



PMI | Africa IRS (AIRS) Project

Indoor Residual Spraying (IRS 2) Task Order Four

MOZAMBIQUE

END OF SPRAY REPORT 2012

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MOZAMBIQUE END OF SPRAY REPORT 2012

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ACRONYMS

AIRS	Africa-wide Indoor Residual Spraying
DDS	District Health Directorate
DPS	Provincial Directorate of Health
ICC	Inventory Control Cards
ID	Identification
IEC	Information, Education and Communication
IRS	Indoor Residual Spraying
M&E	Monitoring and Evaluation
MICOA	Ministry of Environmental Affairs
MINAG	Ministry of Agriculture
MoH	Ministry of Health
NMCP	National Malaria Control Program
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
SEA	Supplemental Environmental Assessment
US	Health Center
USAID	United States Agency for International Development
WHO	World Health Organization

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The views expressed in this document do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

EXECUTIVE SUMMARY

In August 2011, Abt Associates was awarded a three-year Africa-wide Indoor Residual Spraying project (AIRS), IRS 2 Task Order 4, funded by USAID under the President's Malaria Initiative. The mandate of the project is to limit exposure to malaria and reduce the incidence and prevalence of malaria in up to 17 countries in sub-Saharan Africa. The key objectives of the program in Mozambique are to reduce malaria-associated morbidity and mortality in six districts in Zambézia province and establish a model IRS program that will set national performance standards.

Abt implemented the project in close collaboration with Mozambique's National Malaria Control Program (NMCP), the Provincial Health Directorate in Zambézia province, the District Health Directorates in the six districts, the Ministry of Environmental Affairs (MICOA) and the Ministry of Agriculture (MINAG).

The AIRS offices in Mozambique were opened in March 2012 after the asset transfer from the incumbent contractor to Abt was complete. From March through June, procurements were made, and enumeration exercises began in July. The project's main achievements are listed below:

TABLE I: AIRS MOZAMBIQUE AT A GLANCE

Number of provinces/districts covered by PMI-supported IRS in 2012	6 districts in Zambézia province (Milange, Morrumbala, Mocuba, Namacurra, Nicoadala, and Quelimane)
Insecticide	Pyrethroid
Number of structures covered by PMI-supported IRS in 2012	536,558
Number of structures targeted by PMI-supported IRS in 2012	585,299
2012 spray coverage	92%
Population protected by PMI-supported IRS in 2012	2,716,176 (including 174,370 pregnant women and 501,522 children under 5)
Dates of PMI-supported IRS campaign	8 October–17 December 2012
Length of IRS campaign	61 days
Number of people trained with US government funds to deliver IRS ¹	1,121 ²

As part of entomological monitoring, AIRS conducted baseline and monthly monitoring activities. To determine quality of spraying, the project conducted quality assurance tests in 12 houses. The test results for average 24-hour mortality were 100% for the month of October, using standard World Health Organization (WHO) cone assays.

¹ This is based on the PMI indicator definition. It includes only spray personnel such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, Information, Education and Communication (IEC) mobilizers, drivers, washers, porters, pump technicians, and security guards.

² 1,097 spray operators, plus 24 supervisors and government staff that attended the full IRS Training of Trainers.

I. INTRODUCTION

I.1 PROJECT OBJECTIVES IN 2012

Specific objectives for 2012 of the AIRS Mozambique program included the following:

- Ensure a seamless transition between the incumbent and Abt in order to move forward with planning, implementing, and monitoring the 2012 IRS campaign.
- Cover at least 85 percent of the 608,344³ targeted and eligible structures found in six selected districts of Zambézia, and protect as many as 1,778,635 lives from malaria transmission in the target areas.
- Continue entomological monitoring in collaboration with *Instituto Nacional de Saúde*/Centers for Disease Control and Prevention.
- Assess and improve national and local capacity in organizing, planning, implementing, and evaluating IRS campaigns; build capacity in areas that need it most.
- Identify cost- and operation-efficiency, to streamline the IRS campaign, lower cost of implementation, and limit stock and supply chain error.
- Improve monitoring and evaluation efforts and increase data quality, in reaction to the 2011 General Audit by the United States Office of the Inspector General.
- Improve environmental compliance with respect to implementation of IRS.

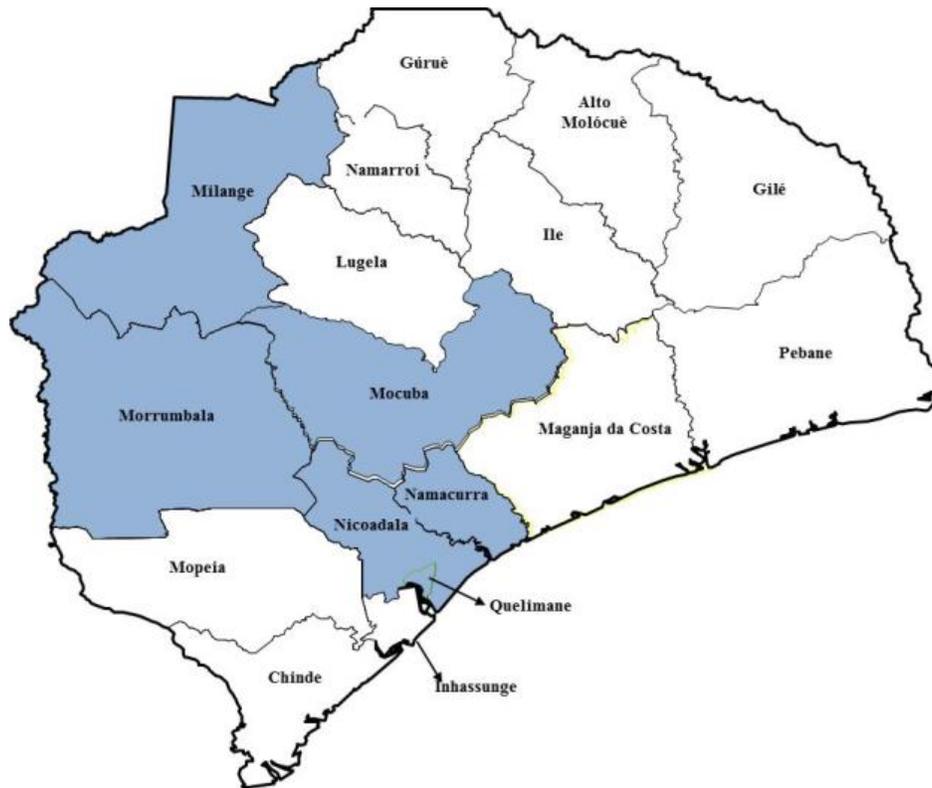
I.2 SPRAY SITES

Zambézia province (Figure 1), located in the central Mozambique, has a total population of 4,563,018⁴ and is divided into 17 districts. AIRS Mozambique is spraying in 6 of the 17 districts—Milange, Morrumbala, Mocuba, Namacurra, Nicoadala, and Quelimane. In these districts, AIRS Mozambique has established 28 operational sites with washing areas, soak pits, and refurbished stores. It also has a central warehouse in Quelimane.

³ Estimated target from 2012 work plan.

⁴ Projection from 2007 population census.

FIGURE 1: MAP OF ZAMBÉZIA PROVINCE



1.3 INSECTICIDE SELECTION

The choice of class of insecticide for IRS is a critical issue with the emergence of insecticide resistance. In order to select the insecticide to be used in the 2012 campaign, AIRS Mozambique conducted a susceptibility study. Two- to five-day-old emergent *An. gambiae* s.l. were exposed to 0.05% deltamethrin and 0.05% lambda-cyhalothrin (pyrethroids), using the WHO Standard Kit to determine their level of susceptibility to the insecticides. A single replicate of *An. funestus* was exposed to 0.05% deltamethrin, because not enough of these mosquitoes were available to test their susceptibility to lambda-cyhalothrin. In both cases, only female mosquitoes were used for the test. The controls were exposed to clean paper impregnated with oil. The emergent mosquitoes were pooled together per district in the process of testing and the results were reported per respective district. The knockdown rates were recorded every 15 minutes until two hours post-exposure. The mortality rate observed in the test tubes and control tubes was observed 24 hours post-exposure, and corrected appropriately using Abbott's formula when control mortality was between 5% and 20%.

Several replicates were performed for Nicoadala and Mocuba districts using *An. gambiae* s.l. mosquitoes: 5 replicates for Nicoadala, (n = 100) and 4 replicates for Mocuba (n=80), using deltamethrin. Two replicates of 40 *An. gambiae* s.l. each were also tested with deltamethrin in Murrumbala and lambda-cyhalothrin in Mocuba. One replicate of *An. funestus* from Mocuba was also tested with deltamethrin.

