout the campaign in accordance with developments in the locust situation.

Overall, more than 2 432 flying hours were used as of 10 September 2014, of which 42 percent (1 017 hours) were for treatments, 42 percent (1 025 hours) were for surveying and 16 percent (nearly 391 hours) were for deployments. In total, nearly 474 000 litres of conventional pesticides (Chlorpyrifos 240 ULV), 142 000 litres of IGRs (Teflubenzuron 50 UL) and 83 kg of biopesticides (Green Muscle®) were used for control operations undertaken during the campaign.

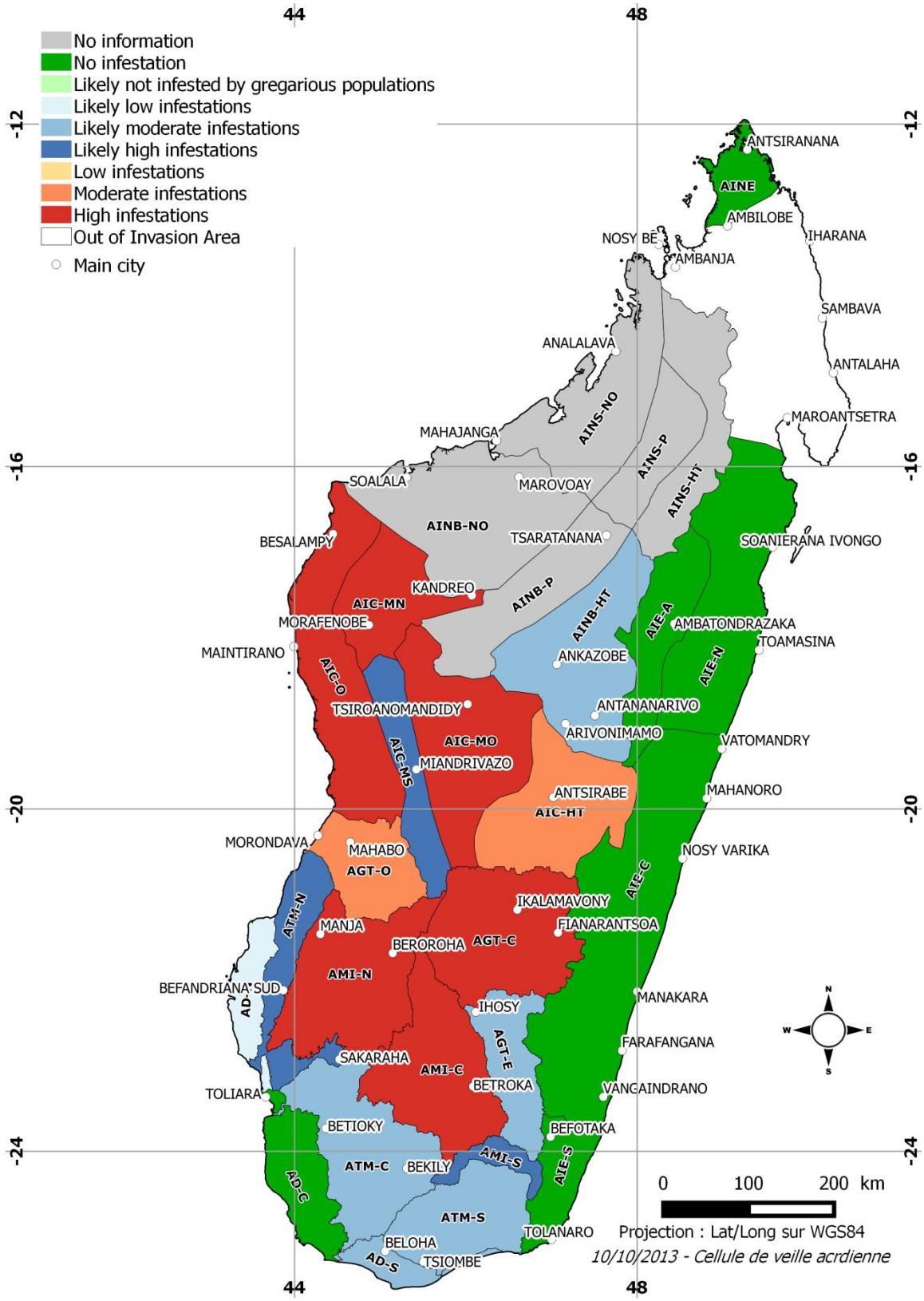
The 2013/14 campaign significantly contributed to the strengthening of national capacities through specific trainings planned and delivered in various technical topics. These trainings were complemented by on-site practical training sessions regularly carried out by various experts in the field, in addition to specialized technical trainings.

