



PRESIDENT'S MALARIA INITIATIVE



PMI | Africa IRS (AIRS) Project

Indoor Residual Spraying (IRS 2) Task Order Four

ZAMBIA 2014

END OF SPRAY REPORT

SPRAY CAMPAIGN: OCTOBER 13 – DECEMBER 23, 2014

APPROVED: MARCH 31, 2015

Recommended Citation: PMI | Africa IRS (AIRS) Project Indoor Residual Spraying (IRS) Task Order 4. *Zambia End of Spray Report*, Bethesda, MD. Abt Associates Inc.

Contract No.: GHN-I-00-09-00012-00

Task Order: AID- GHN-I-00-09-00013

Submitted to: United States Agency for International Development/PMI

Submitted on: February 23, 2015

Re-Submitted on: March 27, 2015

Approved: March 31, 2015

Abt Associates Inc. 1 4550 Montgomery Avenue 1 Suite 800 North
1 Bethesda, Maryland 20814 1 T. 301.347.5000 1 F. 301.913.9061
1 www.abtassociates.com



ZAMBIA 2014
END OF SPRAY REPORT

CONTENTS

Contents iii

Acronyms vii

Executive Summary	ix
1. Country Background	1
2. Pre-Season Activities	3
2.1 Selection of IRS Districts and Catchment Areas.....	3
2.2 Selection of Catchment Areas in PMI Districts	3
2.2.1 Selection of Catchment Areas in DFID Districts	3
2.2.2 Selection of Districts and Provinces for IRS	4
2.3 District Planning Meetings	6
2.4 Insecticide Selection	6
2.5 Logistics Needs and Procurement	6
2.5.1 International Procurement.....	7
2.5.2 Local Procurement	7
2.5.3 Material Distribution to the Districts and Operation Sites	8
2.5.4 Seasonal Staff Hired	8
2.6 IRS Trainings.....	9
2.6.1 Training of Trainers	9
2.6.2 Cascade Training	10
2.6.3 Data Collection Training	11
2.6.4 Logistics Training.....	12
2.6.5 Procurement Training	12
3. Information, Education, and Communication	13
3.1 Community Mobilization.....	13
3.1.1 Recruitment of HCCs	13
3.1.2 Orientation of HCCs for IRS Community Mobilization	13
3.2 Door-to-Door Mobilization	14
3.3 Mass Media Communication	14
4. Implementation of IRS Activities	15
4.1 IRS Supervision	16
4.2 Logistics	17
4.2.1 IRS Storage and Insecticide Stock Management.....	17
4.2.2 IRS Transport Services.....	18
4.3 IRS Payment Services	18

5. Post-Season Activities	19
5.1 Post-Spray Review Meetings	19
5.2 Post-Spray Inventory	20
6. Monitoring and Evaluation	21
6.1 Key Objectives	21
6.2 M&E System Development and Implementation	21
6.3 mSpray Implementation	22
6.3.1 Lessons Learned and Recommendations	22
6.4 Data Quality Assurance and Control	23
6.4.1 Physical Data Verification	23
6.4.2 Database Quality Control	24
6.4.3 Random Spot Checks	24
6.5 IRS Results 24	
6.5.1 Insecticide Usage	26
7. Environmental Compliance	29
7.1.1 Letter Report	29
7.2 Pre-Season Environmental Compliance Assessment (PSECA)	29
7.2.1 Pre-Season Environmental Compliance Inspection	29
7.3 Medical Clearances	30
7.4 Insecticide Adverse Effect Training	30
7.5 Mid-Season Environmental Inspections	30
7.5.1 Morning Mobilization and Transport Inspections	30
7.5.2 Home Owner Preparation and SOP Performance Inspections	31
7.5.3 Storekeeper Performance Inspections	32
7.5.4 End of Day Cleanup Inspections	32
7.5.5 Spray Data Collection Verification (DCV) Form Inspections	33
7.6 Incidents 34	
7.7 Post-Season Environmental Assessment	34
7.7.1 Closure of Storerooms and Soak Pits	34
7.8 IRS Waste Disposal	34
8. Capacity Building	35
9. Entomology	37
9.1 Vector Species Composition and Densities	37
9.1.1 Mosquito Density	38
9.2 Quality Assurance of IRS and Insecticide Decay Rate	39
9.3 Malaria Vector Susceptibility Using WHO Bioassays	41
9.4 Training 47	
9.5 Entomology Laboratory	47
9.6 Challenges	47
10. Challenges and Lessons Learned	49
10.1 Challenges	49

10.2 Lessons Learned	50
References	51
Annex 1: Spray Coverage by Catchment Area	52
Annex 2: M&E Plan Matrix – 2014 Campaign Results	66

LIST OF TABLES

Table 1: AIRS Zambia 2014 IRS Campaign Summary	x
Table 2: Target Structures for 2014 IRS.....	5
Table 3: Number OF PERSONS Hired	9
Table 4: Number of TOT Participants, by Gender	9
Table 5: Number of Spray Operators Trained to Implement IRS	11
Table 6: Number and Type of Seasonal Trainings	12
Table 7: Spray Start and End Dates by District.....	15
Table 8: Post-Spray Meeting Participants.....	19
Table 9: 2014 Campaign Results.....	25
Table 10: Insecticide Usage	26
Table 11: Categories of Insecticide Contaminated Waste.....	35
Table 12: Mosquito Distribution by Species Collected by PSC and CDC Lights Traps in November, December 2014 and January 2015 in the 6 Sentinel Sites	38
Table 13: Average Density of Malaria Vectors in Sites with IRS and in Control Sites in November, December 2014 and January 2015.....	38
Table 14a : Susceptibility Status of <i>An. funestus</i> s.l. in Central and Eastern Provinces in 2014.....	42
Table 14b : Susceptibility Status of <i>An. gambiae</i> s.l. in Central and Copperbelt Provinces in 201	42
Table 15a: Susceptibility Status of <i>An. funestus</i> s.l. in Northern Province in 2014	43
Table 15b: Susceptibility Status of <i>An. gambiae</i> s.l. in Northern and MUCHINGA Provinces in 201	43
Table 16A: Susceptibility status of <i>An. funestus</i> s.l. in Luapula Province in 2014	44
Table 16b: Susceptibility status of <i>An. gambiae</i> s.l. in Luapula Province in 2014	45
Table 17: Susceptibility status of <i>An. funestus</i> s.l. in Muchinga Province in 2014	47

LIST OF FIGURES

Figure 1: Map of Zambia Showing Malaria Transmission Intensity, 2010	4
Figure 2: Map of Zambia Showing Malaria Prevalence Among Children under 5 years by Province, 2006-2012.....	5
Figure 3: IRS Practical Training Sessions.....	10
Figure 4: IRS Daily Performance Tracker	26
Figure 5: Percent Mortality of Susceptible Strain after 30 Mins Exposure to Pirmiphos-Methyl via WHO Cone Bioassays at T0 (48 Hours after IRS in November) and T2 (January/ Two Months after IRS)	40

ACRONYMS

AIRS	Africa Indoor Residual Spraying
BCC	Behavior Change Communication
CEHO	Chief Environmental Health Officer
CHW	Community Health Worker
COP	Chief of Party
CSO	Central Statistical Office
DCMO	District Medical Office (r)
DFID	(UK) Department for International Development
DHMT	District Health Management Team
DCV	Data Collection Verification
DEC	Data Entry Clerk
DEV	Data Entry Verification
EC	Environmental Compliance
ECO	Environmental Compliance Officer
EE	Error Eliminator
HCC	Health Center Committee
HLC	Human Landing Catch
IEC	Information, Education and Communication
IRS	Indoor Residual Spraying
IRTAC	Insecticide Resistance Technical Advisory Committee
IVM	Integrated Vector Management
M&E	Monitoring & Evaluation
MCDMCH	Ministry of Community Development, Mother and Child Health
MMI	Macha Malaria Institute
MOH	Ministry of Health
MOP	Malaria Operational Plan
MSL	Medical Stores Limited
NMCC	National Malaria Control Centre
NMCP	National Malaria Control Program
PMI	President's Malaria Initiative
PMO	Provincial Medical Office(r)

PC	Provincial Coordinator
PPE	Personal Protective Equipment
PSC	Pyrethrum Spray Catch
PSECA	Pre-Season Environmental Compliance Assessment
SEA	Supplemental Environmental Assessment
SOP	Spray Operator
TL	Team Leader
TOT	Training of Trainers
USAID	United States Agency for International Development
WHO	World Health Organization
ZEMA	Zambia Environmental Management Agency
ZISSP	Zambia Integrated Systems Strengthening Program

EXECUTIVE SUMMARY

The Africa Indoor Residual Spraying (AIRS) project funded by the United States Agency for International Development (USAID) under the President's Malaria Initiative (PMI) implemented a targeted indoor residual spraying (IRS) campaign in Zambia in 2014. The objective of the AIRS project is to ensure that 85% of all targeted structures are sprayed to limit transmission and reduce the incidence and prevalence of malaria. To achieve this objective, AIRS Zambia conducted IRS from October to December, 2014 targeting 472,000 structures in 40 districts in five provinces, including 15 districts that were funded by the UK Department for International Development through PMI: Eastern (9 districts), Central (4 districts), Luapula (11 districts), Muchinga (7 districts) and Northern (9 districts). Pirimiphos-methyl (Actellic 300CS), which is an organophosphate insecticide, was used in all 40 districts.

The following are achievements and key highlights of the 2014 spray campaign (see Table 1), which lasted 65 operational days:

- A total of 409,544 structures were sprayed out of 438,252 structures found by spray operators in the targeted districts for 93.4% spray coverage. In total, 2,000,824 residents were protected, including 309,250 (15.5%) children under five years old and 60,978 (3.0%) pregnant women.
- A total of 1,592 individuals (39.2% women) were trained using PMI and DFID funds to support IRS activities in the 40 districts. Of these, 1,328 were spray operators and team leaders (782 males and 546 females), 40 were IRS managers (37 males and 3 females), 58 were supervisors (49 males and 9 females), 52 were data entry clerks (43 males and 9 females), 40 were monitoring and evaluation (M&E) assistants (31 males and 9 females), 40 were storekeepers (15 males and 25 females) and 34 were clinicians (19 males and 15 females).
- A total of 112,603 bottles of insecticide were used to spray 409,544 structures in the 40 IRS districts, with a utilization ratio of approximately 1:3.64 (bottles to structures sprayed).
- In order to improve district compliance with environmental and logistics requirements, AIRS Zambia conducted a pre-season environmental compliance assessment (PSECA) and renovated or constructed district facilities, warehouses and soak pits as needed. Insecticide poison management training was conducted for 34 participants from 20 of the 40 districts and mid-season environmental inspections were done using AIRS environmental compliance (EC) tools which were used by the Environmental Compliance Officer (ECO) and Provincial Coordinators (PCs). In 2012, training in poison management was conducted for clinicians drawn from 20 old PMI districts. In 2014, the number of supported districts increased to 40 and therefore AIRS Zambia trained additional clinicians mostly drawn from the new districts.
- All bioassays conducted within 48 hours of spraying in November 2014 to assess the quality of spraying in the target districts recorded 100% mortalities of susceptible Kisumu strain *An. gambiae* s.l. Two months post-IRS, average percentage mortalities of 100% was still being recorded.

TABLE 1: AIRS ZAMBIA 2014 IRS CAMPAIGN SUMMARY

Number of PMI-supported provinces	5 (Eastern, Northern, Luapula, Central, Muchinga) *
Number of districts covered by PMI-supported IRS	40
Number of structures sprayed by PMI-supported IRS	409,544
Number of structures targeted by PMI-supported IRS	438,252
2014 spray coverage	93.4%
Population protected by PMI-supported IRS	2,000,824 (309,250 children <5 years, 60,978 pregant women)
Dates of IRS campaign	October 13 – December 23, 2014
Length of campaign	65 days
Number of people trained with U.S. Government funds to deliver IRS ¹	1,460

* Note that DFID supported Luapula and Central provinces

¹ This figure only covers spray personnel (i.e. spray operators, team leaders, supervisors, clinicians.)

I. COUNTRY BACKGROUND

Zambia covers an area of approximately 752,600 square kilometers with a population of approximately 15,023,315 people, of which 2,770,815 are children under the age of five years (CSO, Zambia: 2013). The entire population is at risk of malaria, including children under five years of age and pregnant women. The country has three distinct malaria epidemiological strata: low with parasitemia below 1%, moderate with parasitemia between 2 and 14% and high transmission with parasitemia above 15% in children above 5 years (Masaninga et al, 2013). Most of the districts exhibit malaria that is characterized by seasonal peaks of transmission occurring between March and April. Climate (humid subtropical or tropical wet and dry) and altitude are major factors that influence malaria prevalence in the country. Other contributors are: poor housing (especially in peri-urban and rural areas), high human concentration, and the presence of lakes, swamps and dambos (especially in the Luapula and Northern provinces of the country). Based on the National Malaria Strategic Plan 2011 -2015, the country seeks to consolidate the significant progress made over the previous five years in malaria control through fine-tuning strategies that call for focused and sustained high impact interventions based on evidence that looks at epidemiological patterns.

IRS was conducted in Zambia in the Copperbelt province beginning in the 1930's. However, by the 1980's, IRS in Zambia had ceased. It was re-launched in 2003. PMI has been supporting IRS in Zambia since 2008. Beginning in 2011, the change in the epidemiological outlook in malaria incidence that left the eastern half of the country with the most burden prompted adjustments from concentrating on the rail line area to 20 districts in three provinces in the eastern half of the country. District-wide blanket IRS coverage was changed to focal spraying to cover the high risk areas in 2014. The IRS in the eastern half of Zambia is funded by PMI and DFID.

In May, 2014, Abt Associates was contracted by PMI to implement IRS in Zambia under AIRS Project. PMI, DFID and the Zambia Ministry of Health (MOH) identified 40 high-burden malaria districts in five provinces in which to implement focal IRS. The five provinces in which IRS was implemented were Central (4 districts), Eastern (9 districts), Luapula (11 districts), Muchinga (7 districts) and Northern (9 districts) with a total of 472,000 structures targeted. A total of 409,544 structures out of 438,252 structures found in the 40 districts were sprayed between October and December of 2014 using an organophosphate insecticide (Actellic 300CS). Since Actellic 300CS has a long residual life (over six months in some countries) it was decided that spraying would occur only once a year. The catchment area was based on a number of factors, including high malaria prevalence, based on malaria cases reported in 2013 from the health facilities serving the catchment areas, and population/structure density.

Working in collaboration with the MOH and the Ministry of Community Development, Mother and Child Health (MCDMCH), AIRS was tasked to achieve at least 85 percent spray coverage in the IRS target areas using Actellic 300CS. In addition, AIRS provided technical support in the following activities:

- Training, capacity building, and advocacy at the national and district level as a means of achieving IRS sustainability. This included building the capacity of government officials and partners to undertake high-quality IRS.
- Daily monitoring of the IRS program via supervision of data collection and data entry using the AIRS Access database and the M&E supervisory tools, plus the mSpray platform, developed by Akros in seven districts in Luapula.
- Logistics assessments and coordination of all procurement, delivery, and storage of spray pumps, spare parts, insecticides, and personal protective equipment (PPE).

- Safe and correct insecticide application, thus minimizing human and environmental exposure to IRS insecticides, in compliance with the Pesticide Evaluation Report and Safer Use Action Plan (PERSUAP) and Supplemental Environmental Assessment (SEA).
- Coordination of sensitization and mobilization activities with health center committees (HCC) to raise the populations' awareness and acceptance of IRS and to encourage ownership.
- Conduct entomological surveillance including assessing malaria vector density and species composition in intervention areas; establish vector feeding time and location; monitor the quality of insecticide application and insecticide decay rates and assess vector susceptibility.
- Maintenance of the entomological laboratory to ensure that all necessary studies can be carried out throughout the year.

2. PRE-SEASON ACTIVITIES

2.1 SELECTION OF IRS DISTRICTS AND CATCHMENT AREAS

In 2014, PMI-supported districts selected areas for spraying based on the following:

- Malaria burden
- Population density
- Structure density
- Accessibility and practicality
- Available resources
- Existing integrated vector management (IVM) interventions

A process to determine the location and quantity of structures to be sprayed (targeting) was carried out. The main purpose of IRS targeting was to maximize resources to prevent the spread of malaria by spraying structures in clearly defined focalized areas of high malaria burden.

2.2 SELECTION OF CATCHMENT AREAS IN PMI DISTRICTS

A micro-planning meeting was held where the districts came up with catchment areas for spraying in PMI districts in Eastern, Muchinga, and Northern provinces. Each district listed the number of catchment areas by number of structures, number of people and by malaria incidence per catchment area. The catchment areas were ranked in descending order starting with the one with the highest malaria incidence. Based on accessibility, practicability, the availability of resources, existing IVM interventions and population, the districts selected the number of structures for spraying in 2014. Using the total number of structures, the districts worked out the number of days for implementation, as well as the number of spray operators, team leaders, and supervisors needed for the spray campaign.

2.2.1 SELECTION OF CATCHMENT AREAS IN DFID DISTRICTS

In the DFID districts in Central and Luapula provinces, with technical support from Akros, the districts carried out a targeting exercise. They undertook the following steps:

1. Create 'target areas' based on population density using enumerated structures and minimum structures per settlement
2. Determine a malaria burden 'ranking' for all target areas across the 15 districts
3. Determine the 'cut-off' point for the amount of structures to be targeted
4. Assign spray targets per district based on the target areas that fall within the 'cut-off' point & district input
5. The districts decided on the final 'target area' locations based on evidence and local knowledge

Enumeration was done using satellite imagery in the 15 districts. A total of 270,000 structures were enumerated. Buffers of 50 meters were created around each structure to ensure an operationally manageable population density. These buffers were joined to create a large 'target area'. The number of structures within each of these 'target areas' was known. Target areas of less than 25 structures were excluded. A total of 1,212 'target areas' were created for the 15 districts.

Ranking target areas

- Each target area fell within a health facility catchment area.
- Incidence was assigned to each target area based on the incidence of the health facility catchment area it falls within.
- Predicted cases was worked out using the number of structures in a particular target area AND the assigned incidence.
- Predicted case counts and incidence were ranked separately and then combined to create the final 'target area ranking'.
- Outcome: All 1,212 'target areas' were ranked from most important to least important in terms of malaria burden.

Determining a cut-off point

- After satellite enumeration was completed, Akros and AIRS agreed upon a target of 125,731 structures in these 15 districts.
- There was a ranking from highest to lowest 'target areas' in terms of importance and the number of structures in each 'target area' was known.
- The ranking to see how many of the highest ranked target areas fell within the AIRS target of 125,731 structures was used. That became the 'targeted areas for spraying'.
- Outcome: The 'targeted areas for spraying' and how many structures fell in each 'targeted area' were known.