The results of the susceptibility tests of deltamethrin against *An. gambiae* s.l. mosquitoes showed a high knockdown effect, in which the majority of mosquitoes were knocked down within the first 45 minutes

of exposure. The average knockdown rates at 45 and 60 minutes post-exposure for Nicoadala were 62% and 91%, for Morrumbala 85% and 100%, and for Mocuba 72.5% and 95%, respectively. Moreover, the test mortality rates for deltamethrin were 100%, indicating that *An. gambiae* s.l. was fully susceptible to the insecticide across all three districts where tests were done. This result is consistent with similar studies conducted in the province in 2010 and 2011. The response of *An. funestus* to deltamethrin was also encouraging, with 100% mortality observed. The study had limitations due to an inadequate sample size in some of the districts, and the fact that the study was restricted to only three districts out of six PMI-supported districts. Still, results from this study indicate that the two important vectors of malaria in Mozambique—*An. gambiae* s.l. and *An. funestus*—are fully susceptible to deltamethrin (pyrethroid) in the three IRS districts of Nicodala, Morrumbala and Mocuba.

Another pyrethroid tested was lambdacyhalothrin, and results showed an average 90% mortality in Mocubda district.

Based on the limited insecticide-resistance data collected, the insecticide class selected for the 2012 spray cycle was pyrethroids. There are, however, indications of the potential development of resistance to pyrethroid, so their effectiveness needs to be systematically monitored.

The procurement of insecticide started in July, with the first purchase order for 350,100 sachets of deltamethrin executed in August 28. The insecticide was delivered to the Quelimane central warehouse on September 10, 2012. AIRS Mozambique had also inherited 93,323 sachets of alphacypermethrym, which was applied in one targeted district (Mocuba) in the 2012 campaign.

2. PRE-SPRAY ACTIVITIES

2.1 GEOGRAPHICAL RECONNAISSANCE

To ensure continuity and consistency in data, Abt used data available from the previous IRS implementers, who had conducted geographical reconnaissance in 2010. However, Abt carried out an enumeration exercise to define the number of eligible structures to be sprayed. A total of 580 mobilizers/enumerators were recruited and trained to carry out the exercise. See Section 3 for more information regarding enumeration.

2.2 MICROPLANNING

Microplanning took place in July 2012. The project staff facilitated the meetings and worked closely with officials of the NMCP, the Ministry of Health (MoH), and the District Health Directorate (DDS). The staff prepared a detailed roll-out strategy and action plan, which contained personnel requirements and selection criteria as well as logistics and transportation requirements. The staff also decided on the number and location of stores and soak pit sites, quantities for IRS equipment, and a training schedule.

2.3 LOGISTICS NEEDS AND PROCUREMENT

The logistics needs assessment started with the development of the 2012 IRS work plan. Table A-1 in the annex shows the key commodities the project procured internationally and domestically for the spray operation. Data from the 2011 campaign was used to determine, in collaboration with the Provincial Directorate of Health (DPS) and DDS, the number of operational base stores, soak pits, and spray teams needed for the spray operation in each district. A total of 34 stores and 28 soak pit locations were established for 150 spray teams in the six districts.

2.4 HUMAN RESOURCE REQUIREMENTS

The project deployed 1,923 seasonal workers, 26% of whom were female, for the IRS mobilization/enumeration and spray campaigns in the six districts as shown in Table 2 below.

TABLE 2: NUMBER AND GENDER OF HIRED SEASON STAFF

Type of Personnel	No. of Males	No. of Females	Total
Spray operator	705	195	900
Team leaders	124	26	150
Supervisors	11	1	12
Information, Education and Communication (IEC) mobilizers	336	244	580
IEC supervisors	5	1	6
Pump technicians	28	0	28
Storekeepers	32	2	34
Washers	54	21	75

Security	56	0	56
Drivers	57	0	57
Data assistant	1	0	1
Data entry clerk	13	11	24
Total	1,422	501	1,923
Percentage	74%	26%	100%

Workers were recruited in June for the enumeration activity and in September for the spray campaign. Candidates who passed the pre-IRS health check-up and a written exam attended the trainings. The project added a 20% buffer to the number of spray operators invited for training to account for expected workforce attrition, and to allow the best candidates to be offered positions.

2.5 TRAINING

AIRS Mozambique conducted a series of trainings between June and September 2012 in preparation for the campaign. Trainings took place in each of the six districts; AIRS Mozambique staff were trained in their respective districts depending on the type of training. The training involved classroom and practical lessons in IRS techniques. Table 3 below describes the trainings conducted.

TABLE 3: TRAINING DESCRIPTION

Type of training	From	To	Venue	Brief Description
IEC mobilizers	6/26/2012	7/1/2012	6 districts	Training curriculum included mobilization techniques, IEC materials, environmental compliance, data collection, and reporting.
Training of Trainers	8/16/2012	8/18/2012	Mocuba	Training topics included: IRS concept, supervision of IRS, IRS spray technique, stock control of insecticide, data recording, pump maintenance, IRS spray schedule management, environmental compliance for IRS, proper use of Personal Protective Equipment (PPE), and general personal and community safety for IRS.

Spray operators	9/10/2012	9/21/2012	5 districts (Namacurra's training took place in Mocuba)	The training program lasted five days and the curriculum covered both lectures and practical exercises. The lecture portion included topics such as spraying techniques; insecticide (Fendona, K-Othrine); health and environmental protection; care of IRS equipment; pump parts; and collection and recording and reporting of data. The practical exercises consisted mainly of spray techniques, preparation, dilution and mixing of insecticide, and progressive rinsing.
Washers	9/10/2012	9/17/2012	6 districts	Trained in proper use of PPE, progressive rinsing, and health and environmental compliance procedures.
Stock-keepers	9/10/2012	9/17/2012	6 districts	Training included supply chain system, stock card use and recording, delivery note, inventories, and proper storage and handling of insecticide, as well as health and environmental risks of lost inventory.
Data entry and management	7/11/2012 (phase 1) 11/27/2012 (phase 2)	7/13/2012 (phase 1) 11/29/2012 (phase 2)	Quelimane	The training addressed AIRS Access Database orientation, data entry, reporting, filing of data collection forms, data security, computer use and care, IRS forms, and communication flow for IRS.
Environmental compliance	8/14/2012	8/15/2012	Mocuba	The objective of the training was to familiarize Health, Environment and Agriculture staff with Best Management Practices for IRS. The training included discussion groups on environmental compliance for IRS.

Pump technicians	9/20/2012	9/21/2012	6 districts	Training curriculum included pump parts and functions, care and maintenance of PPE and other equipment, and first aid. The pump technicians were trained by the district team that had participated in the Training of Trainers.
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In total, the project trained 1,953 persons, as reported in Table 4 below.

TABLE 4. MOZ IRS TRAINING MATRIX

Categories of Persons Trained	Training on IRS Delivery								Other Trainings							
	Training of Trainers		Spraying Operations		Logistics Training		Technical Maintenance		Data Entry and Management		Structure Enumeration/ IEC Training		Coveralls Washing		ECO	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
NMCP – Provincial	1	0														
NMCP – District															5	1
MICOA															5	1
Agriculture															1	0
District Coordinators	4	2														
District Supervisors	11	1														
IEC Coordinators	4	1														
Data clerks									15	13						
Spray operators			860	237												
Mobilizers											371	269				
Warehouse keepers					31	3										
Pump technicians							28	0								
Washers													21	68		
TOTAL M/F	20	4	860	237	31	3	28	0	15	13	371	269	21	68	11	2
TOTAL Trained	24		1097		34		28		28		640		89		13	

2.6 ENVIRONMENTAL COMPLIANCE

A Supplemental Environmental Assessment (SEA) for IRS in Mozambique was approved by USAID in September 2011, authorizing the use of pyrethroids, carbamates, and organophosphates in eight districts of Mozambique, including the six that were sprayed in 2012. This SEA, which expires in August 2015, contains the Environmental Mitigation and Monitoring Plan, which documents the environmental

compliance requirements and activities for the Mozambique IRS project. A letter report was submitted to USAID on September 10, 2012.

AIRS's Mozambique's Environmental Compliance Officer (ECO), in close collaboration with provincial health, environment, and agricultural departments, conducted an assessment of environmental compliance in all 28 stores and 28 soak pits prior to IRS operations. The ECO also developed an environmental compliance monitoring plan and a checklist for the insecticide storage facilities, soak pits and spray staff, and beneficiary compliance with environmental health and safety standards.

During the pre-spray period, the project established the following to comply with local and international environmental standards:

- All soak pits were constructed to meet international standards and recommendations, and were ready to be used for spray operations.
- All specified materials in the soak pits (sawdust, charcoal, and stone) were layered according to prescribed dimensions.
- All stores were renovated to meet PMI standards and readied for spray operations.
- Monitoring systems to track used insecticide sachets were established, all storekeepers were trained on the proper management of the stores, and washers were trained on the equipment washing process.
- Nine new storerooms and three new rinsing sites were constructed according to local and international environmental standards.