In order to sustain the achievements of the efforts of the first campaign and return to a locust recession situation in 2016, it is essential that all of the funds required for the second campaign and the entire Three-year Programme are secured. If the second and third locust campaigns cannot be carried out in a timely manner, the return to a locust recession situation in 2016 will not be guaranteed. A situation of chronic locust upsurge might then prevail and persist (as it happened from 2010 to 2012), eventually developing into a new plague.

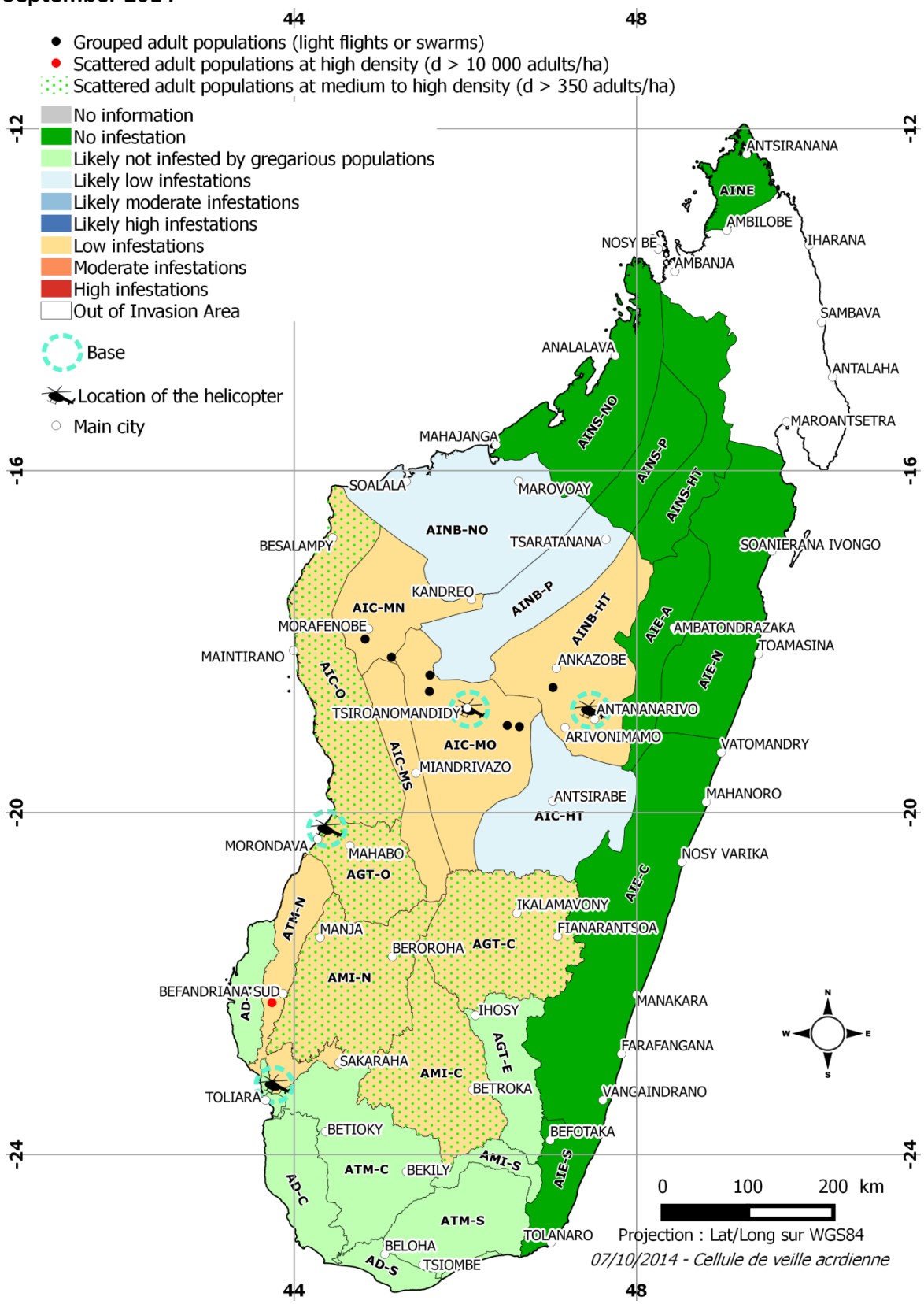
ANNEXES

Annex 1. Maps of locust situation

September 2013



September 2014



Annex 2. Trainings delivered during the first campaign

Trainings planned for Campaign 1	Trainings delivered	Function	Date	Duration	Beneficiaries
Management of information on locusts, weather, etc.	YES	International Locust Expert	February 2013/ August 2014	5 days	Locust Watch Unit (3 members)
Geographic Information System	YES	International GIS Expert	October 2013	1 month	Locust Watch Unit (4 members)
Geographic Information System	YES	International GIS Expert	February 2014	1 month	Locust Watch Unit (4 members)
Pesticides Stock Management System (PSMS)	YES	International PSMS Expert	November 2013	10 days	Staff of CNA and PPD (4 persons)
Radio data management	YES	Radio technician			CNA staff
Organization and management of an aerial base	YES	Campaign Coordinator Special Advisor in Logistics and Security	October 2013	1 day	PCN and CNA staff (staff of the aerial bases, scouts, ground control teams) and helicopter crews (26 persons)
Collection and transmission of locust, anti-locust and environmental data	YES	International Campaign Coordinator and National and International Locust Experts	November 2013	1 day	PCN and CNA staff (staff of the aerial bases, scouts, ground control teams) (15 persons)
Training on calibration of the aircraft spraying system	YES	Campaign Coordinator	October/ November 2013	1 day	PCN and CNA staff (staff of the aerial bases, scouts, ground control teams) and helicopter crews (26 persons)

Training on calibration of the vehicle-mounted spraying system (Micronair AU 8115)	YES	International Expert in spraying techniques	February 2014	3 days	3 CNA agents
Use of biopesticides	YES	International Biopesticides Expert	March 2014	1 month	5 CNA agents
Monitoring of the impact of treatments on human health and the environment	YES	International Environmental Expert	February 2014	1 month	CNA (3 agents) and PCN staff (2 agents)
Use of the drum crusher	NO	-		-	Postponed to 2015