Deciding the final target areas

- Districts used maps and local knowledge to decide on the final target areas.

2.2.2 SELECTION OF DISTRICTS AND PROVINCES FOR IRS

The 40 districts in the Central, Eastern, Luapula, Muchinga and Northern provinces were selected for IRS during the October 2014 campaign (see Figures 1 and 2 below) based on the malaria burden as was reported during the Malaria Indicator Survey (MIS 2010). In 2014, a total of 472,000 structures were targeted for spraying while 2,046,120 persons were targeted to be protected through IRS.

FIGURE 1: MAP OF ZAMBIA SHOWING MALARIA TRANSMISSION INTENSITY, 2010

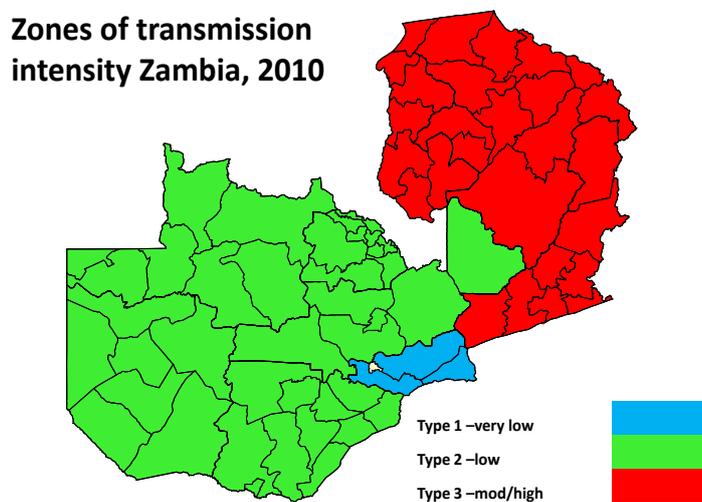


FIGURE 2: MAP OF ZAMBIA SHOWING MALARIA PREVALENCE AMONG CHILDREN UNDER 5 YEARS BY PROVINCE, 2006-2012

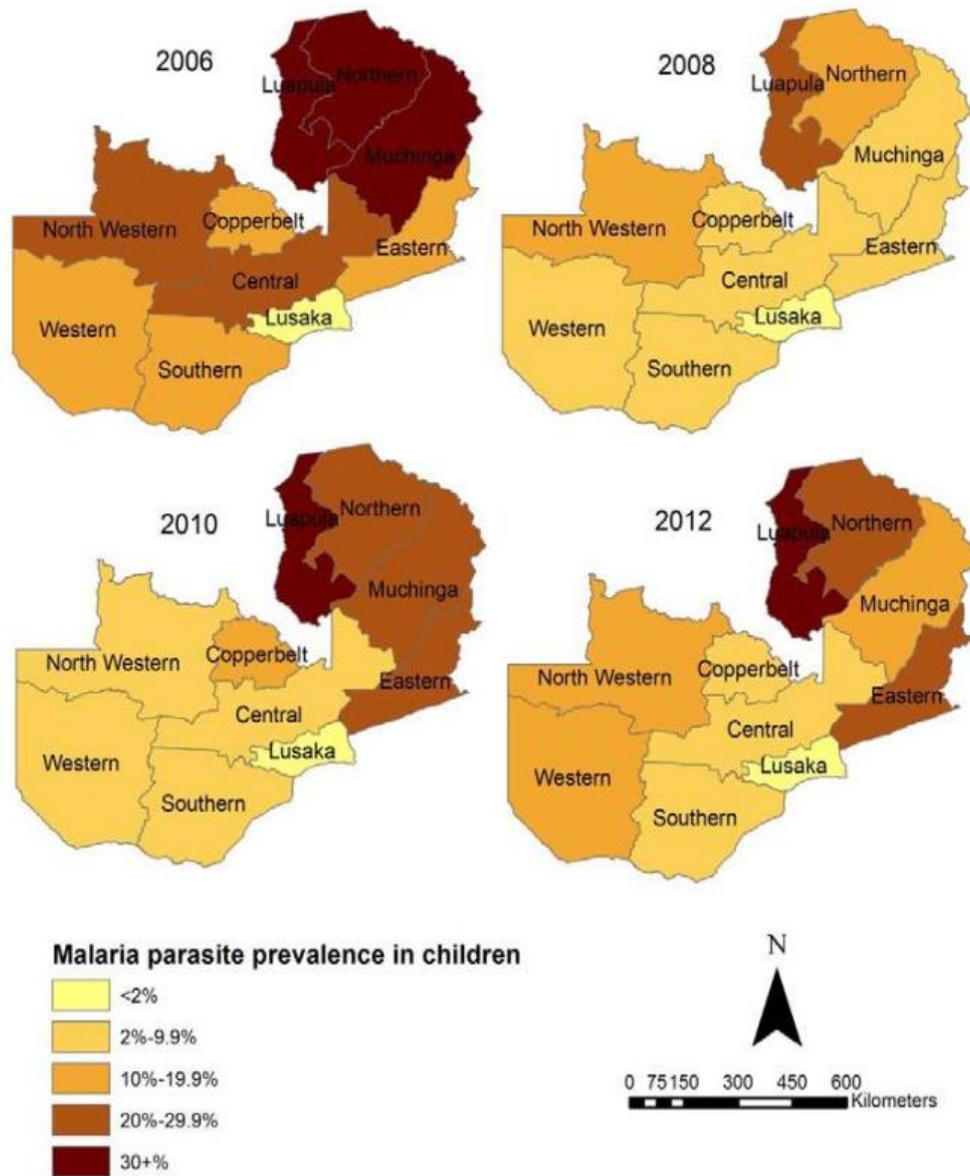


Table 2 shows a summary of the number of target structures and the target population in the 40 districts.

TABLE 2: TARGET STRUCTURES FOR 2014 IRS

Province	Number of Districts	Number of Target Structures	Target Population
Central	4	7,357	31,893
Eastern	9	193,298	837,947
Luapula	11	118,374	513,151
Muchinga	7	45,200	195,942

Northern	9	107,771	467,187
Total	40	472,000	2,046,120

2.3 DISTRICT PLANNING MEETINGS

Following the choice of the target districts in the five provinces, collaboration and coordination between stakeholders was intensified. Micro-planning meetings with provincial and district authorities were held in each of the five provinces from June- July 2014. In total, 125 participants attended micro-planning meetings in Chipata, Nakonde, Kasama, Mansa and Kabwe districts. In each of the provincial meetings, a three-day planning meeting was organized to discuss and develop an IRS operational plan with district teams. In addition, the roles and responsibilities of each of the positions on the district IRS operation structure were discussed and agreed upon. The issues discussed during the micro-planning meetings included:

- Target area selection and quantification of requirements;
- Community mobilization plan for IRS;
- Roles of various positions on the district operations chart;
- Supervision of IRS activities during the IRS operations; and
- Activity time-lines.

2.4 INSECTICIDE SELECTION

An organophosphate, pirimiphos-methyl (Actellic 300 CS), was used during the 2014 IRS campaign in the 40 districts. The selection was based on data obtained from insecticide susceptibility assays that were carried out in 2013 and 2014. The susceptibility assays showed that the predominant local vector species (i.e. *Anopheles gambiae* and *Anopheles funestus*) exhibited varying levels of susceptibility to the different classes of insecticides, but full susceptibility to organophosphates.

Zambia has a rigorous insecticide resistance management (IRM) structure that supports entomological studies on which selection of insecticide is based. The Insecticide Resistance Technical Advisory Committee (IRTAC) that comprises representatives from the Tropical Diseases Research Centre (TDR), the Macha Malaria Institute (MMI), the University of Liverpool, Johns Hopkins University, Centre for Disease Control, AIRS/PMI and the National Malaria Control Centre (NMCC) reviews the entomological studies that are carried out and makes recommendations to the Insecticide Resistance Management Technical working group that finally selects the insecticide of choice. For the 2014 IRS campaign, Actellic 300 CS was chosen for the whole country.

2.5 LOGISTICS NEEDS AND PROCUREMENT

In February, a team of at least three staff per province were sent to all of the PMI/DFID supported provinces to conduct a needs assessment. Data collection tools were used to capture the consumption data, number of personnel to participate in the campaign, PPE requirements per person for the entire spray period, stock on hand and the quantity that was needed to procure. The findings were discussed with all relevant stakeholders and documented.

AIRS Zambia made local and international procurements using an open tender process and collected bids/quotes for commodities to be purchased. With the help of the districts, the AIRS team established the number and type of vehicles required for each district based on number of personnel and the topography of the areas.

2.5.1 INTERNATIONAL PROCUREMENT

The list below shows the commodities that were procured internationally. These quantities were based on the number of spray operators and the balance brought forward from the 2013 spray campaign.

QTY	Description	Unit
33,282	Disposable respirators	Each
1,475	Helmet / Hard Hat	Each
1,491	Face shield / Visor (Universal)	Each
1,491	Face shield Bracket (Universal)	Each
147	Hudson Spray Pumps	Each
85	Goizper spray pumps	Each
1,524	Hudson Nozzles (8002)	Each
130,211	Organophosphates (Actellic 300 CS)	Bottle

Since the Goizper spray pump was used for the first time, there was keen interest to evaluate its performance. A small assessment from the field revealed the following:

- There weren't frequent blockages
- The pump was easy to handle because of its weight and double slings
- Women were more comfortable in handling the pump
- The pump did not require regular servicing

2.5.2 LOCAL PROCUREMENT

Lusaka office

Local procurements were done through open tendering and local shopping. Items such as protective clothing (gum boots, towels, and overalls), tooth brushes, soaps, plastic bags, and bags for spray operators were procured centrally and distributed to the districts. Procurement of services for processing payments for spray operators (SOPs) was also done centrally through a limited bidding process.

District level procurements

AIRS operates in 40 districts funded by PMI and DFID. Procurements that were done in close collaboration with the Lusaka office were transport services, food, operational site refurbishment, cascade training services and fuel. The districts collected quotations and submitted them to AIRS for processing. A total of 222 vendors were engaged in the 40 districts.

For all level of procurements, the selection was based on the lowest evaluated bidder. However in most cases, due to a limited number of established vendors in remote areas of operations, the selection was dependent on the situation in the given area.

The list below shows the items that were procured locally.

QTY	Description	Unit
2,542	Short gloves	Pair
2,072	Coveralls/Overalls	Each

10,000	Refuse Bags	Each
247	Plastic sheets	Roll
1,544	Face Towels	Each
1,539	Standard Towels	Each
400	Gum Boots	Each
2,910	Mutton Cloths	Each
1,086	Insecticide Carrier Bags (ICB)	Each
3,019	Stockings	Pair

Challenges and Recommendations

- There was late submission of the procurement requirements to the procurement unit by the districts. *Recommendation:* With the introduction of the position of District Coordinator (DC), it will be easier to coordinate all of the procurements in all of the districts.
- There were frequent changes regarding starting dates and logistic requirements by some of the districts. This resulted in rushed procurements, delays in the procurement process and sometimes the wrong items were procured. *Recommendation:* During the 2015 IRS campaign, the PMI AIRS program will work with all the provincial medical offices to ensure that everyone agrees with the spray campaign start date and they implement IRS in a uniform manner according to the implementation schedule. The program will also develop a standard work plan for all districts that will show the flow of activities and ensure that activities are implemented early.
- Lack of financial capacity by many vendors to provide services before AIRS could pay them an initial payment. *Recommendation:* In the 2015 IRS campaign, the PMI AIRS program will engage suppliers who are financially stable so that the initial work does not stall.
- Sometimes, the district health offices procured goods and services without prior approval from AIRS. *Recommendation:* With the introduction of the DC position, all procurements and logistics will be coordinated by this person.
- Lack of coordination among stakeholders at the district level. *Recommendation:* It is hoped that there will effective communication/coordination among key stakeholders in all districts by the PMI AIRS program through the DC.

2.5.3 MATERIAL DISTRIBUTION TO THE DISTRICTS AND OPERATION SITES

All of the insecticides for the 2014 spray campaign were received and stored at Central Medical Stores Limited (MSL) while the PPE was stored at the NMCC in Lusaka ready for distribution. The delayed insecticide shipment delayed the start of IRS. This forced AIRS to conduct IRS during the early part of the rainy season, especially in provinces that had an early onset of the rainy season, i.e. Luapula and Northern provinces.

2.5.4 SEASONAL STAFF HIRED

For the 2014 spray season, AIRS Zambia hired seasonal staff to help with the implementation of IRS in the target districts (see Table 3).

TABLE 3: NUMBER OF PERSONS HIRED

Categories of Persons Hired	Number of staff hired to deliver IRS										Total
			Spray Ops		Data Capture						
	M	F	M	F	M	F					
Spray Operators			707	353							1,060
Team Leaders			75	188							263
Data Entry Clerks					30	6					36
M&E Assistants					31	9					40
TOTAL M/F			782	541	61	15					1,399
TOTAL/hired			1,323		76						1,399

2.6 IRS TRAININGS

Prior to the commencement of IRS trainings, the NMCP reduced the number of training days with AIRS taking an active role in discussions and reviewing of materials. The time allocated to practical training was largely unaffected. The trainings materials covered the following key topics:

- Introduction to malaria control;
- IRS micro-planning, scheduling and logistics management;
- Spray techniques and processes;
- Environmental compliance and personal safety;
- Advocacy and social mobilization;
- IRS data collection; and
- Supervision of IRS activities.

2.6.1 TRAINING OF TRAINERS

The training of trainers (TOT) were organized and conducted in collaboration with the MOH/ NMCC and the MCDMCH in June and July. In order to increase the pool of trainers in the districts, two or three participants were trained in each district. A total of 98 (86 males and 12 females) supervisors were trained. The trainings were conducted by master trainers who have been developed over the years. The TOT is mainly aimed at training a cadre of environmental health staff to train spray operators in their districts. During the training, they covered methods of IRS training and supervision of spray operators and it consisted of both theory and practical sessions through group discussions, demonstrations, lectures, role playing and plenary sessions. The participants included district IRS managers and one or two supervisors for each of the 40 districts. After the TOT, the participants returned to their respective districts to conduct IRS training for SOPs and team leaders (TLs). The number of trainers used in each district was based on the number of participants to be trained and it was drawn from the pool of district trainers.

TABLE 4: NUMBER OF TOT PARTICIPANTS, BY GENDER

Support	Province	Number of Participants	Total
---------	----------	------------------------	-------

		Male	Female	
PMI	Eastern	20	2	22
	Muchinga	17	0	17
	Northern	19	4	23
DFID	Central	10	1	11
	Luapula	20	5	25
Total		86	12	98

FIGURE 3: IRS PRACTICAL TRAINING SESSIONS



2.6.2 CASCADE TRAINING

The SOP and TL training was organized and conducted in close collaboration with district and province officials for 10 days in September. In all of the 40 target districts, training sites were arranged by the district but they were paid by AIRS. The major objective of the training was to equip the SOPs and TLs with the skills to conduct quality IRS.

All of the SOPs and TLs were selected by the districts and they underwent a thorough medical examination in their respective district hospital to ensure that they were medically and physically fit to perform IRS activities. All female SOPs and TLs were also screened for pregnancy.

The selection criteria required to be a SOP or TL was:

- Physically and medically fit;
- Be 21 years or above in age;
- Be able to read and write;
- And residing in the district at the time of selection.

The SOPs and TLs were taken through an intensive 10-day theory and practical sessions which covered content in:

- Introduction to malaria control;
- Spray techniques;

- Handling and managing insecticides;
- Handling and maintaining spray pumps;
- Personal and environmental safety;
- Leading a spraying team;
- Data collection and filling out data collection forms; and
- Basics of IEC for IRS.

A total of 1,065 spray operators (707 males and 358 females) were trained and details are provided in Table 5.

TABLE 5: NUMBER OF SPRAY OPERATORS TRAINED TO IMPLEMENT IRS

Support	Province	Training Sites	Spray Operators		
			Male	Female	Total
PMI	Eastern	9	219	131	350
	Muchinga	7	113	37	150
	Northern	9	176	82	258
DFID	Central	4	38	10	48
	Luapula	11	161	98	259
Total		40	707	358	1,065

2.6.3 DATA COLLECTION TRAINING

The AIRS Zambia team, led by the two M&E Managers and the Database Manager, facilitated data collection training sessions during the TOT for IRS managers and supervisors. They also facilitated some of the data collection trainings for SOPS and TLs, and led the training for M&E assistants and data entry clerks, with short-term technical assistance support from the home office M&E Specialist. The training focused on the following key topics:

- Familiarity with data collection forms (SOP and TL forms, and the AIRS supervisory toolkit);
- Understanding key IRS definitions (e.g. eligible structure) and indicators;
- Supervisory roles and responsibilities;
- Reviewing collected data and spotting irregularities;
- Timely, consistent, and accurate reporting;
- Setting appropriate and realistic reporting timelines;
- Establishing a backup reporting/ communication protocols;
- AIRS database and security protocols; and
- Data quality assurance and control.

A total of 92 M&E field staff was trained; 52 data entry clerks (DECs) and 40 M&E assistants. Between October 2-8, 40 DECs and 40 M&E assistants were trained while an additional 12 DECs were trained from November 5-7.

2.6.4 LOGISTICS TRAINING

The IRS logistics standard operating procedure manual is available for use by all IRS commodity managers at different levels in the IRS supply chain. This manual is intended to guide the storekeepers and IRS managers in their day to day activities pertaining to IRS logistics. Forty (40) storekeepers were trained in the use of the IRS logistics standard operating procedures.

2.6.5 PROCUREMENT TRAINING

All staff involved in the procurement process in the 40 districts was trained during two days. Participants were trained in the following;

- Quantification of needs for procurements at the district level
- Procurement procedures for the IRS program in line with USAID requirements
- Evaluation of bids and the approval process/thresholds
- Contract management and the emphasis on fixed priced contract terms
- Explanation of what a conflict of interest is during the procurement process
- Certification of works, payment and submission of invoices to the Lusaka office for payments

Please see Table 6 for a full listing of seasonal staff trained in IRS support and implementation.

TABLE 6: NUMBER AND TYPE OF SEASONAL TRAININGS

Categories of Persons Trained	Training on IRS Delivery										Total	
	Training of Trainers		Spray Operations		Data Capture		Logistics Training		Poison Control/ Adverse Events			
	M	F	M	F	M	F	M	F	M	F		
IRS Managers	37	3										40
Supervisors (EHTs)	49	9										58
Spray Operators			707	358								1,065
Team Leaders			75	188								263
Data Entry Clerks					43	9						52
M&E Assistants					31	9						40
District storekeepers							15	25				40
Clinicians									19	15		34
TOTAL M/F	86	12	782	546	74	18	15	25	19	15		1,592
TOTAL/Training	98		1,328		92		40		34			

3. INFORMATION, EDUCATION, AND COMMUNICATION

To effectively sensitize the community so that people accept IRS, , AIRS Zambia worked in close collaboration with MOH/MCDMCH, the districts and Health Centre Committees (HCCs) to mobilize communities.