3. COMMUNICATIONS ACTIVITIES

Community mobilization is considered one of the core components of IRS in Mozambique. During the 2012 campaign, the AIRS Mozambique IEC team worked intensively with the DPS, DDS, and community leaders in the six districts where IRS was implemented. (The IEC team consisted of the IEC Coordinator, operations manager, and Monitoring and Evaluation [M&E] manager.) Through community leaders, AIRS Mozambique was able to reach all 51 localities with IRS IEC messages, as well as select mobilizers directly from the communities in which they live in order to carry out to house-to-house interpersonal communication efforts.

AIRS conducted mobilization in two phases. Phase I consisted of house-to-house mobilization two months prior to the start of the campaign. The mobilizers visited IRS-targeted areas to sensitize the community with messages on how to prepare their homes for spraying, the purpose of IRS, and environmental protection measures. The mobilizers/enumerators also enumerated the structures using an enumeration sticker, each with a unique identification (ID) number, which was placed on the door of each eligible structure. The unique ID number is used on the Daily Spray Operator Form to identify the structure and track whether it was sprayed.

Phase 2 began at the start of the campaign and included meetings with the communities and their leaders. These meetings took place a day or two before spray day in the targeted areas. The purpose of these meetings was to inform communities of the immediate visit by spray operators and again sensitize the beneficiaries on proper preparation of their homes, environmental protection, and the importance of IRS and how it reduces malaria transmission.

In addition to verbal messages, other materials were developed and disseminated by IEC mobilizers during the spray campaign. Table 5 shows the types and numbers of communication materials produced and distributed.

TABLE 5: IRS CAMPAIGN COMMUNICATION MATERIALS

Item	No. Distributed
Brochures	290,450
T-shirt	840
Hat	50

Table 6 lists major communications and promotional activities carried out. Pre-spray messages were aired on local/community radio stations in four of six IRS districts, Quelimane, Mocuba, Milange, Morrumbala. Nicoadala and Namacurra do not have local radio stations, so Quelimane's station was used to cover these districts. On average two local languages, plus Portuguese, were used in all of the local radio spots. The common dialects in the province are Chuabo (Quelimane, Nicoadala and Namacurra), Manhaua (Mocuba), Lomue (Mocuba), and Sena and Lolo (Morrumbala).

TABLE 6: IRS CAMPAIGN COMMUNICATION ACTIVITIES

Activity	Frequency
Community meetings	404
Radio spots (before, during, and after spray)	120
Radio program (interactive show)	1
IRS launch	6 (1 per district)
Malaria Day	1

On October 8, 2012, AIRS Mozambique held launch ceremonies for IRS activities in the six districts, with the main ceremony held in Mexixine, Namacura District. The main launch was presided over by the Permanent Secretary for Namacurra District, representing the Governor.

MOBILIZERS' ENUMERATION DATA

AIRS Mozambique added a structure enumeration process to the mobilization campaign, which consisted of identifying each eligible structure and serializing the identified structure with a unique number. AIRS hired 580 enumerators/mobilizers out of the 640 individuals that were trained on structure identification and door-to-door mobilization. The project added a 10% buffer to the number of enumerators/mobilizers invited for training, to account for attrition. The enumeration and sensitization exercise lasted for 40 days. Enumeration and sensitization results by gender are reported in Table 7.

TABLE 7. IRS ENUMERATION AND MOBILIZATION RESULTS

District	Structures Enumerated	Structure Mobilized		# of Adults Reached with IRS Messages			Acceptance of IRS			IEC/ Behavior Change Communication Material Distributed
		Yes	No	Men	Women	Total	Yes	No	% of Mobilized Structures Accepting IRS	
MORRUMBALA	111,609	100,492	11,117	206,333	213,181	419,514	100,254	238	99.8%	36,532
MILANGE	157,238	126,028	31,210	222,441	228,865	451,306	117,228	12,338	93.0%	95,344
NICOADALA	93,765	83,838	9,927	170,093	179,199	349,292	83,618	502	99.7%	71,271
QUELIMANE	52,882	48,395	4,487	29,818	47,068	76,886	48,215	1,333	99.6%	12,803
MOCUBA	136,769	121,548	15,221	275,816	287,856	563,672	121,166	385	99.7%	104,967
NAMACURRA	75,601	62,486	13,115	128,206	129,404	257,610	62,367	218	99.8%	18,949
Grand Total	627,864	542,787	85,077	1,032,707	1,085,573	2,118,280	532,848	15,014	98.2%	339,866

The enumerations exercise was used to establish a target against which to judge spray progress in Year I of the IRS campaign under AIRS. The enumeration exercise originally identified 627,864 structures; however, before spray operations began this figure was reduced by 3,735 structures (580 enumerated structures excluded from areas in Milange, and 3,155 excluded from areas in Namacurra) in areas that the government decided to exclude from IRS and instead provide with mosquito nets. During the spray campaign, the districts reduced the number of targeted structures a second time by 2,150 (1,850 and 300 from the districts of Namacurra and Milange respectively). This provided the final enumeration figure of **621,979** that was used to track spray progress during the campaign.

Data on acceptance of IRS during the enumeration/mobilization activity was collected by having enumerators/mobilizers ask mobilized households whether they would be willing to accept IRS during

the spray campaign. This was done to gauge community acceptance prior to the campaign and highlight any communities that might need additional IEC/Behavior Change Communication community outreach activities to increase acceptance. Overall the program registered a high IRS acceptance rate during enumeration, of 98%. This high rate could be attributed to the strong involvement of community leaders in all the localities. Low acceptance was noted in some areas of Milange district, which borders Malawi and has a large number of foreigners.

Of enumerated structures, 86.4% were mobilized. Across all districts, the most common reason for non-mobilization was absenteeism. Many structures were found closed due to people being absent from their homes. Enumeration/mobilization activities took place during the farming season; hence, farming responsibilities were the likely reason for most of the absenteeism.

AIRS Mozambique tracked lessons learned from the 2012 enumeration exercise that will be used to improve IRS activities in 2013. Some of the lessons learned during mobilization/enumeration include:

- The inclusion of community leaders as enumerators/mobilizers helped reduce the number of households that were not mobilized. This is because community leaders have direct contact with the community and can access the community at any convenient time.
- Documenting country-specific available definitions of eligible structures in a clear and precise way helped to harmonize the approach to IRS in all target districts. The structure definition document was shared with all trained district supervisors, and it formed part of the basis for training of enumerators/mobilizers.

4. SPRAY ACTIVITIES

4.1 SPRAY OPERATIONS

IRS operations began in the six districts on October 8 and lasted for 61 working days, ending on December 17. Daily spray operations took place in all 28 base sites simultaneously, except for five days when some bases experienced rain. At the start of the campaign, AIRS senior staff, together with the Province Malaria Program Managers, were positioned at strategic points in the targeted districts to supervise the first day of the event and respond to urgent requests. Throughout the campaign, DPS, DDS and Health Center supervisors observed the spray activities and were provided with checklists. In addition, a PMI official visited the spray operations during the 9th week of the spray campaign.

Based on the number of structures to be sprayed per district, teams were located at the 28 spray bases. Each team consisted of one team leader and six spray operators. The distribution of spray teams by base is shown in Table 8.

TABLE 8: DISTRIBUTION OF SPRAY TEAMS BY SPRAY BASE SITES

District	Base	Nr of spray operators	Nr of teams
Quelimane	Quelimane	90	15
Nicoadala	Nicoadala	60	10
	Namacata	24	4
	Maquival	30	5
	Madal	18	3
Namacurra	Namacurra	30	5
	Furquia	24	4
	Macuse	24	4
	Mexixine	12	2
Mocuba	Mocuba	96	16
	Muaquiua	6	1
	Munhiba	24	4
	Mugeba	42	7
	Namajavira	36	6
Milange	Milange	102	17
	Liciro	12	2
	Coromana	24	4
	Molumbo	42	7
	Dulanha	12	2
	Majaua	18	3
Morrumbala	Morrumbala	54	9
	Muandiua	30	5
	Sabe	6	1
	Megaza	12	2
	Pinda	18	3
	Chire	30	5
	Derre	18	3
	Guerissa	6	1
TOTAL		900	150

Daily spray activities started at 6:00 a.m. and ended around 1:00 p.m. In some bases the spray schedule was set according to the communities' daily routines. For example, the spray teams had to occasionally stay beyond 2:00 p.m. to spray the structures of farmers who left home for field work early in the morning and did not come back until after 1:00 p.m.