Annex 3. Expertise planned and actually implemented during the first campaign

Field Experts planned for campaign 1	Mission completed	Function	Dates of mission		Duration (month)
			Start	End	
Environmentalists for developing the PGSE	YES	International Experts, Environmentalists	26/08/2013	30/09/2013	1 x 2
Locust Expert	YES	International Locust Expert	28/08/2013	31/10/2013	2
		International Junior Locust Expert	18/01/2014	30/04/2014	3
		International Junior Locust Expert	18/01/2014	30/06/2014	5.5
		International Locust Expert	05/08/2014	28/08/2014	1
Security Logistician	YES	Special Logistics/Security Advisor	02/09/2013	01/11/2013	2
			27/01/2014	10/03/2014	2
Aircraft Logistician	YES	Aircraft Logistician	10/09/2013	20/12/2013	3
			10/02/2014	31/08/2014	2
		Aircraft Logistician	15/03/2014	16/04/2014	1
Logistician	YES	International Consultant – Logistics	25/05/2014	31/07/2014	2
Campaign Coordinator	YES	Campaign Coordinator	09/09/2013	08/11/2013	2
			17/01/2014	10/03/2014	2
			13/05/2014	30/06/2014	1.5
		Campaign Coordinator	01/11/2013	06/12/2013	1
			01/03/2014	15/05/2014	2.5
GIS Expert	YES	International GIS Expert	06/09/2013	14/11/2013	1
			09/01/2014	09/02/2014	1

Field experts planned for campaign 1	Mission completed	Function	Start	End	Duration (month)
Experts for management and analysis of data on locusts, weather and damage to crops and pastures (Locust Watch Unit)	YES	Junior Consultant in support to the Locust Watch Unit	14/06/2014	13/05/2015	3
		Locust Watch Unit (locust data)			12
		Locust Watch Unit (weather data)			12
		Locust Watch Unit (damage to crops and pastures)			12
		National GIS Expert	10/2013		
Pesticides Management Expert	YES	International Expert in pesticides management (PSMS)	05/11/2013	19/11/2013	0.5
Biopesticides Expert	YES	International Biopesticides Expert	10/03/2014	09/04/2014	1
Environmentalist	YES	International Environmental Expert	15/02/2014	15/03/2014	0.5
Expert for the installation of the drum crusher	NO	Mission postponed. Training will be performed when the construction of the pesticide warehouse is complete.			
Inputs Management Expert	YES	Inputs Management Expert	Remote work		
Expert in spraying techniques	YES	Consultant in spraying techniques	18/01/2014	30/06/2014	3
Risk Management Expert in support of the PNUA	YES	International Expert (PNUA)	06/09/2013	25/09/2013	0.25
Evaluation of the Campaign	YES	International Consultant for the evaluation of the campaign	02/06/2014	05/07/2014	1
Assessment on the impact of the locust plague on crops and pastures	YES	International Consultant (CFSAM)	01/07/2014	30/07/2014	1
		International Consultant (CFSAM)	01/07/2014	30/07/2014	1