3.1 COMMUNITY MOBILIZATION

3.1.1 RECRUITMENT OF HCCs

The HCCs were recruited based on whether any part of their catchment area was targeted for spraying or not. A performance related contract was signed between the HCC from 299 recorded catchment areas and AIRS Zambia with a commitment to pay an initial down payment of 20%. If 85% of the targeted structures were sprayed then HCC were paid an agreed upon amount of money.

The main objective of recruiting HCCs was to strengthen community participation in IRS given the fact that they were already trained to do both IEC and mobilization and did not need more training. As they were community members, they also knew where the structures were to be found and had prior knowledge of other competing activities that could affect IRS coverage such as funerals and ‘Munada’ (market days).

3.1.2 ORIENTATION OF HCCs FOR IRS COMMUNITY MOBILIZATION

Despite a lack of need to train HCCs, it was however necessary to orient them on the key features that related to mobilization of communities towards IRS activities. This was done by respective IRS managers in each district and it was strengthened by the provincial coordinator of each province. Some of the key issues that were emphasized included the following:

- To explain the purpose of the IRS campaign to the communities;
- How to identify an eligible structures for IRS;
- To inform beneficiaries about the benefits of IRS;
- Explain the preparation of structures for spraying;
- How to dispel common myths and misconceptions about IRS;
- Explain instructions to the householders and do’s and don’ts after spraying;
- Ensure awareness of the program by involving and engaging other community stakeholders such as traditional and religious leaders.

3.2 DOOR-TO-DOOR MOBILIZATION

The plan was to conduct door-to-door mobilization of households because it is the most effective method of mobilization.. This was started at least two days before the spray teams moved into the community and continued up to the day of spraying. During this exercise, HCC members sensitized households on when a spraying team was scheduled to visit them, why it was important for them to participate and what they were required to do to prepare for the spraying activities. When the spraying teams arrived, they would then assist with the deployment of teams and they would lead them to the houses they had earlier visited. Some other members continued mobilizing more households until the final day of spraying in that community.

The door-to-door mobilization effort was done in collaboration with the Neighborhood Health Committees (NHCs). However, from a quick assessment that was done, it was clear that in most districts, there was lack of coordination between the districts and NHCs with regard to messaging and timing of the spray campaign in several catchment areas. Therefore, this resulted in a significant number of the targeted households who were not available at their homes at the time spray operators visited them.

3.3 MASS MEDIA COMMUNICATION

The Minister of Health launched the IRS spray campaign on national television and the radio. Radio and television spots were aired and televised during most days of the campaign. In the provinces, particular districts that have community radio stations aired radio spots while the Zambia News Information Services (ZNIS), who have a presence in all districts, provided public announcement systems about IRS spraying activities, which was coordinated by IRS managers with the support of the district health management teams (DHMTs). The radio spots that were used were developed by the NMCP for use in community radio stations.

While the ZNIS was supposed to provide public announcements to all target catchment areas, unfortunately this was limited to the catchment areas around the urban side of the districts because of long distances to some catchment areas in the districts. The information on IRS from the radio spots couldn't reach as many areas as planned because some catchment areas had no signal or had low radio signal strength. Even in the areas where the signal was good, some people were unable to access the information because they don't own radio or television sets.

4. IMPLEMENTATION OF IRS ACTIVITIES

IRS implementation was carried out over a 65-day period from October 13 to December 23. The start dates were staggered by district and therefore the end dates varied from district to district. Table 7 below shows the start and end dates of the spray campaign for each district.

TABLE 7: SPRAY START AND END DATES BY DISTRICT

Province	Districts	Spray Details		
		No. Spray days	Spray Start Date	Spray End Date
Eastern	Chadiza	29	27-Oct	13-Dec
	Chipata	38	13-Oct	06-Dec
	Katete	38	20-Oct	04-Dec
	Lundazi	40	20-Oct	13-Dec
	Mambwe	23	13-Oct	18-Dec
	Nyimba	31	13-Oct	22-Nov
	Petauke	40	20-Oct	13-Dec
	Sinda	15	27-Oct	20-Nov
	Vubwi	14	20-Oct	06-Nov
	Chama	27	27-Oct	18-Dec
Muchinga	Chinsali	13	3-Nov	20-Nov
	Isoka	15	27-Oct	04-Dec
	Mpika	23	27-Oct	12-Dec
	Mafinga	15	19-Nov	12-Dec
	Shiwang'andu	12	3-Nov	20-Nov
	Nakonde	23	28-Oct	17-Dec
Northern	Chilubi	30	22-Nov	23-Dec
	Kaputa	25	22-Oct	02-Dec
	Kasama	28	27-Oct	08-Dec
	Luwingu	21	27-Oct	08-Dec
	Mbala	23	10-Nov	16-Dec
	Mporokoso	19	27-Oct	08-Dec
	Mpulungu	18	13-Nov	06-Dec
	Mungwi	23	3-Nov	15-Dec
	Nsama	27	5-Nov	15-Dec
Luapula	Mansa	39	17-Oct	19-Dec
	Chembe	14	29-Oct	17-Nov
	Chipili	10	22-Oct	04-Nov
	Samfya	30	28-Oct	05-Dec

Province	Districts	Spray Details		
		No. Spray days	Spray Start Date	Spray End Date
	Lunga	8	23-Oct	03-Nov
	Mwense	30	20-Oct	06-Dec
	Kawambwa	27	21-Oct	22-Dec
	Mwansabombwe	20	30-Oct	05-Dec
	Nchelenge	31	20-Oct	09-Dec
	Chiengi	19	28-Oct	02-Dec
	Milenge	15	27-Oct	20-Dec
Central	Mkushi	9	18-Nov	08-Dec
	Luano	6	17-Nov	24-Nov
	Serenje	13	18-Oct	03-Nov
	Chitambo	7	18-Nov	26-Nov

4.1 IRS SUPERVISION

IRS supervision was conducted by teams from AIRS Zambia, MOH/MCDMCH at the central and provincial level, PMI, and the DHMT. Supervision of the spray operations was conducted at all levels. This was facilitated by the district IRS operations structure that was put in place:

- Each spray team was composed of five SOPs and was supervised by a team leader. In mSpray districts, each team was composed of three SOPs and was supervised by a team leader.
- Every three spray teams were under the supervision of a supervisor who reported to the government district IRS manager who reported to the DCMO. Spray activities of all the districts in a province were coordinated by a provincial coordinator who was a full-time AIRS staff member.
- During the spray campaign 7 consultants were engaged to support some districts that seemed to have had some supervision and administration challenges. These staff members coordinated supervision and routine daily administrative activities by working closely with district IRS managers and other government district staff. They were in the field at least six days every week. The provincial coordinator provided supportive supervision to the districts in the province of his responsibility.
- SOP performance was monitored using the performance tracker that was communicated on a daily basis by all districts to their provincial coordinator who in turn compiled and submitted the tracker for the province to the operations manager. This was further strengthened by the use of supervision checklists that assisted in assessing the performance of SOPs and TLs, tracked environmental compliance, and assessed the quality of data collection and entry.
- The DCMOs and their teams occasionally visited the field to supervise IRS activities. Moreover, AIRS Zambia also engaged DECAs and M&E assistants to facilitate data entry and follow up on M&E issues in the field. Regular meetings were held at all levels (national, district and sector) to review the progress of IRS and check on the implementation of recommendations reached during the operations.
- Supervisors and IRS managers met on a daily basis to review the daily progress and re-plan for the following day. When they had some difficulties or some serious concerns, they were communicated to the provincial coordinators immediately.

Challenges

- Dissemination of performance tracker results to the central level was a challenge because most IRS managers did not update the performance tracker regularly. In fact, in most cases, the tracker was not used to plan the next day's work. This was probably because some IRS managers did not understand the importance of the performance tracker and that data from the tracker should be sent to the central level diligently so that progress of the spray campaign could be followed on a daily basis.

Recommendation: The performance tracker will be introduced to the IRS managers at the Training of Trainers (TOT) as a tool for real time field data collection. IRS managers will be trained on how to update and send the performance tracker data to the central level on a daily basis.

- Most IRS managers did not use supervisory checklists consistently and correctly.

Recommendation: IRS managers will be trained on all aspects of supervision by the various AIRS units during the TOT.

- M&E assistants could not always visit the minimum number (30 structures) of structures that had been sprayed in the previous 2 to 3 days for verification purposes. This was due to transportation challenges at the district level as the few hired vehicles could not be used to service the M&E assistants due to time limitations.

Recommendation: During the 2105 IRS campaign, AIRS Zambia will plan and coordinate with the various districts on how resources on the ground could be best used so that sampled structures could be visited for data verification 2 days after the structures have been sprayed.

4.2 LOGISTICS

4.2.1 IRS STORAGE AND INSECTICIDE STOCK MANAGEMENT

Although orders for the insecticides were placed well in advance so that implementation of the IRS program could commence by 15th September 2015, the insecticides were not received until the last week of September 2015. This was due to shipment challenges at the ports of dispatch. This challenge necessitated the implementation start date to be moved to 13th October.

All insecticides were received and stored at MSL before they could be distributed to all of the districts. The logistics manager was in charge of managing stock at the central level and provided overall supervision for the 80 storekeepers under the program. Each district store was managed by two stores officers who are Government employees. Most of the districts had their own store rooms where all of the commodities were kept, however, there were a few districts, which used storage facilities that belonged to district councils and other well-wishers. In most cases, they were used for free. All the districts, including newly created ones, had some type of storage infrastructure that was managed by storekeepers trained by the AIRS program on management of IRS commodities.

All IRS commodities were stored according to the standard operating procedure for storage of IRS commodities. Inadequate storage space is the biggest challenge for some districts. To enhance tracking of the insecticide usage, the IRS Daily Insecticide Usage Register was in place to account for the quantity issued, quantity used, quantity returned, number of empty containers and the possible discrepancy.

4.2.2 IRS TRANSPORT SERVICES

Fifty eight (58) transporters were engaged to transport SOPs. A maximum of 3 vehicles were contracted for each district and most transporters provided two vehicles. Districts also provided additional vehicles to transport staff and AIRS contributed fuel.

4.3 IRS PAYMENT SERVICES

Two service providers were contracted to process payments for IRS spraying teams (SOPs and M&E staff). The districts prepared the pay sheets, registers and attendance sheets for verification and approval by the provincial coordinators. Once verified and approved, the excel pay sheets were forwarded to procurement to proceed with payment. The procurement staff verified the pay sheet for accuracy and then paid the vendors.

Cascade training allowances were processed based on pay sheets and then remitted to a paying firm. The implementation allowances were processed based on the estimated costs arising from the implementation quantifications.

5. POST-SEASON ACTIVITIES

5.1 POST-SPRAY REVIEW MEETINGS

IRS post-spray review meetings were conducted at the provincial level. The main purpose of the meetings was to:

- Review the overall 2014 IRS implementation, experiences and achievements; and
- Review IRS challenges in the 40 PMI-supported districts and come up with recommendations for the next spray cycle.

The IRS post-spray review meetings were convened by MCDMCH and MOH through the Provincial Medical Office (PMO) with support from AIRS.

The meetings were held in Chipata (Eastern Province), Mansa (Luapula and Central Provinces) and Mpika (Muchinga and Northern Provinces). They were held in the three respective towns to accommodate districts based on their geographical locations. Each meeting lasted two days and was held from February 5- 13, 2015. A summary of the number of people who attended the review meetings is shown in Table 8. Those who attended the meeting include officials from MCDMCH, MOH, PMO, DCMO, AIRS, Akros, and PMI.

TABLE 8: POST-SPRAY MEETING PARTICIPANTS

Province	Venue	Dates	No. of Participants		Total
			Male	Female	
Eastern	Chipata	Feb.5 - 6, 2015	22	2	24
Luapula & Central	Mansa	Feb.9 - 10, 2015	27	3	30
Northern & Muchinga	Mpika	Feb.12 - 13, 2015	34	3	37
Total					91

The following are the recommendations which came from the review meetings:

- Recruitment of DEC's and M&E assistants should be from the districts in which they will operate. The districts, through the DCMO, will recommend the persons based on the recruitment guidelines that will be provided by MCDMCH and MOH in collaboration with AIRS.
- IRS implementation should start as early as September. This means that planning for IRS should start earlier. IRS commodities should be distributed at least two weeks before implementation.
- All training materials should be ready in time for the TOT and cascade trainings.
- It was agreed that an IRS implementation manual/guideline outlining what is expected of the districts would ease procurement challenges that were experienced in 2014, should be produced and made available in time for the micro planning meetings.
- Communication to the districts should be through the District Coordinators (DCs) who are the

bridge between AIRS and the districts. This will lead to uniform communication and information between districts.

- Airtime should be provided to IRS managers, DECs, and chief environmental health officers to ease communication challenges. It was pointed out that reading emails is expensive at the district level and therefore, districts need support from AIRS.
- In mSpray districts, it was recommended that the districts should physically count the total number of structures per catchment area before targeting the structures for spraying. This problem arose after spray teams discovered that some structures that were targeted for spraying were not actually sprayable. Some were chicken houses.
- All stakeholders, AIRS, Akros and the district staff should coordinate IRS activities closely with PMO staff so that IRS activities are not disrupted without sufficient notice.
- The sensitization and community mobilization strategy should be well thought through. At the planning stage, districts should strategize how best sensitization and community mobilization should be carried out.
- The districts should consider procuring laptops for the districts to enable them to have continued access to IRS data. The districts should put this in their action plan and NMCP needs to support this.
- All trainings for IRS field staff should be done in the presence of IRS managers. This will reduce misunderstandings and will improve monitoring and supervision.
- All stakeholders should ensure they play their role of ensuring that payments to field staff and vendors are performed on time. Delayed payments causes frustration among field officers and vendors and makes vendors and spray operators mistrust district staff.

5.2 POST-SPRAY INVENTORY

In order to ensure safe and effective completion of the spray season, the AIRS team undertook post-spray compliance activities. All IRS materials and equipment, remaining insecticides, and insecticide-contaminated wastes were returned to the district warehouses. All equipment was tested to see if it functioned properly. Broken equipment will be repaired and unsalvageable equipment, like plastic sheets, will be discarded according to environmental compliance protocols. All remaining insecticides are currently stored according to instructions provided by PMI, MOH, MCDMCH, and the Zambia Environmental Management Agency (ZEMA) at the district warehouses. The quantity and functionality of all other IRS materials and equipment was checked and registered to help plan for the next spray season. All insecticide contaminated waste generated from operations was disposed of in ways compliant with environmental regulations using disposal facilities available in the district.

6. MONITORING AND EVALUATION

M&E for the 2014 IRS campaign followed the processes outlined in the 2014 AIRS Zambia Work Plan. The AIRS M&E approach incorporated successful aspects of the ZISSP M&E system and lessons learned from IRS M&E activities in other AIRS countries.

6.1 KEY OBJECTIVES

The key objectives of AIRS Zambia M&E activities were:

- To emphasize accuracy of both the data collection and the data entry process through comprehensive training and supervision at all levels;
- To streamline and standardize data flow, minimize error, and facilitate timely reporting;
- To ensure IRS data security and storage for future reference through the establishment and enforcement of proper protocols; and
- To document lessons learned and good practices observed in the implementation of the project activities and apply to future project years.

6.2 M&E SYSTEM DEVELOPMENT AND IMPLEMENTATION

The AIRS Zambia M&E system was drafted and defined before the start of IRS implementation to ensure the collection, management, and reporting of high-quality data. As noted above, the Zambia team adopted the AIRS M&E system but considered and incorporated the successful aspects of ZISSP's M&E system. The first step was to adapt the Daily SOP Form to include the indicators that AIRS reports, such as vulnerable populations (e.g. pregnant women and children under five years) and population protected, by gender. The M&E team comprehensively explained the revised SOP form during the TOT training to IRS managers and supervisors for the cascade training of SOPs. The SOP form served as the primary tool for data collection. To support data collection and entry and the supervision of both, AIRS hired two staff to fill the M&E assistant and DEC positions respectively, in each of the 40 districts. AIRS Zambia also utilized the Client Technology Center (CTC) located at the Abt home office and used the AIRS database which served as a tool for implementation and management to track key performance and output indicators. M&E and senior technical AIRS staff also used the database to generate “real-time” reports for quick feedback and to reconcile and prevent additional errors in data collection and entry.

Spray data was collected by SOPs, and verified by team leaders, supervisors, and M&E assistants. The M&E assistants handed over the forms to the data centers for entry. Data entry clerks (DECs) performed a final verification of spray data and manual arithmetic before updating the database. At the end of each day, the M&E team reviewed the data entry progress for all the districts and gave an update to the Home Office via email. The M&E team reviewed data entered for errors and addressed issues with DECs immediately. For quality control purposes and timely generation of weekly client spray progress reports, all data was expected to be delivered and entered within 48 hours of spraying. However, in most instances, data was not entered or synced within 48 hours due to several reasons that included:

- DEC poor/slow performance, staff turnover, and laptop software glitches

- Prolonged unavailability of power in some districts
- Frequent internet outage by some mobile carriers in some districts
- DECAs would be assigned other duties by the district, i.e. during health week, and would not be able to enter data during this period
- SOPs would sometimes camp when spraying in far flung areas and in such instances DECAs would either go camping with SOPs and enter data but not sync or would wait until SOPs were back to base

Daily SOP Forms were filed in binders according to spray date and team number at the data centers. A daily electronic back-up of spray data was created onto each computer hard disk and also to an external hard drive for data safety and storage.

6.3 MSPRAY IMPLEMENTATION

AIRS Zambia in collaboration with Akros implemented the mSpray tool in seven districts in Luapula province for data collection and management. The mSpray platform is a cloud-based data recording and management system that allows spray personnel to electronically collect spray data and GPS coordinates by mobile phone or tablet. Data was submitted to a shared project folder or cloud for immediate viewing of spray campaign progress. We list below the key features of the mSpray tool for data collection and management:

- Data captured directly on mobile forms that are loaded onto a smartphone or tablet
- Pre-programmed data entry controls on mobile devices to reduce illogical data errors
- Real-time data availability via a shared, cloud-based monitoring and reporting platform to immediately address campaign challenges and improve spray progress

6.3.1 LESSONS LEARNED AND RECOMMENDATIONS

- Using WhatsApp messenger enabled the supervisors and TLs to send screenshots of target areas to team members who were experiencing low internet connectivity. In addition, WhatsApp was also used to send group messages to keep the team up-to-date.
- Two out of 7 mspray districts had either limited or no power and the team had to use generators to charge tablets.
- Using mSpray maps to determine spray coverage and plan the next target areas proved to be of **tremendous** help to the IRS managers during the IRS operation:
 - mSpray enabled IRS managers/supervisors to verify the actual point of data collection through its map feature.
 - mSpray is able to map field IRS activities to a visualization tool that provides near real time feedback on spray outcome. IRS managers are able to make near real time strategic decisions on the use of resources based on coverage achieved.
 - The high quality enumeration data generated from mSpray provides total information on number of structures, estimated sprayable surface area and location of each and every structure.
 - mSpray is capable of identifying appropriate IRS target areas using a quantifiable scientific approach utilizing a range of variables e.g. malaria incidence, environmental factors, population density etc. This process is systematic, structured and reproducible.