Spray operators collected spray data using the Daily Spray Operator Form, and their team leaders collected and verified the data and then deposited the forms at the bases. The forms were delivered to the district level from the base sites by hired staff with motorbikes. In parallel, base supervisors and stock-keepers completed the Daily Base Progress Form, which was designed to provide an operational-level evaluation for the sites' progress. This information was reported directly to each District Coordinator through a cellphone on a daily basis. Then each District Coordinator reported the information to the Spray Operations Coordinator, who compiled and reported the information to the operations manager as part of a daily monitoring system. This system allowed immediate measures to be taken as necessary. Supervision and monitoring were prioritized throughout the spray period, and included representatives from many government agencies, as shown in Table 9.

TABLE 9: SUPERVISION AND MONITORING BY PARTNERS

Organization	Number of People	Average Number of Days
NMCP (National level)	1	5
NMCP (Province level)	6	30
PMI	7	2
MoH (District level)	30	60
Ministry of Agriculture (Province level and District level)	7	10
Ministry for Environmental Coordination (Province and District level)	7	10

4.2 LOGISTICS AND STOCK MANAGEMENT

The project used inventory control cards (ICC) to record each item in the central warehouse and 28 peripheral storerooms. At the storerooms, issues and receipts of items were recorded on the stock cards with details of transactions and quantities involved. The ICC for the insecticide stock in every storeroom was closely monitored. Storekeepers updated the cards daily with the movement of stock in or out of the storage facility.

Prior to dispatch of commodities from the central warehouse to the storerooms, a distribution spreadsheet was designed, tracking the flow of the commodities from the central warehouse to the district level and from this point to peripheral storerooms. This spreadsheet also showed the number of teams at each spray site. A dispatch book was designed to control all IRS commodities going in and out at the central and district warehouses. All insecticide boxes were numbered according to their final destination, so each district received boxes of insecticides with different marked numbers. A dispatch note was used to track distribution from the warehouse to the operational store, which returned a signed copy as proof of delivery. The quantities of each item received were entered on the items' ICCs.

In addition to tracking insecticide use via the Daily Spray Operator Forms, all insecticide was also tracked at the storeroom level. In the base storerooms, insecticide sachets were issued only to team leaders who completed and signed the issue forms. The storekeeper would immediately enter this on the ICC to obtain the stock balance record. At the end of each spray day, spray operators turned in

their used and unused sachets to the team leader, who collected them and submitted them to the storekeeper, who recorded the full sachets on the stock card as a positive adjustment, updated the stock balance, and returned the unused sachets to the full stock. The used/empty sachets were recorded on the Daily Utilization Record Form that tracks each store's empty sachets and utilization trend. This reconciliation process enabled the storekeepers to ensure a valid daily inventory and to alert AIRS Mozambique program staff of discrepancies between the stock and the records.

4.3 ENVIRONMENTAL COMPLIANCE SUPERVISION

To ensure that environmental standards and regulations were adhered to, the AIRS Mozambique project worked closely with local government institutions mentioned in Table 9 above throughout the operation. Environmental compliance inspections were jointly carried out to evaluate mitigation measures put in place. Such measures included the mandatory use of PPE by all personnel with potential contact with pesticide, the use of well-constructed soak pits to manage the effluent waste generated before and after the day's activities, poison warning signs on soak pits and storerooms, and posted emergency and spill procedures in stores.

During inspections, spray personnel were observed to be wearing prescribed PPE and using proper techniques for cleaning of equipment and disposal of wastes. There were no spills of insecticides observed during the supervision visits, no reports of negative impacts on the environment or beneficiaries, and no spray operators reported health problems (or adverse effects) as a result of misuse of insecticide.

The inspection teams were satisfied with the environmental compliance practices and measures in place and the general practice in the field. There were two vehicle accidents that were reported in the weekly reports during the campaign in Nicoadala and Morrumbala, one in each district.

WASTE DISPOSAL

Solid waste from the campaign, including packaging materials, and used disposable nose masks, was collected from all district warehouses to the central facility for incineration purposes. The incineration process took place in Nicoadala District during the first two weeks of January 2013. A post-spray environmental compliance assessment was completed and documented. The safety signs at the soak pit doors are in place and there is plant growth around the soak pits, which do not show signs of polluted soil or contamination. The soak pits will be covered with plastic to prevent additional plant growth that would impair the performance of the soak pit in subsequent campaigns.

5. POST-SPRAY ACTIVITIES

5.1 CLOSING OF IRS OPERATIONS

POST-SPRAY INSPECTION

The 2012 IRS operations officially ended on December 17, 2012. Immediately after the campaign came to an end, the environmental post-spray evaluation was implemented in the six districts in coordination with the Ministries of Health, Agriculture and Environment. The evaluation consisted of verifying the complete closure of latrines, rinsing areas, soak pits and washing areas, including the gates of the site in general, and ensuring that all environmental standards were followed during the movement of insecticide and empty sachets. A checklist was used to evaluate the level of accomplishment.

POST-SPRAY EVALUATION MEETING

The post-spray evaluation meeting took place on February 8, 2013, with all the covered district staff participating (supervisors, medical officers and District Health Directors). The focus of the conference was to report results, document challenges encountered during the spray operations, discuss lessons learned, and make recommendations for the next (2013) spray cycle.

The meeting agenda had two broad sessions: a plenary session with presentations by all categories of participants, and then breakout meetings for six working groups. During the breakout meetings, participants discussed the following topics:

- Renovation of spray base site
- Recruitment of IRS personnel
- Training
- Enumeration and mobilization
- Campaign implementation
- Supervision
- Lessons learned
- IRS closure
- Preventing poor spray quality
- Preventing pilferage of IRS materials
- Adhering to environmental compliance
- Motivation of the spray team
- Sustainability of the IRS project in Zambézia Province

Lessons learned and recommendations from the post-spray evaluation meeting are included in Sections 10 and 11 of this report.

5.2 LOGISTICS

Following completion of spray operations, stocks of insecticide were moved from the 28 operational centers to the central warehouse in Quelimane. The AIRS project handled the transportation of used insecticide sachets, unused sachets, pumps, and other commodities to the central warehouse facility. Progressive rinsing barrels and washing buckets were also collected and stored in the central

warehouse. The inventory shown in Table A-2 in the annex will be maintained and monitored until the next spray round.

6. ENTOMOLOGY

AIRS Mozambique worked closely with the NMCP and the DPS to conduct IRS entomological monitoring. The NMCP and DPS technicians, as well as the AIRS Mozambique Entomologist and Entomological Assistant, were engaged in the baseline data collection and the monitoring activities. For monitoring vector behavior, density, composition, and seasonality, four sentinel sites were selected (Nicoadala, Mocuba, Morrumbala, and Maganja da Costa). Three sites in intervention areas were selected, and one site in a comparable non-intervention district (Maganja da Costa) was selected.

6.1 MONITORING VECTOR DENSITY, DISTRIBUTION, AND SEASONALITY AND BEHAVIOR

The first entomological data collection on vector density, distribution, and seasonality and behavior was completed before the start of spraying operation. Subsequent post-spray entomological monitoring activities will be conducted monthly for six months.

6.1.1 PYRETHRUM SPRAY COLLECTION

A total of 427 female adult mosquitoes were collected in all areas by Pyrethrum Spray Collection during the months of September, October, and November 2012. Of these, the 123 collected in the four sites in September included *Anopheles funestus* s.l. (37.4%) and *Culex* species (62.6%). The 108 mosquitoes collected in October were 11.1% *Anopheles gambiae* s.l., 13.9% *Anopheles funestus* s.l., and 75% *Culex* species. In November, 196 adult female mosquitoes were collected: 5.1% were *Anopheles funestus* s.l., 0.5% were *Anopheles coustani* s.l., and 94.4% were *Culex* species.

