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# PMI | Africa IRS (AIRS) Project

## Indoor Residual Spraying (IRS 2) Task Order Four

# SEMI-ANNUAL REPORT

## APRIL 2013–SEPTEMBER 2013



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**SEMI-ANNUAL REPORT**  
**APRIL 2013–SEPTEMBER 2013**

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# ACRONYMS

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<b>AIRS</b>	Africa Indoor Residual Spraying Project
<b>CAP</b>	Country Capacity Assessment
<b>CB</b>	Community-based
<b>CDC</b>	Centers for Disease Control and Prevention
<b>CHV</b>	Community Health Volunteers
<b>COP</b>	Chief of Party
<b>COR</b>	Contracting Officer's Representative
<b>CREC</b>	Entomological Research Center of Cotonou
<b>CTC</b>	Client Technology Center
<b>DCOP</b>	Deputy Chief of Party
<b>DEC</b>	Data-Entry Clerks
<b>DPS</b>	Provincial Health Directorate/ Direcção Provincial de Saúde
<b>DRC</b>	Democratic Republic of Congo
<b>DDT</b>	Dichlorodiphenyltrichloroethane
<b>ECO</b>	Environmental Compliance Officer
<b>EEM</b>	Enhanced Entomological Monitoring
<b>EOSR</b>	End of Spray Report
<b>F&amp;A</b>	Finance and Administration
<b>HBR</b>	Human Biting Rates
<b>HEW</b>	Health Extension Worker
<b>HLC</b>	Human Landing Catches
<b>IEC</b>	Information, Education, and Communication
<b>INRB</b>	Institute for Bio-medical Research/Institute National de Recherche Bio-medicales
<b>IQK</b>	Insecticide Quantification Kit
<b>IRS</b>	Indoor Residual Spraying
<b>IVCC</b>	Innovative Vector Control Consortium
<b>IVM</b>	Integrated Vector Management
<b>LLIN</b>	Long-lasting insecticidal nets
<b>LQAS</b>	Lot quality assurance sampling
<b>M&amp;E</b>	Monitoring and Evaluation
<b>MOH</b>	Ministry of Health
<b>MOU</b>	Memorandum of Understanding
<b>N/A</b>	Not Available

<b>NESREA</b>	National Environmental Standards and Regulations Enforcement Agency
<b>NGO</b>	Non-Government Organization
<b>NIBR</b>	National Institute of Biomedical Research
<b>NIHR</b>	National Institute of Health Research
<b>NMCP</b>	National Malaria Control Program
<b>NMIMR</b>	Noguchi Memorial Institute of Medical Research
<b>PMI</b>	President’s Malaria Initiative
<b>PPE</b>	Personal Protective Equipment
<b>PSC</b>	Pyrethrum Spray Catches
<b>PSDQA</b>	Post-Spray Data Quality Audit
<b>SMS</b>	Short Message Service
<b>UCAD</b>	Université Cheikh Anta Diop
<b>USAID</b>	United States Agency for International Development
<b>USG</b>	United States Government
<b>VCU</b>	Vector Control Unit
<b>WHO</b>	World Health Organization
<b>WHOPES</b>	World Health Organization Pesticide Evaluation Scheme
<b>ZEMA</b>	Zambia Environmental Management Agency
<b>ZISSP</b>	Zambia Integrated Systems Strengthening Project

# EXECUTIVE SUMMARY

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During this reporting period (April 1, 2013 through September 30, 2013), the Africa Indoor Residual Spraying (AIRS) project, under the guidance of the United States Agency for International Development (USAID)'s Presidents Malaria Initiative (PMI), implemented indoor residual spraying (IRS) campaigns in Benin, Ethiopia, Ghana, Liberia, Mali, Nigeria, Rwanda, Senegal and Zambia. The project covered an average of 95.4% of targeted structures, and protected more than 8.5 million people from malaria. Details regarding all monitoring and evaluation (M&E) outcomes by country are reported in Annex A.

## TOP-LINE RESULTS FROM IRS CAMPAIGNS, APRIL–SEPTEMBER 2013

- 2,369,294 structures sprayed
- 95.4% average spray coverage
- 8,574,444 people protected from malaria including:
  - 203,832 pregnant women
  - 1,407,718 children under five years of age
- 12,320 people trained with United States government (USG) funds to deliver IRS

AIRS conducted rigorous entomological monitoring in 10 project countries to identify local malaria vectors and their biting habits, measure mosquitoes' susceptibility to different insecticides, and track residual efficacy of different insecticides<sup>1</sup>. This data helped inform decisions regarding insecticide selection for future IRS campaigns.