- GPS coordinates were not collected in some areas due to a poor GPS signal.
- Users were not using the Locate Me function on Smartphones because it does not provide an accurate location.
- Duplicate IRS sticker numbers were recorded due to: data entry error, re-entry, actual duplicate numbers, etc.
- Some TLs were entering the wrong target area, hence data was not updated on mSpray.
- Target areas were not based on village names. As a result, some villages were divided into targeted and non-targeted areas.
- mSpray used the Google Maps GPS function to accurately pinpoint location. Offline maps should also be added.
- AIRs should redesign the IRS Sticker to have a peel-out mini sticker for the SOP form. Add a feature on mSpray to capture the IRS sticker number by using its camera.
- The next mSpray implementation should use offline maps and add a “Navigate to” location feature.
- The next mSpray implementation should use village names from the previous spray campaign to ensure an entire village is targeted rather than parts of it.

6.4 DATA QUALITY ASSURANCE AND CONTROL

During the 2014 spray season, AIRS Zambia used the AIRS M&E Supervisory Toolkit, which consists of the following two tools to standardize and improve data collection:

- Error Eliminator (EE) forms to verify the completeness and correctness of spray data collected in the field. The EE facilitates a systematic review of the SOP forms and easily exposes common errors for correction by supervisors at various levels. During the spray campaign, the EE was completed daily by team leaders for 100% of their SOPs, and by IRS managers and supervisors as well as AIRS senior staff visiting the districts.

A review of the implementation data revealed that IRS Managers reviewed less than 5 SOP forms with EE per week and that M&E team reviewed about 15 SOP forms per week while all the other AIRS staff reviewed about 2 SOP forms per week using the EE form.

- Data Collection Verification (DCV) forms check the accuracy of data collected in the field. M&E assistants and supervisors used the DCV form to ensure that the data recorded on the Daily Spray Operator Forms matched the information reported by households.

A review of the implementation data revealed that M&E assistants averaged about 15 structures that they verified using the DCV form, while AIRS staff verified an average of 10 structures using the DCV form, during the time that they were in the field. The M&E assistants were usually faced with transportation challenges and were frequently unable to visit sprayed structures in far flung areas 2 to 3 days after the structures had been sprayed.

6.4.1 PHYSICAL DATA VERIFICATION

Physical data verification was performed at three different levels:

- Team Leader Level: 100% of spray data collected on SOP forms were reviewed, arithmetically verified.
- District Level: supervisors and IRS managers performed random checks.

- Data Entry Level: Data clerks reviewed each form (100%) for typos and transcription errors, and verified the arithmetic before entering the data into the database.

Additionally AIRS and MOH staff performed random data verification as they visited the various districts.

6.4.2 DATABASE QUALITY CONTROL

AIRS Zambia used the Access database programmed audit checks and data locks to reduce the number of data entry errors. AIRS Zambia also used the IRS Reporter (cleaning/reporting) tool to help data clerks clean and reconcile data. Additionally, AIRS Zambia required DECAs to enter data in two ways: 1) by spray “Totals” or a summary of each Daily SOP Form in order to produce “real-time” reporting of spray progress, and 2) by spray “Details” data (line-by-line or structure-by-structure) for more accurate data entry and high quality data. During data cleaning via the IRS Reporter, DECAs investigated and reconciled discrepancies between spray “Totals” and “Details” data for a final dataset reporting campaign results. Corrections were made to the paper spray forms and the database, where necessary.

6.4.3 RANDOM SPOT CHECKS

The M&E team performed daily data verification activities of the Access database to guarantee the quality of the data. They scanned the database and ran spray progress reports to identify progress and anomalies in data entry. In the event they found discrepancies between data collected and data entered that could not be reconciled at the data center, the M&E team contacted the field supervisor for clarification to resolve the issue.

M&E assistants conducted field checks by visiting villages previously sprayed a few days prior to randomly interview households on their spray status. They collected these data using the DCV form and compared them with data collected on the SOP forms. Any discrepancies were addressed and rectified with the appropriate AIRS staff.

6.5 IRS RESULTS

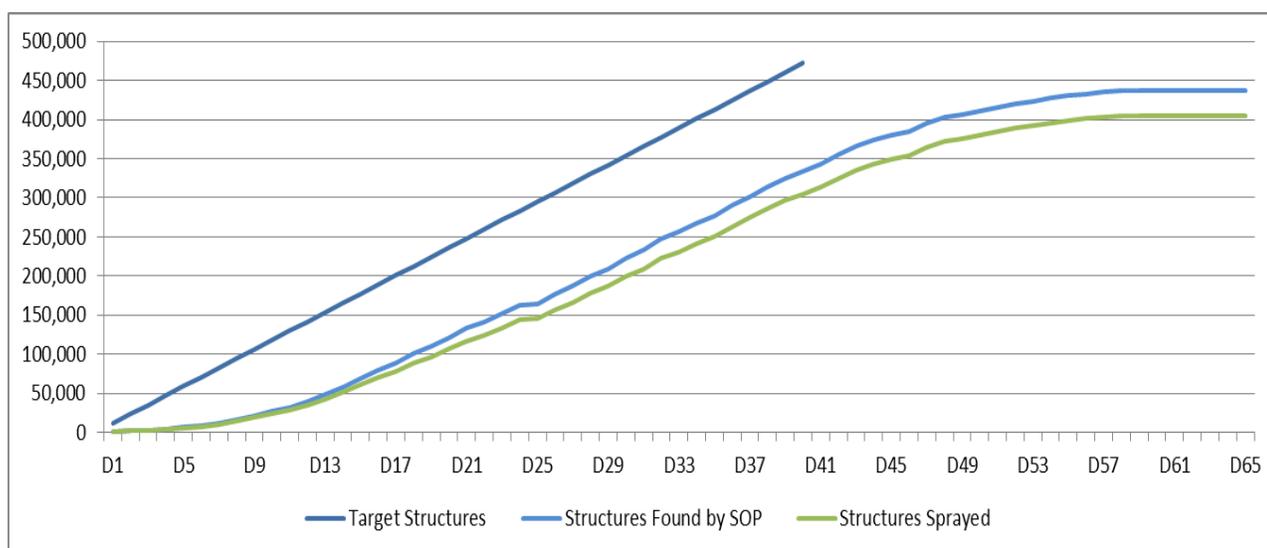
During the spray campaign, 409,544 structures of the 438,252 structures found were sprayed, resulting in 93.4% spray coverage. However, 5 districts, all from Luapula province, achieved less than 85% spray coverage. For more details, including spray coverage by catchment area, refer to Annex I. A total of 2,000,824 people were protected, including 60,978 pregnant women and 309,250 children under five years old (see Table 9).

TABLE 9: 2014 CAMPAIGN RESULTS

Support	Province	Districts	Total Structures Found	Total Structures Sprayed	Spray Coverage (%)	Total Population Protected			
						Male	Female	Pregnant Women	Children < 5 Years
PMI	Eastern	Chadiza	14,432	13,668	94.70%	25,666	25,487	1,233	8,547
		Chipata	35,497	33,057	93.10%	75,790	76,615	3,687	21,709
		Katete	28,527	26,075	91.40%	55,348	57,371	2,591	15,635
		Lundazi	22,396	22,120	98.80%	47,745	49,780	2,878	12,181
		Mambwe	8,759	8,066	92.10%	16,801	16,378	948	4,837
		Nyimba	12,509	11,136	89.00%	24,420	23,924	1,178	7,478
		Petauke	33,123	33,055	99.80%	71,719	73,110	4,642	22,720
		Sinda	6,004	5,796	96.50%	13,748	13,985	643	4,345
		Vubwi	5,238	4,856	92.70%	10,527	10,194	459	3,330
	Muchinga	Chama	15,646	14,648	93.60%	34,994	35,390	2,264	10,835
		Chinsali	6,080	6,042	99.40%	17,746	16,208	1,128	4,967
		Isoka	5,228	4,634	88.60%	10,136	9,963	706	3,429
		Mpika	10,565	9,599	90.90%	28,007	28,831	2,662	9,064
		Mafinga	5,723	5,471	95.60%	12,054	12,505	884	3,433
		Shiwang'andu	3,884	3,690	95.00%	9,986	9,147	712	2,799
		Nakonde	11,216	11,129	99.20%	30,054	28,528	2,495	9,876
	Northern	Chilubi	16,200	15,982	98.70%	42,880	42,471	3,554	15,555
		Kaputa	10,269	9,296	90.50%	24,464	22,734	2,055	8,055
		Kasama	19,090	18,507	96.90%	44,976	45,659	2,888	12,295
		Luwingu	10,748	10,375	96.50%	27,644	26,348	2,185	8,736
		Mbala	10,944	10,393	95.00%	26,656	25,922	1,488	9,211
		Mporokoso	10,018	9,453	94.40%	23,720	23,650	1,340	7,706
		Mpulungu	8,322	7,851	94.30%	22,046	21,745	2,004	8,237
		Mungwi	8,951	8,255	92.20%	21,665	20,336	1,029	6,194
Nsama		8,485	8,050	94.90%	22,255	21,270	1,897	7,007	
DFID	Luapula	Chembe	3,539	2,926	81.80%	7,491	7,653	290	2,596
		Chipili	2,065	1,873	90.60%	5,011	5,021	291	1,654
		Samfya	15,769	15,360	97.20%	42,817	44,996	2,924	13,452
		Lunga	1,357	1,347	99.30%	3,353	3,683	161	1,175
		Mansa	18,435	15,293	83.00%	38,497	40,200	1,725	12,430
		Mwense	14,618	13,860	94.80%	35,737	37,057	1,823	11,203
		Kawambwa	9,145	7,925	86.70%	20,625	20,901	768	6,701
		Mwansabombwe	4,310	3,628	84.20%	9,993	9,964	510	3,295
		Nchelenge	18,315	17,367	94.80%	46,532	46,191	2,338	13,632
		Chiengi	11,962	8,981	75.10%	23,625	23,368	1,332	7,766
	Milenge	2,898	2,375	82.00%	5,856	6,132	324	2,008	
Central	Mkushi	1,629	1,599	98.20%	3,714	3,432	177	1,074	

	Luano	1,006	953	94.70%	2,128	2,119	124	576
	Serenje	3,306	2,986	90.30%	8,187	7,712	330	1,897
	Chitambo	2,044	1,867	91.30%	5,246	4,985	311	1,610
Total	National	438,252	409,544	93.45%	2,000,824		60,978	309,250

FIGURE 3: IRS DAILY PERFORMANCE TRACKER



6.5.1 INSECTICIDE USAGE

The total number of bottles used during the 2014 campaign was 112,603. A total of 20,363 bottles were not used during the 2014 spray campaign season. On average, one bottle sprayed 3.64 structures (see Table 10). The average number of bottles used by a spray operator per day was 4, and each operator, on average, sprayed 14 structures per day in the 40 target districts.

TALBE 10: INSECTICIDE USAGE

Province	District	Structures Sprayed	Bottles Used	Avg Sprayed Structures per Bottle	Avg Bottles per SOP per Day	Structures Sprayed per Day per SOP
Eastern	Chadiza	13,668	3,043	4.49	3	14
	Chipata	33,057	7,475	4.42	4	17
	Katete	26,075	6,924	3.77	5	19
	Lundazi	22,120	6,029	3.67	4	15
	Mambwe	8,066	2,117	3.81	3	13
	Nyimba	11,136	2,328	4.78	3	12
	Petauke	33,055	10,190	3.24	6	19

Province	District	Structures Sprayed	Bottles Used	Avg Sprayed Structures per Bottle	Avg Bottles per SOP per Day	Structures Sprayed per Day per SOP
	Sinda	5,796	2,190	2.65	5	13
	Vubwi	4,856	804	6.04	3	17
Muchinga	Chama	14,648	2,913	5.03	2	11
	Chinsali	6,042	1,713	3.53	4	13
	Isoka	4,634	1,354	3.42	2	8
	Mpika	9,599	2,988	3.21	4	12
	Mafinga	5,471	1,195	4.58	4	16
	Shiwang'andu	3,690	953	3.87	4	17
	Nakonde	11,129	3,800	2.93	5	14
Northern	Chilubi	15,982	5,280	3.03	7	22
	Kaputa	9,296	3,482	2.67	5	12
	Kasama	18,507	7,244	2.55	7	18
	Luwingu	10,375	3,066	3.38	3	11
	Mbala	10,393	3,020	3.44	4	14
	Mporokoso	9,453	2,707	3.49	4	13
	Mpulungu	7,851	2,682	2.93	4	13
	Mungwi	8,255	2,769	2.98	4	11
	Nsama	8,050	3,312	2.43	6	14
Luapula	Chembe	2,926	761	3.84	3	10
	Chipili	1,873	327	5.73	2	10
	Samfya	15,360	2,762	5.56	3	18
	Lunga	1,347	256	5.26	3	13
	Mansa	15,293	4,025	3.80	3	12
	Mwense	13,860	4,710	2.94	5	15
	Kawambwa	7,925	1,784	4.44	2	10
	Mwansabombwe	3,628	672	5.40	2	11
	Nchelenge	17,367	2,676	6.49	2	14
	Chiengi	8,981	2,772	3.24	5	15
	Milenge	2,375	797	2.98	4	12
Central	Mkushi	1,599	338	4.73	3	12
	Luano	953	163	5.85	3	20
	Serenje	2,986	600	4.98	3	17
	Chitambo	1,867	382	4.89	4	18

Province	District	Structures Sprayed	Bottles Used	Avg Sprayed Structures per Bottle	Avg Bottles per SOP per Day	Structures Sprayed per Day per SOP
Total		409,544	112,603	3.64	4	14

Please see the M&E Plan Matrix in Annex 2 for a full list of project indicator targets and results.

7. ENVIRONMENTAL COMPLIANCE

Before the launch of the 2014 spray campaign in October, the ECO was principally responsible for conducting environmental compliance assessments and inspections to ascertain that all of the IRS operational sites in all districts met the minimum requirement. Mid-season inspections were also conducted during IRS operations to ensure that all operational related activities were conducted in a safe and environmentally sound manner through a holistic strategic approach with no adverse impacts on the community, SOPs and the environment. Soon after the IRS spray campaign came to an end, clean-up and waste disposal procedures were implemented in accordance with the PMI BMP as mandated by the Environmental Mitigation and Monitoring Plan (EMMP).

7.1.1 LETTER REPORT

AIRS Zambia prepared a country-wide Supplemental Environmental Assessment (SEA) in 2012 that covered all classes of insecticides, including organophosphates, which were used in the DFID and PMI-supported districts in the 2014 spray campaign. Therefore, the project was only required to prepare a Letter Report to address AIRS' preparedness for IRS in the 40 districts. The AIRS Zambia ECO submitted a Letter Report on July 16, 2014, two months before the start of the spray campaign. The letter report was submitted for informational purposes on July 16, 2014 and did not require concurrence.

7.2 PRE-SEASON ENVIRONMENTAL COMPLIANCE ASSESSMENT (PSECA)

In preparation for the 2014 spray season, the ECO and DCMO representatives identified facilities for the storage of pesticides, PPE, and other IRS commodities. Warehouses that did not meet all requirements were renovated to make them suitable. Four months before the commencement of spray activities in October, the ECO travelled to all of the district warehouses to assess any refurbishments that would be required to make these facilities suitable. The Pre-Season Environmental Compliance Assessment (PSECA) tool on the smart phone was used to assess warehouse capacity to store and handle pesticides according to the Food and Agriculture Organization (FAO) standards, as well as U.S. and the Zambia environmental regulations.

The PSECA tool was also used to assess all of the facilities at the operational sites including warehouses, soak pits, shower rooms, pit latrines, as well as wash bays. Based on the assessment findings, an implementation plan was prepared to address all EC issues that were generated in the checklist. Thereafter, responsibilities were assigned to respective individuals and the refurbishment process commenced immediately. The IRS base refurbishment was done by asking the district representatives to generate a bill of quantities for the works that were needed to be done and attach three quotations from three different vendors to the AIRS ECO and Procurement unit so that they could be analyzed and consolidated before materials could be procured.

A number of new soak pits were constructed whereas the already existing ones were renovated in accordance with the PMI BMP. The use of mobile soak pits was encouraged in areas that were hard to reach, where the distance between the primary soak pit and the spray site was too long.

7.2.1 PRE-SEASON ENVIRONMENTAL COMPLIANCE INSPECTION

After the implementation plan generated by the PSECA was completed, but prior to the launch of the spray campaign, the ECO revisited all IRS bases to confirm that the refurbishment process involving construction and/or renovations of warehouses and soak pits was conducted according to plan. This exercise also involved ensuring that the warehouses were ready to receive and safely store pesticides

and that soak pits were suitable for the environmentally responsible disposal of pesticide-contaminated liquid waste.

7.3 MEDICAL CLEARANCES

All SOPs received and needed to pass a medical examination prior to their engagement and in addition, female SOPs had to pass a pregnancy test. In the course of IRS operations, the ECOs carried out random physical inspections during morning mobilization to check for any SOP difficulties in breathing, fatigue, weakness, and alcohol intoxication etc.

7.4 INSECTICIDE ADVERSE EFFECT TRAINING

In order to orient clinicians to the possible toxic effects of insecticides and their management, two day trainings were conducted in the remaining 20 of the 40 IRS districts, with the objective of strengthening the skills of clinicians in the diagnosis and treatment of pesticide poisoning. The topics covered in the training included: mechanism of action, clinical presentation, and diagnosis and treatment of pesticide poisoning. The training was focused on specific IRS chemicals, namely organophosphates, as well as carbamates, pyrethroids and organochlorines.

A total of 34 participants attended the training from the 20 districts in five provinces of the country. The participants' knowledge was assessed before and after the course. The average score in the pre-course test was 56% with minimum and maximum scores of 25% and 85%, respectively. The post-course test scores improved to an average score of 84% with the lowest and highest scores of 49% and 100%, respectively.