TABLE 10: RESTING DENSITY IN FOUR SENTINEL SITES, SEPTEMBER–NOVEMBER 2012

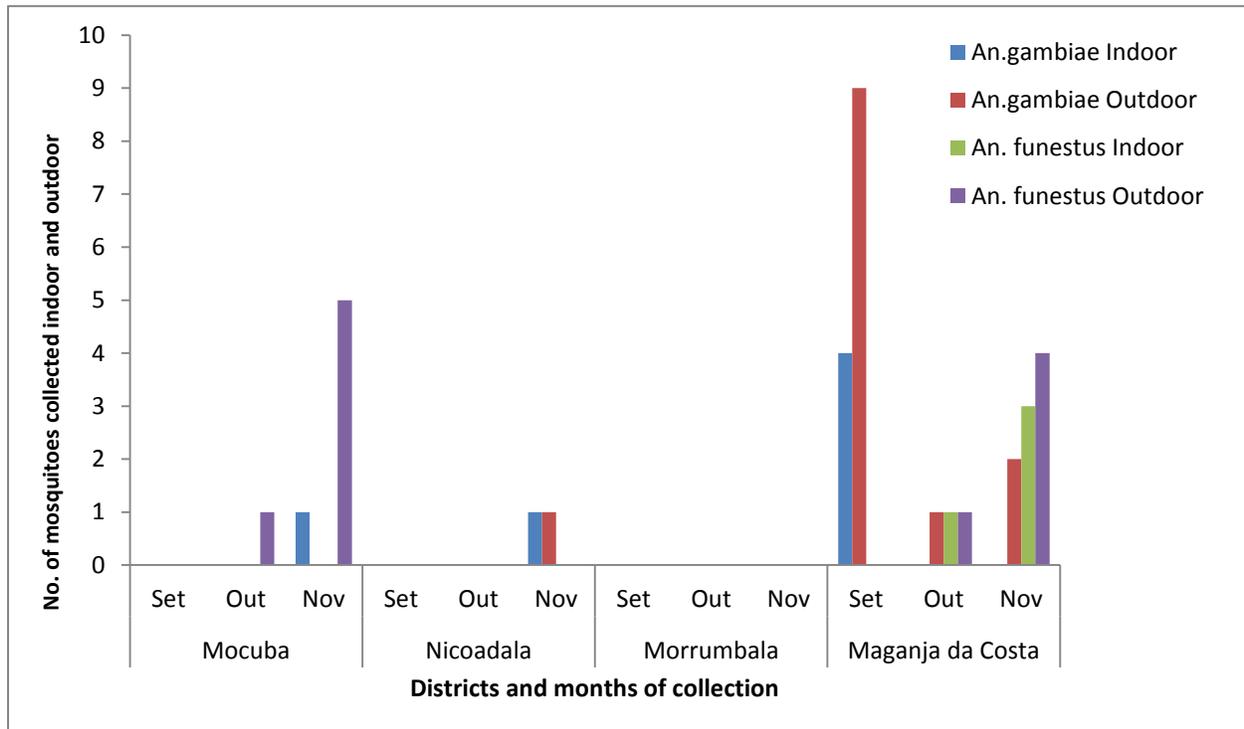
The resting density of female <i>Anopheles gambiae</i> s.l. per house per day:	September	October	November
Maganja da Costa	1.1	1.2	0
Nicoadala	0	0	0
Mocuba	0	0	0
Morrumbala	0	0	0
The resting density of female <i>Anopheles funestus</i> s.l. per house per day:			
Maganja da Costa	4.5	1.1	0.9
Nicoadala	0	0.2	0
Mocuba	0.1	0.2	0.1
Morrumbala	0	0	0
The resting density of female <i>Anopheles coustani</i> s.l. per house per day:			
Maganja da Costa	0	0	0
Nicoadala	0	0	0.1
Mocuba	0	0	0
Morrumbala	0	0	0

6.1.2 HUMAN LANDING CATCHES

AIRS Mozambique selected a cluster of two structures (homes) per village in four villages (Samora Machel in Mocuba, Coqueiro in Morrumbala, Chico in Nicoadala, and Motinho in Maganja da Costa) for 12-hour mosquito collections (6 p.m.–6 a.m.) to monitor vector feeding time, feeding location, and

vector density. A total of 34 adult mosquitoes were collected once monthly (September, October, and November) using Human Landing Catches with four human baits positioned indoors and outdoors at each collection point. Human Landing Catches conclusively generated evidence of direct indoor and outdoor contact between *Anopheles gambiae* s.l. and *Anopheles funestus* s.l. with humans in the three intervention and control districts.

FIGURE 2: HUMAN LANDING CATCH OF ANOPHELES SP FINDINGS, SEPTEMBER–NOVEMBER 2012



Results from field surveys showed variations on vector distribution densities between intervention and control areas. In intervention areas the densities of malaria vector were lower compared to the control area. Overall, data showed an occurrence of *Anopheles gambiae* s.l. at 55.8% and *Anopheles funestus* s.l. at 44.1%. In the intervention area (Mocuba), in October and November (post-spray), *Anopheles funestus* s.l. was found mainly outdoors. It is premature to draw conclusions; however, there are indications that IRS may be affecting mosquito behavior.

6.2 CONE/WALL BIOASSAY TESTS

6.2.1 DETERMINATION OF QUALITY OF SPRAYING AND PERSISTENCE

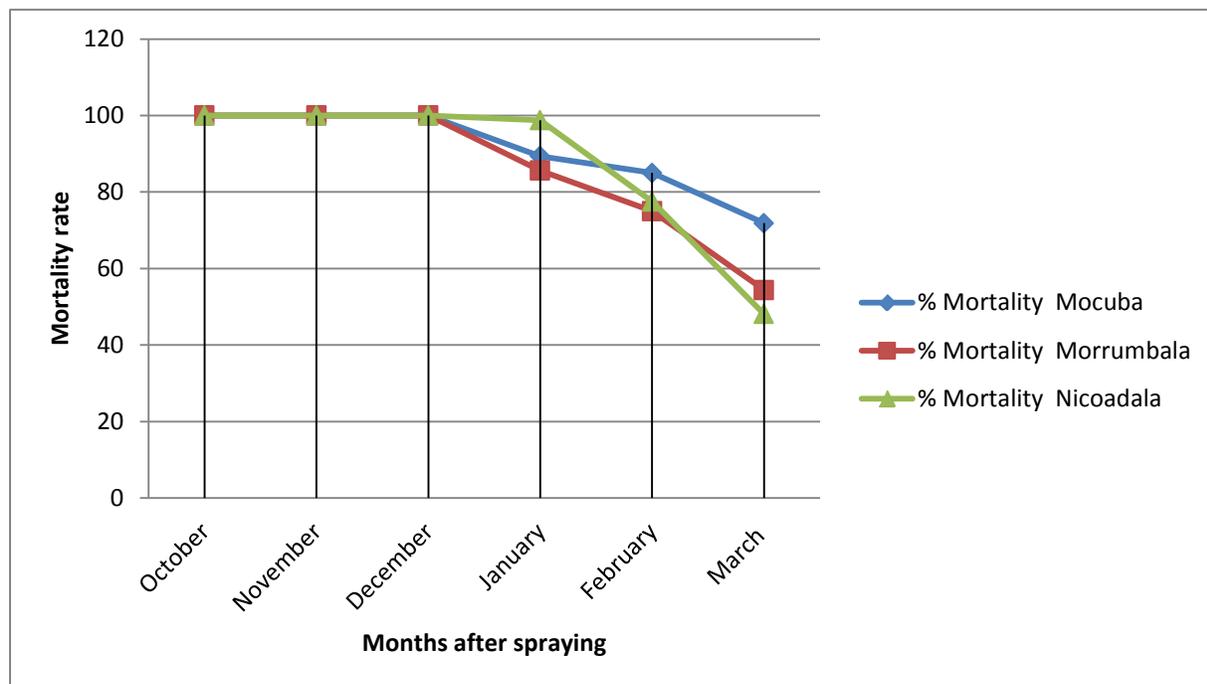
The standard WHO cone bioassays were used to evaluate the quality of the spray operation. The bioassay tests were conducted 24 hours after spraying in Samora Machel, Chico, and Coqueiro villages in the districts of Mocuba, Nicoadala, and Morrumbala respectively. The wall assay tests showed high mortality rates (100%) of susceptible mosquitoes exposed to deltamethrin-sprayed walls in both Nicoadala (Chico) and Morrumbala (Coqueiro) Districts and to alphacypermethrin-sprayed walls in Mocuba (Samora Machel). The 30 and 60 minute knockdown periods showed little variation between the districts sprayed with both deltamethrin and alphacypermethrin.

Based on the results of cone bioassay tests from the three sites, the quality of spray operation appeared to be appropriate.

Cone assays were also used to evaluate the potency of the insecticide at selected resting surface heights of 0.5 meters, 1.0 meters, 1.5 meters, and 2.0 meters. Results of monthly bioassays (Figure 3) show residual activity of insecticides sprayed on the walls of 12 structures in three districts, namely Morrumbala, Mocuba, and Nicoadala, over a period of five months. On average, 100% 24-hour mortality was observed in October, November, and December in all districts. Residual activity of the insecticide declined significantly after three months, particularly in the districts of Morrumbala and Mocuba, where monthly mortality rates were 85.6% and 89.4% respectively during the month of January. In Nicoadala, however, IRS remained effective for slightly longer, and an insignificant decline was observed from 100% to 98.8% in January. In Nicoadala, however, IRS remained effective for slightly longer, and an insignificant decline was observed from 100% to 98.8% in January.

During the months of February and March, in Mocuba and Morrumbala mortality rates continued to decline to 71.9% and 54.4% respectively, whereas in Nicoadala they dropped abruptly to 48.1%. This trend indicates that the insecticide used remained effective after three months of spraying, but effectiveness began to decline after that.