Field Experts planned for campaign 1	Mission completed	Function	Start	End	Duration (month)
Architect	YES	Architect	No field mission carried out during the first campaign		
Engineer	YES	Engineer	20/02/2014	30/05/2014	3

Annex 4. List of inputs

Category	Input	Quantity provided
Pesticides	Conventional pesticide	517 600 litres, out of which 229 600 litres was donated by the Governments of Mauritania (30 000 litres) and Morocco (199 600 litres)
	IGRs	200 000 litres
	Biopesticides	1 500 kg
Vehicles	4 wheel-drive double-cabin pick-up	25
	4 wheel-drive single-cabin pick-up	2
	4 wheel-drive station wagon	2
	Tires for 4 wheel-drive pick-up	160
	Twin-axle, 10-tonne truck	4
	Tires for truck	36
	Winches	4
	Motorcycle	8
	Tires for motorcycle	10
Communication equipment	Fixed SSB radio	11
	Mobile SSB radios (for vehicle)	35
	Satellite phones	7
Global positioning system	Global positioning system devices	100
Information technology equipment	Computers	15
	Printers and scanners	7 printers and 3 scanners
	Digital photo-cameras	6
Entomological equipment	Psychrometer	30
	Electronic digital stopwatch	40
	Entomological pins and boxes	34 entomological boxes of two different sizes and 30 packs of entomological pins
	Magnifier	110
	Tally counter	110
	Binocular	20
	Compass	10
	Vernier caliper	40
	Anemometer/Thermo	50

Entomological equipment	meter	
	Blank labels	1 000
	Cyanide jars	142 jars of different dimensions
	Barometer	60
	Net	40
	Dissection kits	40
Control equipment	Pesticide pumps	6 hand-held pumps, 6 electric pumps
	Biopesticide pumps	6 electric pumps
	Pump for the transfer of biopesticides	10
	Backpack sprayer	90
	Hand-held sprayer	150
	Vehicle-mounted sprayer	2
Camping equipment	Tent for 10 persons	9
	Tent for 3 persons	26
	Single tent	30
	Multi-functional tent	10
	Camping bed	250
	Sleeping bag	250
	Cover	100
	Mattress	
	Cookware camping set	25
	Picnic table	25 tables with 4 chairs & 38 tables
	Foldable chair	152
	Pillow	250
	Water container (25 litres)	20
	Canvas sheet	207
	Hand-washing basin	20
	Generator	3

PPE	Mask	2 500
	Nitrile gloves	3 600
	Polyvinyl chloride gloves	630
	Protective goggles	2 300
	Boots	350
	Cotton overalls	740
	Caps	370
	Industrial aprons	370
Equipment for the assessment on the impact of the treatments on human health and the environment	Test-mate kits	6
	Antidotes	50
Pesticide storage	Forklift	1
	Solvent	4 000 litres

Annex 5. Expenditures under the first campaign by donor and component (in USD)[13]

	Donors contributing to the first campaign of the Three-year Programme												
Components	**Austria**	**Belgium**	**CERF**	**France**	**France *(Agence Française de Développement)***	**Italy**	**Madagascar**		**Norway**	**EU**	**USA (United States Agency for International Development)**	**USA (Office of U.S. Foreign Disaster Assitance)**	**TOTAL**
							Tech. Ass.	**Supplies**					
Component 1	3 778	11 835	894 126	125 668	23 064	124 403	143 709	2 111 787	116 629	1 160 440	425	356 020	**5 071 884**
Component 2	5 630	402 663	3 331 148	210 728	-	292 609	37 218	5 155 226	150 630	2 366 058	-	176 823	**12 128 733**
Component 3	2 787	16 516	5 715	11 392	-	-	82 769	54 829	768	2 401	-	-	**177 176**
Component 4	78 558	67 580	716 516	309 448	47 794	109 411	682 266		217 391	220 553	45 677	285 480	**2 780 674**
Component 5	1 600	-	-	-	50 034	-	-	-	-	-	1 100	-	**52 734**
SUBTOTAL	**92 353**	**498 594**	**4 947 506**	**657 236**	**120 892**	**526 423**	**945 962**	**7 321 841**	**485 417**	**3 749 452**	**47 202**	**818 323**	**20 211 201**

[13] The table above only takes into account the expenditures related to the first campaign. The financial commitments still open as of 31 August 2014 and the expenditures related to the second campaign made before 31 August are not included.