Atropine, which is an antidote for insecticide poisoning, was readily available in all district hospitals as well as central medical stores.

7.5 MID-SEASON ENVIRONMENTAL INSPECTIONS

All AIRS staff and district supervisors were responsible for conducting daily inspections using AIRS EC tools. AIRS operations officers were each assigned a smart phone to use in administering electronic based supervisory checklists to monitor performance while the team from the District Community Medical Office were provided with paper based supervisory checklists which they submitted to the districts IRS managers at the end of the day. During the spray season four inspections were conducted on each spray day and these were morning mobilization and transport inspections, home owner preparation and SOP performance inspections, storekeeper performance inspections, and end of day clean up inspections.

7.5.1 MORNING MOBILIZATION AND TRANSPORT INSPECTIONS

This inspection was performed in the morning during the mobilization of SOPs to ensure that:

- All inventory safeguards and documentation requirements are adhered to;
- SOPs had their breakfast prior to putting on their PPE;
- SOPs put on their PPE properly prior to heading out to spray areas; and
- Vehicles used for transportation of operators or pesticides are roadworthy and properly outfitted for their task.

All SOPs and others who took part in the spray campaign were assigned full PPE which included coveralls, gloves, boots, helmets, face shields, and dust masks for use throughout the spray campaign. All

spray teams began their operations with a morning meal and then put on their PPE in readiness for operations.

In some districts transportation of SOPs and insecticides from the operational sites to the spray sites was done using trucks that were retrofitted with benches, tent and railings. In other districts, attempts to hire trucks retrofitted with benches and railings were futile as vendors were reluctant to participate in the bidding process. As such, two separate vehicles, a bus was hired to transport SOPs and a truck was hired to transport spray pumps. In those districts where only trucks were hired, SOPs sat on benches and placed their spray pumps placed between their legs while en route to the spray sites. Before contracts could be awarded to the vendors, all vehicles were inspected against the PMI BMP to ensure compliance with safety and environmental requirements. All the vehicles hired were equipped with spill management and first aid kits, material safety data sheets and accident/emergency procedures sheets.

In most districts, all of the morning activities were performed as stated in the BMP except a few lapses indicated below:

- TLs were not conducting random physical inspections.
- Some SOPs were eating when they had on their PPE.
- Not all pesticide and contaminated rinsed water was used up to fill SOP tanks which led to cake formation in drum one.
- Drivers were not wearing PPE even though they were provided with coveralls, boots and nose masks.

All of the above highlighted issues were carefully and safely handled by the AIRS staff who were conducting monitoring and supervision in order to ensure that PMI BMPs were adhered to.

7.5.2 HOME OWNER PREPARATION AND SOP PERFORMANCE INSPECTIONS

The main aim of this inspection is to ensure that SOPs are spraying structures that have been correctly prepared for spraying (inside and out) and that they are using correct spray and insecticide handling techniques. The EC team conducted inspections to ensure that SOPs and homeowners follow the prescribed procedures outlined in the PMI BMP. During this inspection, the AIRS EC team inspected the following:

- Use of PPE during spraying,
- Mixing of chemicals,
- Storekeeper performance,
- SOP performance,
- Fire extinguisher status
- Transportation of SOPs to various spray sites,
- Use of warning signs and first aid kits,
- Spill management

These inspections also involved the monitoring household preparation for spraying and interviewing homeowners to assess whether they were provided with adequate information on post-spray activities.

SOPs conducted their operations as they were taught during cascade training. The mixing of the chemical was done in the presence of the homeowners. Homeowners were well notified prior to the

actual spray day. However, in as much as almost all the activities were undertaken in accordance with what is described in the SOPs manual there were few lapses that were noticed and these were:

- Some residents refused IRS because they were not informed in advance
- Some residents refused IRS because they were not satisfied with the last spray campaign
- SOPs were not spraying at the correct speed
- Residents did not confine animals during and after spraying
- Residents in some districts were not informed of post-spray requirements
- SOPs operators did not check for leaks in the morning which led to pumps leaking while they were in the field
- SOPs, in some instances, did not spray all of the recommended surfaces
- SOPs did not observe the triple rinse procedure

In the next spray campaign, all of the above mentioned issues will be dealt with by providing sufficient training to the SOPs and providing homeowners with a leaflet highlighting the steps involved in preparing the structure for spraying, as well as post-spray activities during sensitization. This will enable homeowners to constantly remember what must be done before, during and after spraying.

7.5.3 STOREKEEPER PERFORMANCE INSPECTIONS

The aim of this inspection was to ensure that site storekeepers were following best warehousing practices and accounting for stocks and equipment. The following are some lapses that were observed during inspections:

- There was deficient stock record-keeping of the waste stock.
- The stock balance records of dust masks could not be reconciled.
- First aid boxes were not replenished with the required contents and as such, some first aid items were missing in the first aid box.
- Pregnancy test records were not available in the stores but at the laboratory where examinations were conducted.
- Some personnel were handling pesticides without appropriate PPE.
- Some storekeepers were not familiar with the symptoms of poisoning for the current pesticide being used.
- Some districts experienced improper stacking of chemicals (above 2 meters) as there was insufficient space in the store room.
- There was deficient record-keeping/ a poor filing system.
- In some instances, the personnel entered the pesticide storage area without proper PPE.

As the program was progressing, storekeeper performance improved and eventually all the above mentioned problems were rectified.

7.5.4 END OF DAY CLEANUP INSPECTIONS

The main aim of this inspection was to ensure that spray teams followed the correct EC procedures for cleaning equipment, accounting for insecticide stocks, and storing equipment for the next day. This inspection was conducted at operational sites at the end of the day when SOPs returned from the field.

The EC team carried out inspections of the sites to ensure that cleanup and waste disposal procedures, as mandated by the EMMP, are followed. During this inspection, AIRS staff closely monitored the use of seven rinse barrels during triple rinsing and made sure all effluent from the wash bay was drained into the soak pits. Soak pits together with wash bay were nicely fenced, gated and locked to block unauthorized entry into the premises. In some districts, a full shower by some SOPs was not possible because there wasn't an adequate water supply. However, the SOPs could at minimum, wash their faces and hands with soap before departure to their respective homes. Washing of overalls by the districts that had engaged washers was excellently executed as this did not put much pressure on SOPs. All wastes that were generated during the day were properly handled and packed in preparation for disposal at the end of the spray campaign.

Above all, during the IRS operations, the ECO provided regular supervision and oversight of the campaign. Specifically:

- Close monitoring of the use of PPE by spray operators and supervisors,
- The insecticide tracking system,
- Safety precautions followed by the SOPs in spraying houses to prevent residents' and environmental exposure to insecticides,
- Store management procedures, and
- Precautions followed around operational sites to prevent contamination of the environment.

What is listed below are some of the recurrent issues which were observed:

- Supervisors were not checking the SOP forms after the spray day.
- Rinse and/or waste drums were left uncovered overnight.
- In some districts, due to limited water supply, SOPs did not have a full shower but at a minimum, washed their hands and face with soap and water after removing PPE.
- TLs did not supervise the cleaning and wash-up which led to triple-rinse violations.
- SOPs in some districts did not continue to wear PPE on the way back to the operation site.
- Not all personnel in the wash area continued wearing full PPE.
- Spray pumps in some districts were not hung up to dry.
- In some districts, there was insufficient water for triple rinsing.
- PPE and spray pumps were not properly washed, especially those districts that did not engage washers.

The presence of the AIRS operations staff and ECO played a pivotal role in rectifying the above mentioned problems that were encountered. Districts experiencing insufficient water for the shower rooms as well as end of day clean up were resolved by providing water storage tanks where water can be stored for use during the IRS operations.

7.5.5 SPRAY DATA COLLECTION VERIFICATION (DCV) FORM INSPECTIONS

The aim of this inspection was to ensure that SOPs were capturing accurate spray data via their Daily SOP Forms. The following were some of the recurrent issues:

- SOPs were not posting blank stickers on unsprayed structures.
- SOPs were not accurately reporting data.

- TLs were not filling the EE form.
- In some districts, the insecticide tracking sheet was not completed daily.
- In some districts, supervisors were not checking spray forms after the end of spraying.

7.6 INCIDENTS

During the spray campaign, the project recorded accidents in the districts of Nchelenge, Luano, Mbala and Shiwang'andu. In Nchelenge, four SOPs were involved in road traffic accidents and sustained some injuries. In Luano, a SOP was hatched by a jealous husband when he found the SOP talking to his wife after spraying their house. In Mbala, a community mobilizer fell from a moving truck when it hit a pot hole and sustained injuries. In Shiwang'andu, during the transportation of SOPs from the field to the IRS base, chemical from the pressurized spray pump splashed into a female SOPs eyes after a charged spray pump accidentally sprinkled chemical through the valve due to increased pressure. The affected SOP had her eyes washed immediately and rushed to the hospital. Later on, it was discovered that her eyes were perfect and no permanent damage was caused. All SOPs were thereafter advised to empty all of the chemical in their spray pumps when coming from the field and/or depressurize the pumps before getting onto a vehicle. Finally, an M&E temporary worker died during the period of spraying, although the death was not linked to exposure to insecticide.

7.7 POST-SEASON ENVIRONMENTAL ASSESSMENT

All AIRS staff and the district representatives from the MCDMCH went out to the districts in the provinces to conduct a post-spray inventory and audits of all IRS commodities. The outcome of this exercise will serve as a benchmark in planning for the next spray season. All of the IRS commodities, including the chemical balance in stock, will be safely kept in the district storage facilities for use in the 2015 spray campaign.

7.7.1 CLOSURE OF STOREROOMS AND SOAK PITS

Closure of the IRS bases, specifically the storerooms and soak pits, was principally the responsibility of the ECO supported by the MCDMCH personnel from the respective districts. This was in order to ensure that all of the equipment that was in use during implementation was safely cleaned and kept in stores in readiness for use in the next spray campaign.

Store rooms were thoroughly washed with soap and water. The chemical stock in balance, other IRS commodities, as well as insecticide contaminated wastes, were clearly quantified, labeled and nicely packed. Insecticide contaminated materials are kept in the storehouses awaiting safe disposal in the presence of representatives from ZEMA and MCDMCH.

All soak pits were nicely covered and the gates were locked in order to prevent debris from getting in to the soak pit during the off season as it may adversely affect the effective functionality of a soak pit.

The fact that off spray season normally falls in rainy season a lot of vegetation (grass) during this period grows taller therefore, the ECO instructed the district personnel to conduct periodical grass cutting at specified time intervals (two to three weeks).

7.8 IRS WASTE DISPOSAL

The waste material generated from IRS operations usually falls into two categories, liquid and solid waste. IRS solid waste may further be categorized into three classes as paper, plastic and cloth.

Liquid Waste: These were effluents from the triple rinse process during end of day cleanup which was eventually discharged into the soak pit for safe disposal.

Solid Waste: As highlighted above, there were three categories of solid wastes that were generated during 2014 IRS operations. The three categories were then classified as shown in the table below:

TALBE 11: CATEGORIES OF INSECTICIDE CONTAMINATED WASTE

Plastic	Cloth	Paper
Empty bottles	Used nose masks	Empty Actellic carton boxes
Used plastic sheets	Mutton cloth	
PVC gloves & boots	Worn out overalls	

7.8.1 DETAILS OF EACH WASTE STREAM’S DISPOSAL

The details of each waste stream’s disposal for each category of insecticide contaminated wastes are outlined below:

- A. Liquid Waste:** this type of waste in IRS operations is normally generated during end of day clean up at the time of triple rinsing and it is therefore safely disposed of by means of discharging it into the soak pit.
- B. Solid Waste:** The three types of waste generated and were each disposed of as outlined below:
 - **Plastic:** This category of Solid Waste involved plastic sheets, PVC gloves and Gum Boots as well as empty Actellic bottles. Apart from empty Actellic bottles, all plastic wastes will be collected from other districts and taken to the provincial general hospitals for Incineration in presence of the MOH and ZEMA representatives. However, all empty Actellic bottles after being quantified will be collected from all the 40 district store rooms and transported to Lusaka for thorough washing, sorting and removal of labels as well as lids at Lusaka Cleansing Depot. Thereafter, these bottles will be shredded and made into bales in readiness for shipment to South Africa for recycling into non consumptive products such as Conduit Pipes, Sewer Pipes, fence poles, electric wire fence insulators, pavement blocks, plastic chairs, etc.
 - **Cloth:** Same with plastic materials, all worn out Coveralls, Nose Masks and Mutton clothes were also quantified and await to be incinerated at the main district hospitals in presence of representatives from ZEMA and MCDMCH.
 - **Paper:** This category of solid waste will as well need to be thoroughly incinerated at high temperature and ashes will be disposed of at the designated landfill.

8. CAPACITY BUILDING

In collaboration with MOH/MCDMCH, AIRS Zambia conducted five trainings between March and July to strengthen the skills and knowledge of stakeholders on IRS planning and implementation, logistics management and district management of IRS. The logistics management training was held for all

storekeepers in all of the 40 districts and the district management training was conducted for DCMOs and Provincial Medical Officers from Luapula, Central provinces and DCMOs from new districts from other provinces. The IRS planning and implementation training was handled through the micro-planning meetings that incorporated planning officers and IRS managers while further capacity on this was conducted through the TOTs for supervisors from all of the districts. At the provincial level and central levels, officers were included in the training and supervision teams. To strengthen training capacity, AIRS developed more master trainers to increase the pool of this cadre.

IRS implementation was conducted through the DHMTs in collaboration with the MOH as this promotes sustainability and local ownership of the spraying activities. The MOH/MCDMCH staff participated in the training of the SOPs which led to an active pool of district trainers being available at all times in the districts. In addition, training was conducted in the districts for clinicians in insecticide poisoning to ensure that possible insecticide poisoning can be attended to when and where it may occur.

9. ENTOMOLOGY

Entomological surveillance is an important factor in malaria control because it directly deals with the monitoring of the malaria vector in response to vector control interventions such as IRS and the distribution of LLINs. It is a key component for IRS programming, providing information on the impact of IRS on vector density and behavior in IRS spray areas. Entomological activities also assess the quality of the IRS operations, the decay rates of the insecticide applied, and the vector susceptibility to insecticides used for malaria vector control. AIRS Zambia is supporting the NMCC to generate data on key entomological indicators including:

- Malaria vector species identification
- Vector distribution and seasonality (vector density)
- Mosquito behavior
- Vector susceptibility to insecticides
- Quality assurance of IRS (decay of insecticide applied)
- Sporozoite rates, entomological inoculate rates (EIR) and parity rates

In 2014, the following activities were performed:

- Malaria vectors' susceptibility was assessed to WHOPEs approved insecticides using the WHO protocol in six sentinel sites (three in PMI districts and three in DFID districts).
- AIRS Zambia supported the continued functionality of the national insectary and laboratory through the procurement of a pre-fabricated structure, insectary equipment and salary support of insectary staff.
- AIRS Zambia performed malaria vectors sampling by CDC light trap and pyrethrum spray catch (PSC) in six sentinel sites.
- AIRS Zambia assessed the quality of spray and decay rate of the insecticide applied.

9.1 VECTOR SPECIES COMPOSITION AND DENSITIES

Mosquito collections were carried out on a monthly basis from six sentinel sites using CDC light traps and PSC except in Kasama, Milenge, Mwense and Serenje in December. Mosquitoes collected from Kasama, Katete and Isoka sites were identified to species. *Anopheles* adult vectors were identified to species using the Gilles & Coetzee 1987 identification key.

Prior to the beginning of the IRS campaign in September 2014, which is the dry season, AIRS collected baseline data using indoor CDC light traps and PSC in all sentinel sites. In Kasama, Katete and Isoka districts in September, a total of 416 mosquitoes were collected both from the control and spray sites. About 90% of mosquitoes (373) collected were Culicinae. Only 43 Anophelinae were collected of which 58% (23) were *An. funestus* s.l. and 11.6% were *An. gambiae* s.l. The other *Anopheles* species identified were *An. brunnipes* (2) and *An. squamosus* (2). Nine mosquitoes had their palps, legs and wings broken due to the mosquito's preservation and were unidentifiable. Blood digestion stage information was recorded only for 22 *An. gambiae* s.l. and *An. funestus* s.l. Around 12 (54.5 %) were found fed, seven were unfed, two were half gravid and one was gravid.

9.1.1 MOSQUITO DENSITY

A total of 1,108 mosquitoes were collected in all six sentinel sites from November to January. A total of 154 *Anopheles* mosquitoes were collected, 119 were identified to species, and 35 were not identified due to the palps, legs and wings being broken. AIRS will reinforce the supervision of proper entomological field techniques during the mosquito sampling to ensure that mosquitoes are collected and properly preserved. A total of 79 *An. funestus* s.l. and 12 *An. gambiae* s.l. were collected in treated sites and the control site. The other Anophelinae collected were *An. squamosus*, *An. brunnipes*, *An. tenebrosus*, and *An. distinctus*. A total of 63 malaria vectors were collected in the treated sites compared to 28 in the control sites. Table 12 below shows the Culicidae diversity per site.