FIGURE 3: MORTALITY DECAY RATES IN THREE DISTRICTS TARGETED FOR IRS IN ZAMBÉZIA PROVINCE, OCTOBER 2012- MARCH 2013



7. MONITORING AND EVALUATION

7.1 KEY OBJECTIVES AND APPROACH

AIRS Mozambique used the local lessons learnt from the previous implementer, combined with successful aspects of AIRS M&E systems in other countries, to adjust Mozambique’s M&E system to:

- Emphasize accuracy of both the data collection and the data entry process through comprehensive trainings and supervision at all levels.
- Facilitate use in both field and office settings through straightforward and common-sense design.
- Streamline and standardize data information flow to minimize errors and facilitate timely reporting.
- Ensure IRS data security and storage for future reference through establishment and enforcement of proper protocols.

7.2 DATA COLLECTION AND MANAGEMENT

Data was collected using standardized data collections forms designed to capture all core PMI indicators. All data collection was preceded by training on data capture.

TABLE 11: MOZAMBIQUE IRS 2012 DATA COLLECTION TOOLS

Data collection tool	Used by who and when
Training Participants Registration Form	Used by lead trainer at training workshop to capture category and number of people trained disaggregated by male and female.
Daily Spray Operator Form	Used by spray operators during spray operations to capture structures and rooms found and sprayed, and population protected.
Daily Team Leader Form	Used by spray operator’s team leader during spray operations to summarize information on the Daily Spray Operators Forms.
Mobilization/Eligible Structure Identification Form	Used by mobilizers/enumerators during pre-spray mobilization/sensitization activities to identify and enumerate eligible structures and capture population reached with IRS messages.

TABLE 12: LEVELS OF DATA COLLECTION SUPERVISION

Data	Supervised by
Mobilization/Enumeration Data	District IEC Supervisor, District Coordinator, Provincial-Level IEC Coordinator, M&E manager, operations manager
Spray Data⁵	Team leader, base supervisor, M&E manager, operations manager, data entry clerks, database manager

7.2.1 DATA ENTRY

The AIRS Mozambique M&E team worked with Abt’s internal Client Technology Center to develop a Microsoft Access-based database system. The project procured additional laptops, adding to the stock of

⁵ To ensure data accuracy and reduce mathematical errors there were three level of data verification: team leaders, base supervisors, and data clerks. Initially the program planned to have spray operators summing the data collected on their Daily Spray Operator Forms; however, in the course of spraying it was noted that there were many errors being committed, so the responsibility was shifted to the data clerks.

10 data entry clerk laptops that were available from 2011. The AIRS Mozambique database was installed on each of the 24 laptops that were slated to be used for data entry. Twenty-four data entry clerks were employed at six data entry sites, one site in each district, with two to six data entry clerks assigned per site, depending on the amount of data a district collected per day.

Data were entered simultaneously at each of the six districts. The database was designed to allow two levels of data entry; *total* and *details* data. *Total* data was meant to facilitate quick reporting for program decisions while *details* data was used for the final End of Spray Report.

This database system used a cloud-based file transfer system to compile data from all 24 data entry clerks to create IRS progress reports at the national level. Additionally, the database was linked to an Access report shell, which provided automated local, real-time reports of spray data. The local reports were created by the M&E manager to provide feedback to the District Coordinators, to facilitate program management and decision-making.

7.2.2 DATA STORAGE

Paper data forms are stored in three-ring binders. Enumeration/mobilization data were filed by locality within the binders. Spray data were filed by date and base name. At the end of every day, all 24 databases were backed up electronically.

7.2.3 DATA CLEANING AND VERIFICATION

Data cleaning was done at the district level during the spraying and at the national level after the spraying. It involved the following:

- Ensuring that all data cards were entered correctly.
- Making necessary corrections to ensure that the totals and details data entry were in agreement.
- Checking and removing duplicate records.
- Identifying and entering missing records.

7.2.4 DATA QUALITY AND CONTROL

TABLE 13: METHODS FOR QUALITY ASSURANCE

Quality Control Issue	Method/Tools for Quality Assurance
Spray and Mobilization/Enumeration Data Integrity	<ul style="list-style-type: none"> ▪ Used standardized data collection forms ▪ Comprehensive training on data capture ▪ Multiple levels of supervision <ul style="list-style-type: none"> ➢ Spray operators are supervised by their team leaders, who monitor data capturing and verify collected data. ➢ Supervisors monitor team leaders and verify spray operator and team leader Spray Data Collection Forms. ➢ M&E manager and database manager monitor and verify data capture by spray operators, team leaders, and supervisors. ➢ IEC Coordinator, database manager, District Coordinator and IEC District Supervisor verify and spot-check data collection by mobilizers. ▪ Structure spot checks to cross-check Daily Spray and Mobilization/Enumeration Report. ▪ Database designed with locks and logic checks.
Spray Data Entry and Management	<ul style="list-style-type: none"> ▪ Data entry training for all data entry clerks. ▪ Prompt field data entry and transfer; data forms arrive at data entry sites daily and data entry is also daily.

	<ul style="list-style-type: none"> ▪ Data verification via double-data entry <ul style="list-style-type: none"> ➢ Initial data entry of daily totals per Mobilizer/Spray Operator Form. ➢ Follow-up entry of individual structure data. ▪ Data scan for irregularities by M&E manager and database manager.
Data Security	<ul style="list-style-type: none"> ▪ Data collection forms are printed on durable sheets. ▪ Data collection forms were filed systematically and stored in binders. ▪ Database is designed with password-protected access to restrict unauthorized entry. ▪ Database is backed up daily to an electronic file storage system.

7.3 RESULTS

7.3.1 SPRAY OPERATION DATA

- During the spray campaign a total of 585,299 structures were found by spray operators, of which 536,558 were sprayed, representing 92% spray coverage.
- The total population protected by IRS (all ages) was 2,716,176. A total of 501,522 children under the age of five years and 174,370 pregnant women were protected.

Table 14 provides the summary of the 2012 spray operations data per district, following data cleaning and verification.

TABLE 14: 2012 SUMMARY OF IRS SPRAY RESULTS PER DISTRICT

District	Structures Found by Spray Operators	Structures Sprayed	Spray Coverage	Total Population Protected	Pregnant Women Protected	Children <5 Years Protected	Population Not Protected	% of Population Protected
Milange	143,568	135,290	94%	656,219	36,145	103,170	1,942	100%
Mocuba	142,359	124,924	88%	741,897	50,364	178,262	37,722	95%
Morrumbala	102,906	97,902	95%	434,758	28,865	85,305	6,579	99%
Namacurra	62,980	56,034	89%	265,954	14,929	39,780	1057	100%
Nicoadala	82,240	76,081	93%	372,233	26,912	59,579	8,381	98%
Quelimane	51,246	46,327	90%	245,115	17,155	35,426	1139	100%
Grand Total	585,299	536,558	92%	2,716,176	174,370	501,522	56,820⁶	98%

7.3.2 OUTPUT/PROCESS AND OTHER INDICATORS

Results for output and process indicators described in the 2012 country work plan are reported in Table A-3 in the annex.

Data on insecticide use and number of structures sprayed by operator are presented in Table 15.

⁶ Note, the population unprotected is likely underreported, because the most common reason that a structure was not sprayed was that the structure was locked because the residents were absent from their home. When a structure is locked the spray operators are unable to collect data on the number of people residing in the unsprayed structure.

TABLE 15. INSECTICIDE USE PER DISTRICT

Indicator	Districts						Total/ Average for all 6 Districts
	Milange	Mocuba	Morrumbala	Namacurra	Nicoadala	Quelimane	
Total Sachets Received	105,433	101,530	75,664	49,380	63,018	39,781	434,806
Total Sachets Used	96,550	97,400	63,780	37,962	55,858	38,238	389,788
Total Sachets Damaged/Lost	31	75	24	23	42	174	369
Total Sachets Existing Stock Remaining	8,852	4,055	11,860	11,395	7,118	1,369	44,649
Avg. # Structures Sprayed/Sachet	1.4	1.3	1.5	1.5	1.4	1.2	1.4
Avg. # Structures Sprayed by Spray Operators/Day	12	11	14	10	11	11	12
Avg # Sachets per Spray Operator/Day	9.7	9.2	7.9	9.2	8.9	9.3	9
Avg # Spray Operator Worked/ Day	181	184	159	88	118	71	801

8. FINANCE AND PAYMENT STRATEGIES

The financial unit worked closely with the technical and operational teams. The AIRS Mozambique program explored different strategies for paying the large number of temporary staff during the spraying season, including paying cash through a security agent; using funds transferred into field workers' bank accounts; and mobile banking units. Due to the limitations of the banking system in Mozambique, the most viable option was to pay cash with the help of a security agent, which was the strategy used by the previous IRS implementing partner. The security agent was a valuable asset to the payment operations, and will be included in the 2013 campaign.

9. CHALLENGES

1. **Prohibiting sprayers from eating/drinking during the campaign.** During supervision it was noted that some spray operators were eating and/or drinking. Although measures have been taken (sensitizing activities were carried out aiming to get the spray operators to understand the risk of eating during spraying), there is still a need to control this situation using other methods. These methods should include marking “absent” for spray operators found eating/drinking on that day, which means that the day will not be considered in the timesheet for payment purposes, and spray operators who persist in ignoring the rule should be fired.
2. **Obtaining vehicles equipped with all security features required in the best practice manual.** Many transporters did not agree to send their vehicles to remote areas; those who agreed did not have all required conditions (example: seats in the car for spray operators). They had to improvise the seats for the first week to start transporting spray operators, and were obliged to equip the vehicles with the recommended seats a week after the start of the campaign.
3. **The need to perform susceptibility testing within a very short time and under pressure.** The entomology staff was hired in March and the results of susceptibility tests to inform the type of insecticide to be purchased were required in April. This gave very little time to complete the work.
4. **Limited human capacity for feeding mosquito colonies with human blood for continuous studies of residual insecticide activity.** A small number of mosquitoes were fed, and consequently the response in terms of reproduction was low. The program has only two technicians who are responsible for maintaining a huge colony. Furthermore, in *Anopheles* culture and colony maintenance, blood feeding is one of the most challenging techniques, so that even having an enormous number of people will not suffice to have good mosquito egg production. Moving forward, the program will adopt the use of animals for mosquito feeding. Although ethical guidelines allow the use of live animals, their maintenance requires additional resources and is time-consuming. However, animals provide a constant source of blood, which at the proper temperature provides the necessary stimuli for feeding, and for good mosquito egg production.
5. **Requests for compensation.** The owners of the houses where we have carried out cone bioassays, human landing collections, and pyrethrum spray catches constantly questioned the existence of incentives like cash or nets for letting us work within their residences. This was not something we could provide.
6. **Gathering district-level health authority buy-in.** It was difficult to generate MoH ownership of the IRS activity at the district level, and this resulted in IRS refusals in certain villages. In certain cases, the province-level supervision team had to coordinate with the local community leaders in order to mobilize the refusing householders to get their structures sprayed.
7. **Collection of accurate spray data.** Some spray operators were found to be forging the spray data. This was detected in Mocuba district, and as a result six spray operators were dismissed.
8. **Limited access to water near three spray base sites.** Although most of the spray sites have water nearby, there are three base sites with no water, one in Mocuba, one in Morrumbala, and one in Milange; cars are required to fetch water every day, resulting in a huge amount of fuel spent. For the next campaign, all bases will have a nearby water source. In Morrumbala and Milange, the problem has now been sorted out. In Mocuba we do not currently have a solution, but digging a well could be a reasonable way to address the issue.

9. **Insufficient number of data entry clerks.** The number of data entry clerks was not sufficient to handle the amount of data collected from enumeration/mobilization through to spraying. To address this issue, more data entry clerks were hired between the enumeration/mobilization and spray activities. However, data entry time in Mozambique continued to lag, resulting in delayed data entry of details. In response to this issue, more data entry clerks will be hired in 2013.
10. **Data Cleaning.** The 2012 AIRS database limited back-end access to the administrator only. The M&E manager, in taking into account data entry clerk capacity, had decided not to provide the data entry clerks with access to the database back-ends. This meant that the M&E manager and database manager had to clean the data themselves, and they were unable to clean 24 back-end databases within the short period of time allotted, especially given that data cleaning was interrupted by the holiday season.
11. **Selection and recruitment of spray operators.** Some of the spray operators could not write properly. This resulted in a number of forms being sent back and forth to the field for confirmation and correction when necessary.
12. **Reporting and controlling stolen insecticide.** The system used to track insecticide use was based on the submission of empty sachets, which did not allow AIRS Mozambique to report damaged and lost sachets at the household level. The common method of theft reported was for the spray operators to empty the sachet content into a receptacle and return the empty sachet as “used.” This situation was verified only in Munhiba locality within Mocuba district, where the implicated spray operators were reported to the police. Unfortunately, the copy of the police report did not specify how many sachets each operator had stolen. Although no other theft cases were officially reported, AIRS Mozambique assumes that there were similar incidents in other districts that could not be verified. With that in mind, the program will implement a better system to control insecticide theft/damage. The system will involve working closely with the community. During the campaign in each community a sample of houses will be selected randomly to verify if the household has been sprayed. In addition, households will be encouraged to verify/witness the process of insecticide dilution before the spray operator sprays the structure, to make sure that the content of sachets (insecticide) is used in their homes.

10. LESSONS LEARNED

1. **Weekly meetings with the DPS and AIRS team:** These meetings were invaluable to the success of the IRS operation. During the IRS implementation period, we had weekly meetings to discuss the progress of the IRS campaign district-by-district in order to improve the coverage. It was during these meetings that decisions related to districts requiring extra attention were made. The DPS staff coordinated with the District Health Directors and Medical Chiefs in order for them to be involved in the process. They were able to coordinate with the local community leaders to mobilize the community; however, some district authorities did not take DPS recommendations seriously. For these situations, the provincial supervision team had to intervene.
2. **Hiring of the temporary staff through a temporary agency:** AIRS experienced issues with the contracting of temporary staff due to the process being different than that followed by the AIRS predecessor. After consulting with local legal counsel regarding the local labor law, AIRS will use a temporary recruitment agency to contract the spray operators and other temporary workers for future campaigns.
3. **Supervision:** Effective supervision is strategic to IRS implementation, regardless of the level of training given to spray teams. For effective supervision, a team composed of the Ministries of Health, Environment and Agriculture, together with Abt staff, implemented supervision during the IRS campaign to cover all the areas of the intervention. Checklists were used during this process. Also, meetings with the district-level staff were regularly held after a supervision session to highlight the main concerns and recommend solutions to address the issues, or to find solutions together.
4. **Time to implement IRS:** Normally the period between 6:00 a.m. and 1:00 p.m. is used to spray the structures. Local experiences show that this should not be generalized, as people in some localities visit their fields in the morning, so the spray operators had to move to those areas later than scheduled in order to find the population and get their structures sprayed.
5. **Enumeration stickers:** Community members in a few localities removed stickers used for enumeration for fear that other community members would use the information on the sticker (name) to access the household.

II. RECOMMENDATIONS

1. The timeline for the next spray cycle activities should be discussed and agreed with the District Health Authorities and all partners involved in the campaign.
2. There is a need to focus on spray operator selection, in collaboration with community leaders, to ensure that all personnel involved in the campaign are selected from the spray areas and that they can read and write reasonably to avoid mistakes during the process of filling out IRS forms.
3. Vehicles rented to transport spray operators need to be in good condition, with comfortable seats for the spray operators, and more generally they need to comply with the Best Management Practices recommendations.
4. All sectors (health, environment, agriculture, local government) need to be much more engaged in the implementation of IRS in order to minimize refusals and maximize supervision and safety of spray operators.
5. Better gloves need to be procured, as the 2012 campaign gloves were not very durable.
6. District Health Authorities need to be more selective when appointing the District IRS supervisors; there were cases of negligence by the health supervisors, as they were not interested in monitoring/supervising the IRS activities. This problem could be avoided through a strict selection process.
7. AIRS Mozambique should adopt the data entry supervisory system that is used in other countries and hire M&E Assistants for each targeted district. M&E Assistants would be in charge of directly supervising data entry clerks, and will be responsible for managing daily data cleaning. Additionally, the AIRS database should have a platform to enable data entry clerks to identify and correct errors. These steps will help to ensure clean and high-quality data that is reported on time.
8. Ensure that finance and administration procedures are in place for vehicle rental one month prior to the campaign, which will allow sufficient internal trainings to take place for AIRS Mozambique operations staff. The ECO or operations manager will take part in the inspection and approval of vehicles prior to execution of rental agreements.
9. Ensure a solid understanding by the DPS and DDS regarding the AIRS Mozambique finance and administration policy and procedures at least two months in advance of the campaign, in order to avoid delays during the campaign that result from misunderstandings.
10. Team leaders and supervisors will be trained for a longer period on data collection and proper filling of the Daily Spray Operator Form to ensure that they are capable of noting and correcting errors at the point of collection before it is submitted to the data entry clerks for entry.

11. A community-based system will be developed to better control insecticide theft, and will be presented in the 2013 work plan.