TABLE 12: MOSQUITO DISTRIBUTION BY SPECIES COLLECTED BY PSC AND CDC LIGHTS TRAPS IN NOVEMBER, DECEMBER 2014 AND JANUARY 2015 IN THE 6 SENTINEL SITES

District	Village	Status	<i>An.funestus</i> s.l.	<i>An.gambiae</i> s.l.	Other Anophelinae	Total Anophelinae		Culicinae		Total	
			N	N	N	n	%	n	%	n	%
Kasama	Kalonga	Sprayed	28	2	1	31	33	64	67	95	100
	Nandola	Control	6	0	2	8	89	1	11	9	100
Katete	Mbalani	Sprayed	1	0	0	1	0.3	383	99.7	384	100
	Robert	Control	6	2	4	12	9.2	118	90.8	130	100
Isoka	Nsalamba	Sprayed	24	8	19	51	13.6	324	86.4	375	100
	Chilanga	Control	14	0	2	16	20	64	87.7	80	100
Total			79	12	28	119	11.1	954	88.9	1073	100

TABLE 13: AVERAGE DENSITY OF MALARIA VECTORS IN SITES WITH IRS AND IN CONTROL SITES IN NOVEMBER, DECEMBER 2014 AND JANUARY 2015

Month	District	Site	Status	Houses (N)	Total <i>An. gambiae</i> s.l.	Total <i>Anopheles funestus</i> s.l.	Average density/ House
November	Kasama	Kalonga	Sprayed	12	2	17	1.6
		Nandola	Control	12	0	5	0.4
	Katete	Mbalani	Sprayed	12	0	0	0.0
		Robert	Control	12	0	0	0.0
	Isoka	Nsalamba	Sprayed	12	0	0	0.0
		Chilanga	Control	12	0	0	0.0
December	Katete	Mbalani	Sprayed	12	0	0	0.0
		Robert	Control	12	0	0	0.0
	Isoka	Nsalamba	Sprayed	12	1	4	0.4
		Chilanga	Control	12	0	7	0.6
January	Kasama	Kalonga	Sprayed	12	0	11	0.9
		Nandola	Control	12	0	1	0.1
	Katete	Mbalani	Sprayed	12	0	1	0.1

		Robert	Control	12	2	6	0.7
	Isoka	Nsalamba	Sprayed	12	7	20	2.3
		Chilanga	Control	12	0	7	0.6
Total November- January	Kasama	Kalonga	Sprayed	24	2	28	1.3
		Nandola	Control	24	0	6	0.3
	Katete	Mbalani	Sprayed	36	0	1	0.0
		Robert	Control	36	2	6	0.2
	Isoka	Nsalamba	Sprayed	36	8	24	0.9
		Chilanga	Control	36	0	14	0.4

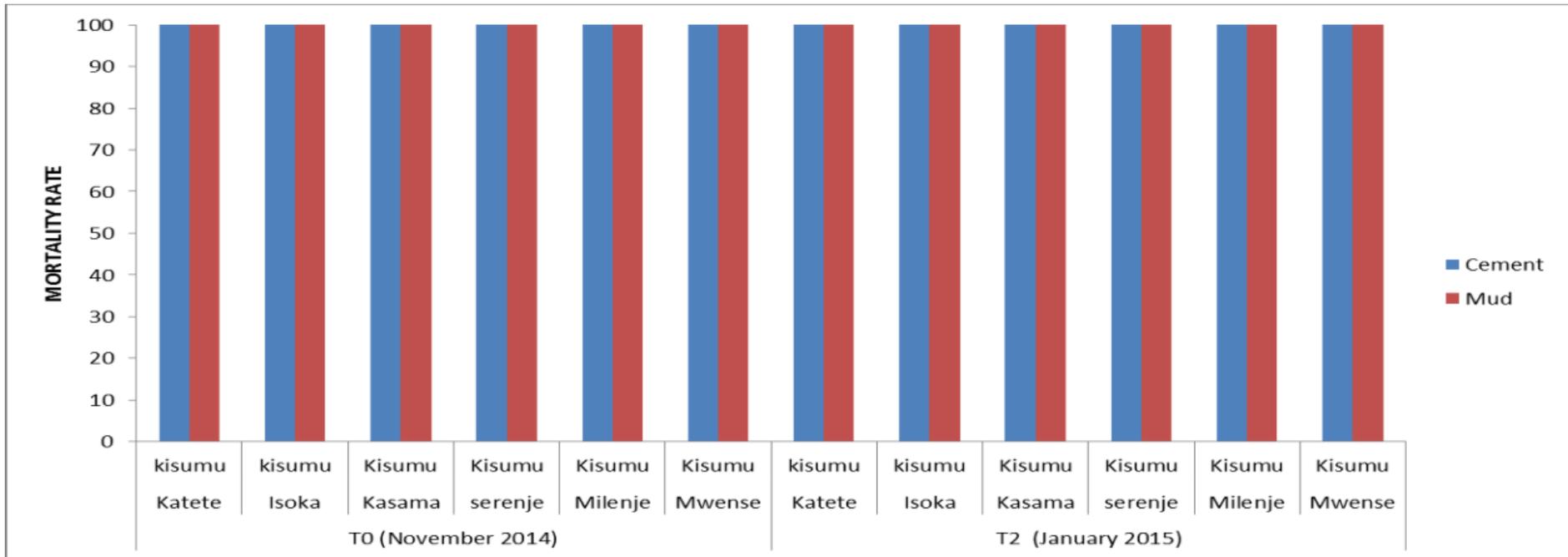
The mean density of malaria vectors in sites with IRS was 0.66 malaria vectors per room compared to 0.30 malaria vectors per room in the control sites. The vector density was generally low in both the intervention and control areas, and therefore it is difficult to make any generalizations from the data collected in the three areas.

9.2 QUALITY ASSURANCE OF IRS AND INSECTICIDE DECAY RATE

Cone bioassays were conducted in 36 sprayed houses in six districts. In each district, two types of houses were selected, three mud and three cement plastered structures. Two unsprayed structures, one mud and one cement were picked as controls.

The initial cone bioassay test was conducted 24 hours after houses were sprayed. Another test was done in January, two months after IRS, to determine the decay of insecticide applied on the walls. The numbers of mosquitoes knocked down after 30 minutes and 60 minutes and dead after 24 hours were recorded. For the control, the percentage of dead mosquitoes at the end of the test was less than 5% for all the tests, and Abbott's formula was not used. All susceptible mosquitoes exposed to the treated walls were killed in November showing that the SOPs applied the insecticide required to kill malaria vectors. Two months after the IRS campaign, the mortality rate of the susceptible strain was still 100% on both mud and cement walls.

FIGURE 5: PERCENT MORTALITY OF SUSCEPTIBLE STRAIN AFTER 30 MINS EXPOSURE TO PIRIMIPHOS-METHYL VIA WHO CONE BIOASSAYS AT T0 (48 HOURS AFTER IRS IN NOVEMBER) AND T2 (JANUARY/ TWO MONTHS AFTER IRS)



9.3 MALARIA VECTOR SUSCEPTIBILITY USING WHO BIOASSAYS

In 2014, adult indoor resting malaria vectors were collected through CDC backpack aspirators from 15 districts. The F0 mosquitoes were reared in the insectary and the F1s were used for susceptibility tests. At least one insecticide from each class was tested. Tables 14a, 15a, 16a, 17 and 14b, 15b and 16b below show the mortality rates of respectively *An. funestus* s.l. and *An. gambiae* s.l. for each province and each site after their exposure to the diagnostic insecticide concentration for one hour and after a 24 hour holding period.

An. funestus s.l. and *An.gambiae* s.l. were very susceptible to pirimiphos-methyl. A 100% mortality rate was recorded at all sites and in all times in 2014. However, the sample of mosquitoes tested for many sites was very small. Additional tests will be performed in February, March, April and May in 2015 during the rainy season, when more *An. funestus* s.l. and *Anopheles gambiae* s.l. are available. *An. funestus* s.l. was also susceptible to DDT at all sites.

Deltamethrin was tested at all sites in 2014. The results showed a high resistance of *An. funestus* s.l. to deltamethrin except in Mkushi district where the mortality rate was 100% in March 2014. Resistance to deltamethrin is suspected in Mungwi, Samfya and Isoka (Kampumbu site) where the mortality rate was 96%, 91.9% and 92%, respectively. Similar results were obtained with permethrin. Resistance of *An. funestus* s.l. to permethrin was observed at all sites except in Kasama district and Isoka where the mortality rates were 100% and 99.1%, respectively. *An. funestus* s.l. was resistant to bendiocarb at all sites except in Mansa (Mwa Nguni site) where resistance is suspected (the mortality was 97.5%, and according to WHO criteria this has been regarded as possible resistance). *An. gambiae* s.l. was resistant to deltamethrin and permethrin at all sites and at all times in 2014. The mosquitoes that survived will be tested by molecular assay for *kdr* mutation detection. The results showed also a resistance of *An. gambiae* s.l. to DDT at all sites except at Kaweme site in Kawambwa district (98%) and at Kateshi site in Mansa district (99.5%) where *An. gambiae* s.l. is susceptible to DDT. A resistance of *An. gambiae* s.l. to DDT is also suspected at Talayi site in Milenge district (92%), at Chipota site in Kawambwa district (91%), and in Mwense district (Kashiba, Mambilima and Mwa Nguni sites).

Most of the LLINs used for malaria control are impregnated with permethrin and deltamethrin. The resistance of *An. funestus* s.l., a major malaria vector in Zambia, to those insecticides is a big concern. The use of an insecticide from other classes for IRS is helpful for vector resistance management in Zambia.

An.gambiae s.l. is susceptible to bendiocarb (carbamate) in Samfya, Milenge (Chipe, lunga and Talayi sites) and Mwense (Chongo and Lubunda sites) districts.

TABLE 14A : SUSCEPTIBILITY STATUS OF AN. FUNESTUS S.L. IN CENTRAL AND EASTERN PROVINCES IN 2014

Province	District	DDT		Deltamethrin		Bendiocarb		Pirimiphos-Methyl		Permethrin	
		14-Jan-Apr		14-Jan-Apr		14-Jan-Apr		14-Jan-Apr		14-Jan-Apr	
		n	%M	N	%M	n	%M	n	%M	n	%M
Central	Mkushi	37	100	54	100	27	81.5	34	100	50	42
	Serenje (chibobo)	57	100	30	60	45	78	25	100	25	36
	Serenje (chipundu)			25	68	50	84	11	100	30	60
Eastern	Katete			44	22.7			12	100		
	Masaiti (Chishibambwe)							25	100		
	Masaiti (Kafukanya)							33	100		

TABLE 14B : SUSCEPTIBILITY STATUS OF AN. GAMBIAE S.L. IN CENTRAL AND COPPERBELT PROVINCES IN 2014

Province	District	DDT		Deltamethrin		Pirimiphos-Methyl	
		14-Jan-Mar		14-Jan-Mar		14-Jan-Mar	
		n	%M	n	%M	n	%M
Central	Serenje (chibobo)	25	86	25	51	50	100
	Serenje (chipundu)	25	82	25	49.1	139	100

Copperbelt	Masaiti (Chishibar)					10	100
	Masaiti (Kafukany)					8	100
	Masaiti (Shimutey)					68	100

TABLE 15A: SUSCEPTIBILITY STATUS OF AN. FUNESTUS S.L. IN NORTHERN PROVINCE IN 2014

Province	District	DDT		Deltamethrin				Bendiocarb		Pirimiphos methyl				Permethrin	
		14-Feb-April		14-Feb-April		14--Apr		14-Feb-April		14-Feb-April		14-Feb-April		14-Apr	
		n	%M	n	%M	n	%M	n	%M	n	%M	n	%M	n	%M
Northern	Kasama	40	100	92	9.7	104	34	99	78	65	100	103	77	113	100
	Mungwi			127	96			156	91	99	100				

TABLE 15B: SUSCEPTIBILITY STATUS OF AN. GAMBIAE S.L. IN NORTHERN AND MUCHINGA PROVINCES IN 2014

Province	District	DDT		Deltamethrin		Bendiocarb		Pirimiphos-Methyl	
		14-Mar-Apr		14-Mar-Apr		14-Mar-Apr		14-Mar-Apr	
		n	%M	n	%M	n	%M	n	%M
Northern	Kasama							62	100
	Mbala	40	32.5					97	100
	Mpulungu	80	23.8					69	100
	Mungwi					80	100	100	100

Muchinga	Chinsali							34	100
	Isoka							89	100

TABLE 16A: SUSCEPTIBILITY STATUS OF AN. FUNESTUS S.L. IN LUAPULA PROVINCE IN 2014

Province	District	DDT		Deltamethrin		Bendiocarb		Pirimiphos-Methyl		Permethrin	
		14-Feb-Mar		14-Feb-Mar		14-Feb-Mar		14-Feb-Mar		14-Feb-Mar	
		n	%M	n	%M	n	%M	n	%M	N	%M
Luapula	Chiengi (Mwabu kasenge)	25	100	76	53.9	69	88.4	40	100	45	23
	Chiengi (Mwengeswa)	25	100	74	48.9	64	76	89	100	69	27
	Kawambwa (chipota)	30	100	44	72	25	77	25	100		
	Kawambwa (Kaweme)	40	100	25	64	23	55	82	100		
	Mansa (Kateshi)	50	100	70	60			25	100	25	44
	Mansa (Mwa Nguni)	50	100	50	56	80	97.5	128	100	25	36
	Mansa (Nsenama)					50	92.5	50	100		
	Milenge (chipe)	75	100	92	58	100	75	107	100		

Milenge (Katena)	30	100	50	76	100	89	88	100		
Milenge (Lunga)	25	100	31	93.5	29	89.7	75	100		
Milenge (Talayi)	28	100	100	67	60	80	80	100		
Mwense (chongo)	72	100	93	90.3	45	84	15	100	72	21
Mwense (Kashiba)	25	100	58	67.2	73	68.5	90	100	50	32
Mwense (Lubunda)	87	100	100	69	97	64.9	97	100		
Mwense (Mambilima)	25	100	100	73	100	75	66	100		
Samfya (chilumba)	25	100					53	100		
Samfya (kantashya)	50	100	124	91.9	37	50	120	100	100	61
Samfya (Maximo)	48	100	100	83	60	85	46	100	100	67

TABLE 16B: SUSCEPTIBILITY STATUS OF AN. GAMBIAE S.L. IN LUAPULA PROVINCE IN 2014

Province	District	DDT		Deltamethrin		Bendiocarb		Pirimiphos-Methyl		Permethrin	
		14-Feb-March		14-Feb-March		14-Feb-March		14-Feb-March		14-Feb-March	
		n	%M	n	%M	n	%M	n	%M	n	%M

Luapula	Chiengi (Mwabu Kasenge)	25	15.5	75	41	25	92	25	100	25	38.4
	Chiengi(Mwengeswa)	16	18.8	100	65	95	96.8	109	100	82	14.6
	Samfya (Chilumba)			60	43.3			25	100		
	Samfya (Kantashya)	50	92	25	87.3	25	100	100	100	19	57.9
	Samfya (Maximo)	100	83	49	69.3	100	98	50	100	50	65.4
	Milenge (Katena)	100	88	69	69.6	100	97.2	50	100	24	54.2
	Milenge (chipe)	100	86	47	29.8	50	100	100	100		
	Milenge (Lunga)	37	70.3	50	71	25	100	128	100		
	Milenge (talayi)	52	92	100	50.8	25	100	82	100		
	Kawambwa (Chipota)	25	91	32	47	25	84	25	100		
	Kawambwa (Kaweme)	25	98	38	59	52	99	81	100		
	Mwense (Chongo)	100	87	97	35.1	24	100	108	100	72	20.7
	Mwense (Kashiba)	50	92	65	63	85	80	125	100	30	50
	Mwense (Lubumda)	60	90	44	72.5	100	98	100	100		
	Mwense (Mambilima)	100	96	40	70	51	82.3	72	100		
Mansa (Kateshi)	60	99.5	55	84.4			75	100	40	35	

Mansa (Mwa Nguni)	50	97	25	68	30	90	75	100	95	18.5
Mansa (Nsenama)					27	88.9	25	100		

TABLE 17: SUSCEPTIBILITY STATUS OF AN. FUNESTUS S.L. IN MUCHINGA PROVINCE IN 2014

Province	Districts	DDT		Deltamethrin		Bendiocarb		Pirimiphos methyl		Permethrin	
		14-Apr		14-Apr		14-Apr		14-Apr		14-Apr	
		n	%M	n	%M	n	%M	n	%M	n	%M
Muchinga	chinsali	32	100	52	58	45	67	46	100	23	83
	Isoka (Kampumbu)	50	100	46	92	42	80	42	100		
	Isoka (Malekani)	77	100	154	90	160	76	118	100	102	99.1

9.4 TRAINING

AIRS conducted a series of in-class and practical workshops to prepare cadres of district-level environmental health officers and human landing collectors to manage entomological data collection in the sentinel sites. In addition, the AIRS Benin Technical Manager traveled from Benin to train the insectary technicians, three environmental health officers and the entomological coordinator on the identification of adult *Anopheles* mosquitoes to species using the Gilles & Coetzee 1987 identification key, as well as ovary dissection for parity determination, in February 2015.

9.5 ENTOMOLOGY LABORATORY

PMI purchased and set up a modern prefab insectary at the NMCC. Through AIRS, PMI plans to furnish the insectary to facilitate its usage.

9.6 CHALLENGES

- Lack of enough equipment such as dissecting microscopes, CDC light trap batteries, back pack aspirator batteries for the six sentinel sites.
- Lack of adequate skills in the field activities and in areas such as morphological identification.

- Poor compliance by some household owners.
- Budget restrictions- prophylaxis for HLC.

10. CHALLENGES AND LESSONS LEARNED

10.1 CHALLENGES

The main challenges experienced during the IRS campaign included:

- In some districts, the rains disrupted IRS resulting in prolonged spray days. In 2015 the AIRS team will ensure that all districts start IRS operations early and almost at the same time.
- Failure to complete spraying within the projected days by some districts. With AIRS hiring District IRS Coordinators, it is hoped that there will be an improvement in the efficiency and therefore IRS operations will be completed in time.
- Competing activities at the district and in the communities such as child health week, farming, market days and caterpillar catching that led to occasional interruption of spray operations. Since AIRS will employ dedicated staff at the district level, it is hoped that IRS Managers will not be needed 100%.
- Some districts were not proactive in ensuring environmental compliance i.e. delayed construction of soak pits and wash rooms. Since AIRS will employ dedicated staff at the district level, it is hoped that IRS Managers will not be needed 100%.
- There was inadequate planning and coordination between spray teams and community mobilizers. AIRS will facilitate communication between the mobilizers and spray teams by providing mobile top up cards.
- Delayed payments for seasonal workers mainly due to delayed or incorrect documentation by the district office. Dedicated AIRS staff at district level will facilitate these payments
- Limited storage capacity at the Central Medical Stores. AIRS will endeavor to distribute all the IRS commodities to the district stores as soon as they are procured.
- Internet in availability in most rural districts. This affected syncing of data and efficient communication in the field. AIRS will procure mobile internet facilities depending on which service provider has the best facilities in the particular district.
- Difficulty in monitoring sentinel sites due to long distances between the sites and the central level laboratory. The program will facilitate logistic arrangements where mosquitoes are delivered to the central laboratory in the shortest period of time.
- In some districts, spray teams were required to camp in far flung catchment areas resulting in raised upkeep costs i.e. makeshift soak pits and government rate daily subsistence allowances. In 2015, Zambia AIRS team is proposing to operate at a sub-district level instead of district level.
- Inconsistent submission/dissemination of progress data by the district due to difficulty in collecting/aggregating data from the far flung spray communities, unavailability of internet service in rural areas, lack of reliable power in some districts, etc. AIRS will procure mobile internet facilities depending on which service provider has the best facilities in the particular district.

10.2 LESSONS LEARNED

- Engagement of health center committees at the operational site level in conducting social mobilization enhanced the acceptability of IRS and engagement of other local leaders, such as religious and traditional leaders should be explored.
- Early starting of spraying is critical to reduce the effects of competing activities; therefore, the start date should be in the first week of September.
- Early micro-planning with a specific timeline is necessary to ensure that all activities are scheduled in a way to permit a specific implementation start date.
- Adequate notice is required to ensure cooperation from the community, therefore to enhance community mobilization the HCCs should be engaged early and consideration of involvement of other local leaders should be explored.
- The use of the field tracking sheet enabled daily performance checks leading to early corrective measures.
- Districts need to own the IRS program.
- Storage of IRS commodities should be decentralized to the provincial level.
- Coordination among all the stakeholders should be enhanced.
- Dissemination of information to the communities on the importance of entomological activities should be improved.
- Potential transporters from other districts should be identified and their vehicles inspected early.
- Coordination between AIRS and the district procurement committee should be enhanced.
- Additional supervision is needed at the district level.

REFERENCES

1. Zambia National Malaria Indicator Survey 2012, Ministry of Health, Lusaka, Zambia
2. Zambia Census of Population and Housing, Population and Demographic Projections, Central Statistical Office, Lusaka, Zambia

ANNEX I: SPRAY COVERAGE BY CATCHMENT AREA

Province	Districts	Catchment Area	Structures Found by SOP	Structures Sprayed	Coverage
Central	Central		7985	7405	93%
	Chitambo	Chitambo	2,044	1,867	91%
		Chalilo	353	334	95%
		Chipundu	108	94	87%
		Chitambo	250	222	89%
		Gibson	868	796	92%
		Kafinda	38	38	100%
		Mpelembe	360	320	89%
		Mulaushi	37	36	97%
		Nakatambo (Missing on target list)	30	27	90%
	Luano	Luano	1,006	953	95%
		Chikupili	440	436	99%
		Mkushi Copper Mine	511	462	90%
		Old Mkushi (Missing on target list)	55	55	100%
	MuKushi	Mkushi	1,629	1,599	98%
		Munsakamba	1124	1097	98%
		Twatasha	505	502	99%
	Serenje	Serenje	3,306	2,986	90%
	Eastern	Eastern		166485	157829
Chadiz ^a		Chadiza	14,432	13,668	95%
		Bwanunkha	1909	1871	98%

Chipata	Chanida	2771	2553	92%
	Chanjowe	1734	1570	91%
	John	1801	1701	94%
	Miti	2900	2754	95%
	Nsadzu	3317	3219	97%
	Chipata	35,497	33,057	93%
	Champhande	1141	1065	93%
	Chikando/Chinunda	1140	1012	89%
	Chinyaku	404	384	95%
	Chiparamba	1486	1287	87%
	Chipungo/ Chipata	825	713	86%
	Chiwoko/ Eastern Command Military/Gondar	871	849	97%
	Chizenje	1310	1245	95%
	Jerusalem	830	820	99%
	Kadama/Katandala	981	923	94%
	Kamulaza	4767	4711	99%
	Kapara/ Kapata	503	457	91%
	Kasenengwa	2408	2305	96%
	Kasenga	718	608	85%
	Katondo	870	729	84%
	Kayeka/Makwe	869	822	95%
	Kwenje	1816	1798	99%
	Madzimawe/ Lunkwakwa	1623	1406	87%
	Madzimoyo	669	630	94%
	Mafuta	1309	1265	97%
Magwero	729	689	95%	
Mkanda/ Mchini	973	877	90%	
Mnoro	860	713	83%	

		Mnukwa	402	368	92%
		Mshawa/ Msekera	1409	1296	92%
		Muzeyi	2110	1865	88%
		Mwami	957	894	93%
		Rukuzye/Namseche	294	269	91%
		Samuel	1732	1717	99%
		Tamanda	715	607	85%
		Vizenge	776	733	94%
	Katete	Katete	28,527	26,075	91%
		Chibolya	967	692	72%
		Chimtende	6807	6490	95%
		Chindwale	1211	1163	96%
		Kafumbwe	3002	2831	94%
		Kagoro	3682	3513	95%
		Kakula	1363	1328	97%
		Kamiza	1908	1697	89%
		Kamphambe	579	573	99%
		Katete Boma	3512	2845	81%
		Mbinga	1707	1665	98%
		Mphangwe	641	514	80%
		Mtetezi ZNS	387	361	93%
		Nyembe	1776	1603	90%
	Undi	985	800	81%	
	Lundazi	Lundazi	22,396	22,120	99%
		Chanyalubwe	912	903	99%
		Chasera	1,239	1,236	100%
		Chijemu	1,410	1,401	99%
Chikomeni		755	749	99%	

		Hoya	1,419	1,417	100%
		Kamilenje	1,399	1,395	100%
		Kamsaro	1,303	1,303	100%
		Kanyanga	1,428	1,326	93%
		Kazembe	1,480	1,480	100%
		Khulikuli	1,042	1,032	99%
		Lundazi Urban/ / Lumezi	1,715	1,704	99%
		Malandula	1,710	1,697	99%
		Mankhaka	756	751	99%
		Munyukwa	1,381	1,371	99%
		Mwase Lundazi	2,933	2,846	97%
		Mwimba	895	891	100%
		Nyangwe/ Mwanya	619	618	100%
		Mambwe	Mambwe	8,759	8,066
	Chikowa		1,713	1,495	87%
	Chisengu		408	365	89%
	Jumbe Boma		1,328	1,149	87%
	Kamoto		763	658	86%
	Mphomwa		1,061	999	94%
	St. Lukes		3,486	3,400	98%
	Nyimba	Nyimba	12,509	11,136	89%
		Chimphanje	830	815	98%
		Chipembe	2831	2710	96%
		Mkopeka	1940	1844	95%
		Msima	1096	1073	98%
		Mtilizi	945	835	88%
		Nyimba/ HACH	3984	3018	76%
		ZNS	883	841	95%

	Petauke	Petauke	33,123	33,055	100%
		Chikuse	1,354	1,354	100%
		Chipungu	1,010	1,010	100%
		Chisenjere	2,405	2,405	100%
		Kalindawalo	4,367	4,366	100%
		Manyane	4,184	4,160	99%
		Miinga/ Miinga Mission	6,489	6,476	100%
		Msanzala/ Nyampodonlo	1,433	1,433	100%
		Mumbi	5,809	5,798	100%
		Mwanjawanthu	3,864	3,845	100%
		Petauke Urban	2,208	2,208	100%
	Sinda	Sinda	6,004	5,796	97%
		Chataika	390	378	97%
		Chilasa	211	208	99%
		Chimunsi	417	408	98%
		Kanjiwa	201	179	89%
		Kasamba	778	752	97%
		Mng'omba	868	854	98%
		Mthandaza	906	862	95%
		Mthunya	1,259	1,237	98%
		Nyanje HAHC	649	637	98%
Sinda		325	281	86%	
Vubwi	Vubwi	5,238	4,856	93%	
	Chikoma	1,765	1,498	85%	
	Mchenjeza	2,379	2,358	99%	
	Mlawe	1,094	1,000	91%	
Muchinga	Muchinga		58,342	55,213	95%
	Chama	Chama	15,646	14,648	94%

		Buli	973	950	98%
		Chama/ Kambombo	4,577	4,060	89%
		Chibale/ Kalovya	2,008	1,950	97%
		Chigoma/ Kambwili	1,079	1,074	100%
		Chikwa	2,043	1,875	92%
		Kapichilasenga	1,475	1,358	92%
		Lundu/ Nthonkho	1,214	1,175	97%
		Mwalala	985	939	95%
		Tembwe	1,292	1,267	98%
	Chinsali	Chinsali	6,080	6,042	99%
		Chinsali	174	172	99%
		Kalwala/ Location	2,334	2,333	100%
		Lubwa	753	737	98%
		Mulilansolo	1,677	1,676	100%
		Nkula/ Mundu	1,142	1,124	98%
	Isoka	Isoka	5,228	4,634	89%
		Kantenshya/Isoka	1,798	1,592	89%
		Kapililonga	2,266	1,972	87%
		Lualizi	1,164	1,070	92%
	Mafinga	Mafinga	5,723	5,471	96%
		Muyombe/Nachisitu	3407	3159	93%
		Thendere	2316	2312	100%
	Mpika	Mpika	10,565	9,599	91%
		Chalabesa	1216	1174	97%
		Chibansa	553	505	91%
		Chikakala	446	389	87%
		Chilonga	639	601	94%
Kaonda		412	365	89%	

		Kopa/Kasenga	810	717	89%
		Luchembe	1113	1038	93%
		Mpepo	898	775	86%
		Mpika	1662	1545	93%
		Mukungule	1031	965	94%
		Tazara Residential	1226	1036	85%
		ZCA	393	330	84%
		ZNS Mpika	166	159	96%
	Nakonda	Nakonde	11,216	11,129	99%
		Mayembe	880	880	100%
		Mwene Chanka	963	963	100%
		Mwenzu	2,271	2,236	98%
		Nakonde	1,813	1,768	98%
		Nawaitwika	2,212	2,205	100%
		Shem	3,077	3,077	100%
Shiwangandu	Shiwangandu	3,884	3,690	95%	
	Ilondola	1,011	988	98%	
	Matumbo	976	892	91%	
	Mulanga	735	668	91%	
	Mwika	1,162	1,142	98%	
Nothern	Northern		103,027	98,162	95%
	Chilubi	Chilubi	16,200	15,982	99%
		Chaba	3,498	3,454	99%
		Chilubi	4,680	4,676	100%
		Kawena HP	747	747	100%
		Matipa	2,149	2,040	95%
		Mofu	981	926	94%
		Nsumbu RHC	2,848	2,842	100%

		Santa Maria RHC	1,297	1,297	100%
Kaputa		Kaputa	10,269	9,296	91%
		Kalaba/Kafwimbi	1,445	1,391	96%
		Kapepula	186	167	90%
		Kaputa/Kaputa Rural	5,567	4,820	87%
		Kasongole/Mukupa Katandula/Nkoshu	3,071	2,918	95%
Kasama		Kasama	19,090	18,507	97%
		Army clinic/ Police Clinic	2,537	2,402	95%
		Chilubula/ Chilongoshi	1,621	1,577	97%
		Chisanga	1,812	1,596	88%
		Chishimba ZNS/ ZNS Chishimba	395	393	99%
		College	1,664	1,531	92%
		Kateshi	363	350	96%
		Lukashya	478	461	96%
		Lukupu	1,898	1,881	99%
		Milima	1,176	1,174	100%
		Misamfu/ Misengo	296	296	100%
		Mulenga Hill	1,393	1,393	100%
		Musa	2,423	2,420	100%
		Tazara	3,034	3,033	100%
Luwingu		Luwingu	10,748	10,375	97%
		Chikoyi	2,732	2,603	95%
		Chungu/ Ipusukilo	996	987	99%
		Luena	1,295	1,257	97%
		Namukolo	2,340	2,196	94%
		Nsombo	1,664	1,637	98%
		Tungati	1,721	1,695	98%
Mbala		Mbala	10,944	10,393	95%

		Chisanza	555	555	100%
		Chozi Tazara	892	885	99%
		Kaseshya	855	788	92%
		Mbala	299	271	91%
		Mpande	739	699	95%
		Nondo	1,340	1,295	97%
		Senga	854	824	96%
		Sumbi	323	314	97%
		Tanzuka/ Maule	363	352	97%
		Tulemane	3,406	3,213	94%
		ZAF	704	630	89%
		ZNS	614	567	92%
	Mporokoso	Mporokoso	10,018	9,453	94%
		Chishamwamba	1,383	1,354	98%
		Chitoshi	1,339	1,301	97%
		Chiwala	608	604	99%
			723	720	100%
		Kapatu	530	525	99%
			23	23	100%
		Mukolwe	445	395	89%
		Mukupu Kaoma	1,405	1,321	94%
		Mulenga Mapesa	247	240	97%
		Shibwalya Kapila/Njalamimba	1,060	1,059	100%
		Township Clinic	2,255	1,911	85%
	Mpulungu	Mpulungu	8,322	7,851	94%
		Isoko	1,674	1,560	93%
		Kaizya/Vyamba	2,387	2,282	96%
		Kasakalawe/Iyendwe	1,218	1,022	84%

Luapula		Mpulungu/Kopeka	3,043	2,987	98%	
	Mungwi	Mungwi	8,951	8,255	92%	
		Chimba/Chifulo	1,484	1,454	98%	
		Chitimukulu/Kapolyo	780	706	91%	
		Malole	1,353	1,283	95%	
		Mungwi/Mumba	2,178	1,788	82%	
		Ndasa	1,488	1,453	98%	
		Nseluka	1,668	1,571	94%	
		Nsama	Nsama	8,485	8,050	95%
	Chishela		1,183	1,125	95%	
	Kakoma		848	833	98%	
	Kampinda		2,039	1,886	92%	
	Mwewe		1,288	1,220	95%	
	Nsama		1,265	1,166	92%	
	Nsumbu		1,862	1,820	98%	
	Luapula			102,413	90,935	89%
	Chiengi	Chienge	11,962	8,981	75%	
		Chipungu RHC	645	302	47%	
		Kabwe RHC	713	443	62%	
		Kalembwe RHC	2,160	1,296	60%	
		Mukunta RHC	2,244	1,555	69%	
		Mwabu RHC	510	200	39%	
		Not in mSpray	2,617	2,585	99%	
Sambula RHC		3,073	2,600	85%		
Kawambwa				87%		

		9,145	7,925	
	Chama RHC	1,253	1,210	97%
	Chibote RHC	708	701	99%
	Chimpempe RHC	94	80	85%
	Chitondo RHC	412	381	92%
	Kabanda RHC	344	310	90%
	Kabila RHC	628	586	93%
	Kawambwa HAHC	303	172	57%
	KTC RHC	915	706	77%
	Munkanta RHC	2,226	1,625	73%
	Mushota Zonal RHC	1,814	1,719	95%
	Muyembe RHC	446	433	97%
	Not in mSpray	2	2	100%
	Mansa	18,435	15,293	83%
	Buntungwa UHC	2,566	2,386	93%
	Central UHC	7,477	6,147	82%
	Chisembe RHC	516	436	84%
	Kabunda RHC	689	513	74%
	Kalyongo RHC	502	450	90%
	Mabumba RHC	1,680	1,581	94%

		Mantumbusa RHC	757	688	91%
		Mibenge RHC	532	512	96%
		Mutiti RHC	297	221	74%
		Muwanguni RHC	427	366	86%
		Not in mSpray	334	255	76%
		Senama UHC	2,658	1,738	65%
	Milenge	Milenge	2,898	2,375	82%
		East 7 RHC	477	288	60%
		Kabange RHC	117	100	85%
		Kapalala RHC	40	32	80%
		Lwela RHC	1,334	1,152	86%
		Mulumbi RHC	460	420	91%
		Sokontwe RHC	470	383	81%
	Mwansabombwe	Mwansabombwe	4,310	3,628	84%
		Chipunka RHC	920	764	83%
		Kazembe Zonal RHC	433	418	97%
		Lufubu RHC	107	88	82%
		Mbereshi RHC	567	467	82%
		Mukamba RHC	922	901	98%
		Salanga RHC			73%

			1,361	990	
Mwense	Mwense		14,618	13,860	95%
	Kashiba RHC		2,438	2,364	97%
	Kawama RHC		1,647	1,499	91%
	Lubunda RHC		1,382	1,326	96%
	Lukwesa RHC		2,864	2,739	96%
	Mambilima RHC		1,628	1,566	96%
	Mununshi RHC		644	584	91%
	Musangu RHC		2,303	2,254	98%
	Musonda RHC		46	40	87%
	Mwense RHC		1,666	1,488	89%
Nchelenge	Nchelenge		18,315	17,367	95%
	Chabilikila RHC		486	433	89%
	Kabalenga RHC		826	758	92%
	Kabuta RHC		3,851	3,195	83%
	Kambwali RHC		1,160	1,159	100%
	Kapambwe HP		397	386	97%
	Kashikishi HAHC		5,020	4,934	98%
	Mulwe HP		1,367	1,341	98%
	Nchelenge RHC		5,208	5,161	99%

	Chembe	Chembe	3,581	2,926	82%	
		Chembe	2135	1613	76%	
		Chipete	377	373	99%	
		Kasomalwela	253	213	84%	
		Kundamfumu	444	419	94%	
		Lukola	372	308	83%	
	Chipili	Chipili	2,065	1,873	91%	
		Chipili	912	835	92%	
		Mupeta	275	229	83%	
		Mutipula	385	334	87%	
		Mwenda	493	475	96%	
	Lunga	Lunga	1,357	1,347	99%	
		Bwalya Mponda	660	652	99%	
		Nsalushi	697	695	100%	
	Samfya	Samfya	15,798	15,460	98%	
		Samfya Stage II	15,798	15,460	98%	
	Grand Total			438,252	409,544	93%

ANNEX 2: M&E PLAN MATRIX – 2014 CAMPAIGN RESULTS

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Actuals					
						Year 1		Year 2		Year 3	
						Targets	Results	Targets	Results	Targets	Results

Component 1: Establish cost-effective supply chain mechanisms including procurement, distribution and storage of IRS-related commodities and execute all aspects of logistical plans for IRS-related activities.