ANNEX

TABLE A-1: INTERNATIONAL AND LOCAL PROCUREMENT INVENTORY

Items	Quantities received	Items	Quantities received
International Procurement		Local Procurement (continued)	
Insecticides (20 gr sachets)	430,350	Thermometer	8
Face shields	100	Generator	6
Head gear / Helmet / Brackets	100	Insecticide stock card	1,000
Rubber gloves-short	1,490	Insecticide Control Form	10,200
Rubber gloves-long	200	Team leader form	11,833
Spare parts kit	130	Polythene sheet	6,300 m
Light traps	12	Calculator	155
6V Battery	24	Markers (box of 12)	144
6V Battery charger	3	Flipcharts	48
Local Procurement		Pens	12,000
Boots (pair)	892	First aid kit	150
Socks (pair)	1,800	Warning sign-soak pit	50
Overalls	550	Masking tape (pack of 6 rolls)	48
Padlock	90	T-shirt	840
Inventory book	1,000	Batteries (pairs)	288
Notebook	1,759	Pamphlets	250,000
Handy Megaphones	106	Enumeration stickers	710,000
Reams	600	M&E (mobilizer) forms	47,333
Black files	555	Spray card	71,000
Pregnancy test and kits	1,400	Inventory book	1,000
Powder soap	13,996	Rubber bands (pack)	48
1L Lubricating oil	541	Padlocks	90
Face towels	1,657	Inventory card	5,000
20L Liquid soap	202		

TABLE A-2: POST-SPRAY PROJECT EQUIPMENT AND MATERIALS INVENTORY

Description	Initial Projection	Additional/Supplementary Qty	Total Stock	Material distributed	Total Returned Useable	Total Damages	Stock Balance	Replacement Need
Megaphones	136	0	136	129	108	21	115	0
Markers	1,555	0	1,555	1,182	35	0	408	0
Charcoal pencils	2,153	0	2,153	1,641	0	0	512	1,000
Adhesive tape	450	0	450	165	2	0	287	50
Scissors	65	0	65	65	0	65	0	25
Calculators	77	155	232	209	103	106	126	50
Clipboards	794	0	794	781	0	0	13	200
First Aid Kits	236	0	236	186	0	186	50	80
Pregnancy test	1,412	0	1,412	588	24	564	848	20
Plastic Aprons	150	0	150	94	91	3	147	0
Team leader ID reflectors	380	0	380	180	110	70	310	0
Paper masks	42,436	0	42,436	35,481	300	35181	7,255	20,000
Gloves short	2,221	0	2,221	2,161	0	2161	60	1,500
Gloves long	204	0	204	200	196	4	200	63
Liquid soap 5L	202	0	202	94	0	94	108	0
Funnels with filter	598	0	598	596	298	298	300	0
Detergent (150g)	23,328	0	23,328	9,779	432	9347	13,981	0
Batteries	1,612	128	1,740	1,486	0	1486	254	1,500
Flashlight	58	20	78	47	19	28	50	44
Strainers (big)	53	0	53	53	33	20	33	0
Towels	2,110	0	2,110	1,376	38	1,338	772	228
Leather Boots	1,096	0	1,096	56	27	29	1,067	0
Rubber boots	2,074	0	2,074	1,565	690	875	1,199	0
Suit working 2pcs	3,488	0	3,488	3,220	2194	1026	2,462	751

Suit 2pc working for Guards	31	0	31	31	0	31	0	0
Bags	2,026	0	2,026	1,511	1,042	469	1,557	900
Hat	3,258	0	3,258	2,022	1874	148	3,110	412
Brace Metal	2,441	0	2,441	1,279	1,217	62	2,379	0
Visors	2,128	0	2,128	1,873	0	1873	255	1,500
Helmets	2,041	0	2,041	1,267	1026	241	1,800	0
Hand grass mower	15	0	15	15	12	3	12	9
Machetes	13	0	13	12	0	12	1	25
Rakes	29	0	29	28	21	7	22	5
Hoes	21	0	21	21	5	16	5	25
Shovel	69	0	69	33	29	4	65	4
Rope 100m	12	0	12	7	0	7	5	25
Pipe wrenches	24	0	24	17	5	12	12	0
Screwspanner / wrench	52	0	52	31	0	31	21	0
Hammers	18	0	18	18	0	18	0	15
Pliers	18	0	18	18	0	18	0	0
French wrench	5	0	5	5	0	5	0	0
Wrench, (size 10/11)	26	0	26	18	3	15	11	0
Star spanner	40	0	40	40	2	38	2	0
Spray pump filters	2,423	0	2,423	90	0	90	2,333	0
Spray pumps spare parts kits	82	0	82	40	18	22	60	0
8002E Pump Nozzles	1,622	0	1,622	46	0	46	1,576	0

TABLE A-3: OUTPUT/PROCESS INDICATORS

Quality Management Indicators		
	Data Collection Method/Comments	
A. Information, Education and Communication		
a. Number of sensitization/mobilization meetings held (including advocacy visits at various levels to stakeholders (federal, state, local government, traditional rulers, relevant ministries, media houses)	a. Activity reports b. AIRS Project, Mozambique Database c. Receipts of radio spots aired	404
b. Number of IRS educational brochures distributed		290,450
c. Number of radio spots/interactive shows aired		121 (120 radio spots, 1 interactive radio show)
B. IRS Training/Supervision Effectiveness		
a. Supervisory Ratio – number of team leaders and spray operators reporting to each supervisor	a. Daily spray operator and team leader form	6 Spray Operators per Team Leader; 5 Team Leaders per Supervisor
C. Stock Management/Record Keeping		
a. Percentage of storage facilities doing stock verification	Stock cards, stock verification reports, Spray Operator Daily Report forms, and end of spray waste disposal report and comparing relevant data to the IRS database tracking system.	28 Storage facilities = 100%
b. Complete tracking of number of sachets in stock, number of empty sachets returned, and number of sachets disposed of		133,516 in stock* 389,788 empty sachets returned 389,788 empty sachets incinerated *Not all sachets were distributed to the districts so this number represents what was returned from the districts (44,649) plus what had remained in the warehouse (88,867)
c. Number of insecticide sachets lost		0
D. Operational Safety		
a. Percentage of health facilities in IRS communities possessing insecticide antidotes and treatment medications	Surveys collecting operational safety information will be carried out at the beginning and end of the spray campaign. Data on severe adverse effects will be collected weekly.	100%
b. Percentage of health workers in targeted communities trained to treat cases of insecticide exposure and poisoning		0%
c. Percentage of female spray operators tested for pregnancy prior to undertaking spray operations		100%
d. Number of verified cases of adverse health events reported to health facilities in targeted communities		0
E. Entomological Indicators		

Quality Management Indicators

	Data Collection Method/Comments	
a. Vector species identification	Data collection on vector density, distribution, and seasonality and behavior was collected using the following methods and reports on: Pyrethrum Spray Collection, Human Landing Catches and Cone/Wall Bioassay Tests.	199 (<i>An. gambiae</i> s.l. 31, 15.58%; <i>An. funestus</i> s.l. 86, 43.22%; <i>An. coustani</i> 82, 41.21%)
b. Vector density – change on vector distribution and seasonality		427 mosquitoes through Nov (<i>An. gambiae</i> s.l. 2.8%; <i>An. funestus</i> s.l. 16.6%; <i>An. coustani</i> 0.2%, <i>Culex</i> 80.3%)
c. Vector behavior – indoor vs. outdoor biting and resting		34 mosquitoes (24 collected outdoor and 10 collected indoor)
d. Percentage of vectors susceptible to insecticide and mechanism of resistance		372 mosquitoes (60 tested to lambda-cyhalothrin and 312 tested to deltamethrin); 98.92% were susceptible
e. Insecticide decay rates on spray surfaces		960 mosquitoes (Morrumbala 100 % mortality, Mocuba 100% Mortality, Nicoadala 100% Mortality 2 months after spraying)
F. Environmental Indicators		
a. Environmental compliance officer oriented and trained	Data will be collected during environmental trainings, supervisions and inspections.	6
b. Number of supervisors, spray team leaders, and spray operators trained in environmental compliance and sensitivity		18 Supervisors, 150 Team leaders and 900 Spray Operators
c. Number of national and sub-national environmental and/or health officers trained in environmental compliance		6 Environmental officers, 12 Health officers & 6 Medical Doctors
d. Number of storehouse/soak pits upgraded		28
e. Percent of storehouses inspected and approved		100%
f. Percentage of operations centers with pesticide exposure antidotes readily available		0%
g. Percentage of operation centers with adequate PPE		100%
h. Number of sites visited/audited by environmental compliance manager		28
i. Percentage of pre-spray, mid-spray, and post-spray inspections performed		100%
j. Number of environmental/health incidents reported		2
k. SEAs completed		0

Quality Management Indicators

	Data Collection Method/Comments	
I. SEA amendment completed (if required)		N/A

TABLE A-4: DAILY SPRAY PROGRESS (TREND GRAPH)