1.1 Procurement

1.1.1 Number and percentage of international insecticide procurement orders delivered in country, at port of entry, at least 30 days prior to the start of spray operations	[Numerator: Number of international insecticide procurement orders delivered in country, at port of entry, at least 30 days prior to the start of spray operations] [Denominator: Total number of international insecticide procurement orders] Calculation: [Numerator ÷ Denominator] x 100	Y1, Y2, Y3	Data source: Logistics and Procurement Inventory Reports Reporting frequency: Each spray season	By Spray Campaign	AIRS	N.A.; 80%	2; 100%	1; 100%	1; 100%	1; 100%	0; 0%
1.1.2 Number and percentage of international procurement orders for equipment, including	[Numerator: Number of international procurements for equipment, including PPE, received at port of entry, 30 days prior to start of spray operations]	Y1, Y2, Y3	Data source: Logistics and Procurement Inventory Reports	By Spray Campaign	AIRS	N.A.; 85%	2; 50%	2; 100%	2; 100%	2; 100%	1; 100%

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Actuals					
						Year 1		Year 2		Year 3	
						Targets	Results	Targets	Results	Targets	Results
PPE, received at port of entry, 30 days prior to start of spray operations.	[Denominator: Total number of international procurements for equipment, including PPE.] Calculation: [Numerator ÷ Denominator] x 100		Reporting frequency: Each spray season								
1.1.3 Number and percentage of local PPE procurement orders that are delivered to the main warehouse, 14 days before the start of spray operations	[Numerator: Number of local PPE procurement orders delivered to the main warehouse 14 days before the start of spray operations] [Denominator: Total number of local PPE procurement orders] Calculation: [Numerator ÷ Denominator] x 100	Y1, Y2, Y3	Data source: Logistics and Procurement Inventory Reports Reporting frequency: Each spray season	By Spray Campaign	AIRS	3; 80%	3; 100%	2; 100%	2; 100%	2; 100%	8; 100%
1.1.4 Successfully completed spray operations without an insecticide stock-out	Milestone: (Achieved/Not achieved)	Y1, Y2, Y3	Data source: Logistics Inventory Report Reporting frequency: Each spray season	By Spray Campaign	AIRS	N/A	N/A	N/A	N/A	Achieved	Achieved
1.2 In-country Logistics, Warehousing, and Training											
1.2.1 Number and percentage of logistics and warehouse managers trained in IRS supply chain management	[Numerator: Total number of logistics and warehouse managers trained in IRS supply chain management using AIRS Project resources.] = 80 persons [Denominator: Total number of AIRS logistics and warehouse managers.] = 80 persons	Y1, Y2, Y3	Data source: Routine training records Reporting frequency: Each spray season	By Spray Campaign By Gender	AIRS	22; 100%	63; 100%, 42 males, 21 females	N/A	N/A	55; 100%	80; 100%

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Actuals					
						Year 1		Year 2		Year 3	
						Targets	Results	Targets	Results	Targets	Results
	Calculation: $[\text{Numerator} \div \text{Denominator}] \times 100$										
1.2.2 Number and percentage of base stores where physical inventories are verified with up-to-date stock records	<p>[Numerator: Number of base stores where physical inventories are verified by up-to-date stock records]</p> <p>[Denominator: Total number of base stores audited.]</p> <p>Calculation: $[\text{Numerator} \div \text{Denominator}] \times 100$</p> <p>(See PIRS for details on sample size for operational audits)</p>	Y2, Y3	<p>Data source: Logistics and Environmental compliance reports</p> <p>Reporting frequency: Each spray season</p>	By Spray Campaign	AIRS	20; 100%	20; 100%	20; 100%	20; 100%	29; 100%	40; 100%
1.2.3 Submit up-to-date inventory records to AIRS Home Office 30 days after the end of each spray campaign	Milestone: (Completed/Not Completed)	Y2, Y3	<p>Data source: Post-Spray Logistics Inventory Report</p> <p>Reporting frequency: Each spray season</p>	By Spray Campaign	AIRS	Completed	Completed	Completed	Completed	Completed	Completed

Component 2: Implement safe and high-quality IRS programs and provide operational management support

2.1 Planning and Design of IRS Programs

2.1.1 Annual IRS country work plan developed and submitted on time	Milestone: (Completed/Not Completed)	Y1, Y2, Y3	<p>Data source: Project records</p> <p>Reporting frequency: Annually</p>		AIRS	Completed	Completed	Completed	Completed	Completed	Completed
--	--------------------------------------	------------	--	--	------	-----------	-----------	-----------	-----------	-----------	-----------

2.2 Support of Safety and Health Best Practices and Compliance with USAID and Host Country Environmental Regulations

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Actuals					
						Year 1		Year 2		Year 3	
						Targets	Results	Targets	Results	Targets	Results
2.2.1 SEA/letter report submitted on time ²	Milestone: (Completed/Not Completed)	Y1, Y2, Y3	Data source: Project records – submitted SEAs/ letter reports Reporting frequency: Each spray campaign	By Spray Campaign	AIRS	Completed	Not completed ³	Completed	Completed	Completed	Completed
2.2.2 Number and percentage of soak pits and storehouses inspected and approved prior to spraying	[Numerator: Number and percentage of soak pits and warehouses/storerrooms inspected and certified by an environmental officer/AIRS Environmental Compliance Officer prior to each spray campaign supported by the AIRS Project] [Denominator: Total number of project soak pits and/or storehouses] Calculation: [Numerator ÷ Denominator] x 100	Y1, Y2, Y3	Data source: Pre, Mid and Post Inspection Reports submitted by environmental officers Reporting frequency: Each spray season	By Spray Campaign By Soak Pit By Warehouse/ Storerroom	AIRS	20; 100%	20; 100%	20; 100%	17; 85%	29; 100% (20 PMI; 9 DFID)	40; 100% (25 PMI, 15 DFID)
2.2.3 Number of government environmental and health officers trained in IRS environmental compliance	Total number of government environmental and health officers trained in IRS environmental compliance using AIRS Project resources	Y1, Y2, Y3	Data source: Training reports from Environmental Compliance Officer	By Spray Campaign By Gender	AIRS	N/A	N/A	N/A	N/A	160; 100%	98 (62 PMI; 36 DFID)

² In Year 1, SEAs were due 30 days prior to the commencement of spraying and letter reports were to be submitted 14 days prior to the commencement of spraying. In Year 2 and Year 3, due dates agreed upon with Washington-PMI will be noted in each country-specific Monitoring and Evaluation Plan to assess indicator 2.2.1.

³ The SEA amendment was completed shortly after the due date because the initial SEA did not cover the seven newly added districts for spray in 2012. The team drafted the amendment and submitted it for approval two weeks prior to the start of spray. It was approved on the first day of spray operations.

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/AIRS Indicator	Annual Targets and Actuals					
						Year 1		Year 2		Year 3	
						Targets	Results	Targets	Results	Targets	Results
			Reporting frequency: Semi-annually								
2.2.4 Number of spray personnel trained in environmental compliance and personal safety standards in IRS implementation	Total number of spray personnel who attend a training in environmental compliance and personal safety standards in IRS implementation using AIRS Project resources, includes all staff who received environmental compliance training - spray operators, team leaders, washpersons, storekeepers, etc.	Y1, Y2, Y3	Data source: Project records – Training reports Reporting frequency: Each spray season	By Spray Campaign By Gender	AIRS	N/A	N/A	N/A	N/A	2,146 (1,458 PMI; 688 DFID)	98 (62 PMI; 36 DFID)
2.2.5 Number of health workers receiving insecticide poisoning case management training	Total number of clinical personnel trained in insecticide poisoning case management using AIRS Project resources	Y2, Y3	Data source: Project records – Training reports Reporting frequency: Each spray season	By Spray Campaign By Gender	AIRS	N/A	N/A	N/A	N/A	80; 100% (50 PMI, 30 DFID)	34 (17 PMI, 17 DFID)
2.2.6 Number of adverse reactions to pesticide exposure documented	Total number of incidents of pesticide exposure reported that resulted in a referral for medical care	Y1, Y2, Y3	Data source: Incident report forms that are required for each incidence of pesticide exposure Reporting frequency: Each spray season	By Spray Campaign By residential/occupational exposure	AIRS	0	0	0	0	0	0
2.2.7. Number of vehicular accidents reported	Total number of vehicular accidents reported	Y1, Y2, Y3	Data source: Vehicular incident report forms that are required for each accident Reporting	By Spray Campaign	AIRS	0	0	0	0	0	2

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Actuals					
						Year 1		Year 2		Year 3	
						Targets	Results	Targets	Results	Targets	Results
			frequency: Each spray season								
2.3 Support Entomological Monitoring Activities and Insecticide Resistance Strategies											
2.3.1 Number of sentinel sites supported by the AIRS project	Total number of entomological sentinel sites supported by the AIRS project	Y1, Y2, Y3	Data source: Entomological reports Reporting frequency: Annually	By Spray Campaign	AIRS	N/A	N/A	N/A	N/A	6; 100% 3 PMI; 3 DFID)	6; 100% 3 PMI; 3 DFID)
2.3.2 Number and percentage of entomological monitoring sentinel sites measuring all five primary PMI entomological indicators	[Numerator: Number of entomological monitoring sites measuring all five primary PMI entomological indicators] [Denominator: Number of entomological monitoring sentinel sites] Calculation: [Numerator ÷ Denominator] x 100	Y1, Y2, Y3	Data source: Entomological reports Reporting frequency: Annually	By Spray Campaign	AIRS	N/A	N/A	N/A	N/A	6; 100% 3 PMI; 3 DFID)	6; 100% 3 PMI; 3 DFID)
2.3.3 Number and percentage of entomological monitoring sites measuring at least one secondary PMI indicator	[Numerator: Number of entomological monitoring sites measuring at least one secondary PMI indicator] [Denominator: Number of entomological monitoring sites] Calculation: [Numerator ÷ Denominator] x 100	Y1, Y2, Y3	Data source: Entomological reports Reporting frequency: Annually	By Spray Campaign	AIRS	N/A	N/A	N/A	N/A	N/A	N/A

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Actuals					
						Year 1		Year 2		Year 3	
						Targets	Results	Targets	Results	Targets	Results
2.3.4 Number and percentage of insecticide resistance testing sites that tested at least one insecticide from each of the four classes of insecticides recommended for malaria vector control	[Numerator: Number of insecticide resistance testing sites that tested at least one insecticide from each of the four classes of insecticides recommended for malaria vector control.] [Denominator: Number of insecticide resistance testing sites] Calculation: [Numerator ÷ Denominator] x 100	Y1, Y2, Y3	Data source: Entomological reports Reporting frequency: Annually	By Spray Campaign By Type of Insecticide	AIRS	N/A	N/A	N/A	N/A	6; 100% 3 PMI; 3 DFID)	3; 50% 0 ⁴ PMI; 3 DFID)
2.3.5 Number of wall bioassays conducted within 2 weeks of spraying to evaluate the quality of IRS	Total number of wall bioassay studies conducted in established sentinel sites to evaluate quality of IRS spraying activities	Y1, Y2, Y3	Data source: Entomological reports Reporting frequency: Per spray campaign	By Spray Campaign	PMI	N/A	N/A	N/A	N/A	72; 100% (36 PMI; 36 DFID)	6: 8.3% (3 PMI; 3 DFID).
2.3.6 Number of wall bioassays conducted after the completion of spraying at monthly intervals to evaluate insecticide decay	Total number of wall bioassay studies conducted at monthly intervals in established sentinel sites to evaluate the rate of insecticide decay on sprayed surfaces	Y1, Y2, Y3	Data source: Entomological reports Reporting frequency: Per spray campaign	By Spray Campaign	PMI	N/A	N/A	N/A	N/A	360 (180 PMI; 180 DFID)	6:8.3% (3 PMI; 3 DFID).

⁴ There were no mosquitoes in PMI districts due to the season when testing was being done.

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/AIRS Indicator	Annual Targets and Actuals					
						Year 1		Year 2		Year 3	
						Targets	Results	Targets	Results	Targets	Results
2.3.7 Number of vector susceptibility tests for different insecticides conducted in selected sentinel sites	Total number of vector susceptibility tests conducted to gauge the effectiveness of individual insecticides proposed for use in spray operations	Y1, Y2, Y3	Data source: Entomological reports Reporting frequency: Per spray campaign	By Spray Campaign By Type of Insecticide	PMI	N/A	N/A	N/A	N/A	12; 100% 6 PMI; 6 DFID)	3; 50% ⁵ 0 PMI; 3 DFID)
2.4 Conduct Communications Activities and Community Mobilization											
2.4.1 Number of radio spots and talk shows aired	Total number of radio spots and talk shows aired in target spray districts to stress the safety and benefits of IRS, ensure successful spray coverage, timely vacating of premises and adherence to IRS safety precautions by community members	Y1, Y2, Y3	Data source: Project records Reporting frequency: Semi-annually	By Spray Campaign	AIRS	N/A	N/A	N/A	N/A	Radio spots: 390 (330 PMI; 60 DFID) Talk shows: 13 (11 PMI; 2 DFID)	0
2.4.2 Number of IRS print materials disseminated	Total number of IRS educational materials developed, printed and distributed to community members in target spray districts using AIRS Project resources	Y1, Y2, Y3	Data source: Project records Reporting frequency: Semi-annually	By Spray Campaign By Type of printed material and message(s)	AIRS	N/A	N/A	N/A	N/A	Posters: 2,000 (1,250 PMI, 750 DFID)	0
2.5 Spray Targeted Structures According to Technical Specifications											
2.5.1 Number of structures targeted for spraying	Total number of structures found in targeted spray districts by Spray Operators	Y1, Y2, Y3	Data source: Daily Spray Operator Forms Reporting frequency: Daily per spray	By Spray Campaign	PMI	N/A	N/A	N/A	N/A	472,000 (352,000 PMI, 120,000 DFID)	438,252 (327,854 PMI, 110,398 DFID)

⁵ The testing was only done once and for only one insecticide-(bendiocarb).

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Actuals					
						Year 1		Year 2		Year 3	
						Targets	Results	Targets	Results	Targets	Results
			campaign								
2.5.2 Number of structures sprayed with IRS ⁶	Total number of structures sprayed in targeted districts	Y1, Y2, Y3	Data source: Daily Spray Operator Forms Reporting frequency: Daily per spray campaign	By Spray Campaign	PMI	N/A	N/A	N/A	N/A	401,200 (299,200 PMI, 102,000 DFID)	409,544 (311,204 PMI, 98,340 DFID)
2.5.3 Percentage of total structures targeted for spraying that were sprayed with a residual insecticide (Spray Coverage)	[Numerator: Total number of structures sprayed in targeted districts] [Denominator: Total number of structures in targeted areas found by spray operators] Calculation: [Numerator ÷ Denominator] x 100	Y1, Y2, Y3	Data source: Daily Spray Operator Forms Reporting frequency: Daily per spray campaign	By Spray Campaign	PMI	N/A	N/A	N/A	N/A	85%	93.4%
2.5.4 Number of people residing in structures sprayed (Number of people protected by IRS)	Total number of people residing in structures sprayed (Actual numbers are collected during spray operations; population estimates are not used.)	Y1, Y2, Y3	Data source: Daily Spray Operator Forms Reporting frequency: Daily per spray campaign	By Spray Campaign By Number of pregnant women By Number of children <5 years old	PMI	N.A.	N/A	N/A	N/A	2,046,120 (1,501,076 PMI, 545,044 DFID)	2,000.824 (1,478,598 PMI, 522,226 DFID) Children < 5 years 309,250 Pregnant women- 60,978
Component 3: Provide on-going monitoring and evaluation and quality control measures											
3.1 Submit Monitoring and Evaluation Plan	Milestone: (Completed/Not Completed)	Y1, Y2, Y3	Data source: Project records		AIRS	Completed	Completed	Completed	Completed	Completed	Completed

⁶ The target per year for this indicator is based on 85% of the number of structures to be targeted as noted in the applicable work plan.

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Actuals					
						Year 1		Year 2		Year 3	
						Targets	Results	Targets	Results	Targets	Results
(MEP) to PMI-Zambia			Reporting frequency: Semi-annual								
3.4 Supply chain review conducted by RTT	Milestone: (Completed/Not Completed)	Y1, Y2	Data source: RTT supply chain review reports Reporting frequency: Semi-annually	By Spray Campaign	AIRS	Completed	Completed	Completed	Completed	N/A	N/A

Component 4:
Contribute to Global IRS Policy-Setting and Country-Level Policy Development of Evidence-Based IRS; Disseminate Experiences and Best Practices

4.1 Number of guidelines/checklists/tools related to IRS operations developed or refined with project support	Total number of implementation guidelines, process checklists and program tools related to IRS operations developed or refined using the technical and/or financial resources of the AIRS Project	Y1, Y2, Y3	Data source: Project records – Activity reports Reporting frequency: Semi-annually	By Guideline/checklist/tool	AIRS	N/A	N/A	N/A	N/A	3	12
4.2 Number of articles/best practices documents published	Total number of articles or other best-practice documents that have been published in relevant journals or through PMI/USAID communications vehicles	Y2, Y3	Data source: EOSR Reporting frequency: Semi-annually	By Spray Campaign By IRS Technical Area	AIRS	N/A	N/A	N/A	N/A	1 article (ento); 2 success stories (geocoding and social mobilization)	0

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Actuals					
						Year 1		Year 2		Year 3	
						Targets	Results	Targets	Results	Targets	Results
4.3 Number of best practice presentations given at national/ regional/international workshops and conferences	Total number of project-related oral and poster presentations delivered in national, regional and/or international meetings related to IRS.	Y2, Y3	Data source: Project records – Activity reports Reporting frequency: Semi-annually	By IRS Technical Area	AIRS	N/A	N/A	N/A	N/A	1 (ASTMH)	0

Component 5 (Cross-cutting): Capacity Building, Knowledge Transfer, Gender Inclusion

5.1 Capacity Building⁷ (Gender Inclusion)

5.1.1 Number of people trained in IRS implementation	Total number of personnel trained in IRS implementation using AIRS Project resources. This figure only covers spray personnel (i.e. spray operators, team leaders, supervisors, mobilizers, clinicians.)	Y1, Y2, Y3	Data source: Project records – Training reports Reporting frequency: Semi-annually	By Spray Campaign By Gender Percentage of Women Trained	PMI	N/A	N/A	N/A	N/A	2,091 (1,418 PMI, 673 DFID)	1,460 (1,012 PMI, 448 DFID) 887 males, 553 females 39.2% women
5.1.2 Number of people trained to deliver or support IRS in target districts	Total number of people trained using AIRS Project resources to implement/support elements of IRS in target districts. This figure includes all cadre that serve a role in IRS.	Y1, Y2, Y3	Data source: Project records – Training reports Reporting frequency: Semi-annually	By Spray Campaign By Gender By Role (e.g., spray operator, storekeeper)	AIRS	N/A	N/A	N/A	N/A	2,227 (1,511 PMI, 716 DFID)	1,592(1,101 PMI, 491 DFID) 976 males, 616 females 38.7% women

⁷ See Appendix B for the disaggregation of trained AIRS staff for indicators under section 5.1 Capacity Building.

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Actuals					
						Year 1		Year 2		Year 3	
						Targets	Results	Targets	Results	Targets	Results
				Percentage of women trained							
5.1.3 Number of personnel trained as IRS implementation trainers	Total number of personnel trained in Training of Trainers (TOT) for IRS delivery	Y1, Y2, Y3	Data source: Project records – Training reports Reporting frequency: Semi-annually	By Spray Campaign By Gender Percentage of women trained	AIRS	N/A	N/A	N/A	N/A	120; 100% 75 PMI, 45 DFID)	98 (62 PMI,36 DFID) 86 males, 12 females 12.2% women
5.1.4 Number of government environmental and/or health officials trained in IRS oversight/ supervision	Total number of national and sub-national/district government environmental and/or health officials who are trained in oversight of IRS implementation using AIRS Project resources	Y1, Y2, Y3	Data source: Project records – Training reports Reporting frequency: Semi-annually	By Spray Campaign By Gender Percentage of Women Trained Type of government official (e.g. environmental /health)	AIRS	N/A	N/A	N/A	N/A	210; 100% 131 PMI, 79 DFID)	98 (62 PMI,f36 DFID) 86 males, 12 females 12.2% women
5.1.5 AIRS conducted a capacity assessment	AIRS Zambia program conducted an assessment of IRS capacity among national and sub-national/district government health officials	Y1, Y2	Data source: Project records – Capacity assessment reports Reporting frequency: Semi-annually		AIRS	Completed	In process	Completed	In progress	Completed	Completed