While carrying out IRS campaigns over the past six months, AIRS has invested in building the skills of local staff and government partners. Examples of this work include:

- AIRS is currently completing Country Capacity Assessments (CAPs), which analyze the capabilities of National Malaria Control Programs (NMCPs) and other government agencies to carry out different aspects of IRS. The assessments are intended to identify opportunities for greater country ownership of IRS in the short- and long-term. Most AIRS country teams have presented the CAP findings to PMI/Washington and PMI-country staff. In addition to sharing the results of the assessment with PMI, AIRS Ghana and AIRS Rwanda have also shared the results of the assessment with local malaria stakeholders, to start planning IRS capacity building activities in the upcoming year.
- In Zimbabwe, AIRS has completed trainings for national and district staff on environmental compliance and supported M&E trainings to reintroduce the use of smartphones for IRS data collection. Additionally, AIRS Zimbabwe supported PMI to implement a national entomology training, which trained various malaria stakeholders on entomological surveillance techniques, entomological surveillance data collection, and the analysis of entomological surveillance data for vector-control decision-making.
- In Nigeria, AIRS worked to ensure that government staff took an active role in supervising spray operations, via training government staff to use the AIRS Supervisory Toolkit and M&E Data Verification Forms, and designating various spray areas to be primarily supervised by government staff.

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<sup>1</sup> In Benin and Senegal, entomological monitoring is completed by local entomological research organizations that are contracted directly by PMI.

AIRS has also introduced new technology and innovations over the past six months, to improve the quality of IRS planning and implementation. A smartphone application was developed by AIRS, and was used in Ghana, Benin, Senegal, Mali, Ethiopia, Rwanda, Mozambique, Angola, and Zimbabwe to improve quality, transparency, and accessibility of environmental compliance data collection. In Nigeria, during the 2013 IRS campaign, AIRS used Short Message Service (SMS) to communicate with seasonal staff, giving them timely updates on IRS campaign implementation, reinforcing training, and providing guidance to correct common IRS campaign implementation errors. AIRS' M&E personnel have also developed several tools to improve the ability of IRS campaign teams to examine IRS campaign data, and ensure its quality and accuracy. The Innovative Vector Control Consortium (IVCC) and Avima worked with AIRS to implement a pilot for Insecticide Qualification Kits in Ethiopia. The kits provide a possible alternative to standard bioassay techniques to note whether walls were sprayed properly during an IRS campaign. The kits include materials that can adhere to sprayed walls and when processed change color according to the concentration of insecticide present. Based on the shade of color that the material becomes, testers can evaluate if enough or too little insecticide was sprayed on a wall.

AIRS also expanded upon past innovations, including the use of the “insectary-in-a-box” model, first developed by AIRS Mali. AIRS built an insectary-in-a-box in Angola, which currently serves as Angola's first insectary. AIRS also expanded the community-based spray campaign model that is used in Ethiopia, to cover five more districts during the 2013 IRS campaign in Ethiopia.

Results of these new innovations are being shared with country partners and the broader malaria control communities through the project website, AIRS' quarterly e-letter, social media, and during presentations at international conferences. AIRS also produced five videos in the past six months to capture voices from the field and highlight the various innovations that country teams are using to improve the efficiency of IRS.

# I. COUNTRY PROGRAM HIGHLIGHTS

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## I.1 ANGOLA

### ENTOMOLOGY

In collaboration with PMI Angola, the Angolan National Malaria Control Program (NMCP) and the Huambo provincial health office, AIRS Angola converted a 40-foot container into the country's first insectary. The insectary is located on the grounds of the Huambo Sanatorium Hospital. This fully functioning insectary will support routine entomologic monitoring for IRS programming, long-lasting insecticidal net (LLIN) distribution, and other vector control interventions implemented in Angola. On September 26, 2013, Huambo officially opened this insectary, with the ribbon-cutting ceremony led by Dr. Serra Van-Dunem, Angola Minister of Health, in the company of Dr. Teresa McGhie, USAID Mission Director, and various dignitaries including the Executive Director of the NMCP, the Vice Governor of Huambo province, and the Director of the Provincial Directorate of Health of Huambo province.

The insectary will also act as a training facility, and it will serve as a regional resource for all entomological monitoring in the southern provinces. The insectary will provide a susceptible colony of mosquitoes for spray quality assurance tests.

### PROGRAM HIGHLIGHTS

The 2013 spray campaign will be carried out in the same three provinces as last year (Huambo, Huila and Cunene.) However, analysis of municipal-level malaria case data showed consistent decline over the past few years in Huambo municipality, leading to a decision to stop IRS in this municipality. IRS will continue to be completed in Bailundo municipality in Huambo province, as epidemiological data continues to note high malaria transmission. In Huila province, IRS will be implemented in two municipalities, Lubango and Chibia, which have been covered by IRS during previous campaigns. In Cunene province, Kwanhama and Namacunde municipalities will also continue to be covered by IRS.

With Angola noting malaria cases decreasing in several municipalities after multiple years of IRS coverage, AIRS Angola is conducting epidemiologic surveillance at municipal hospitals, health centers (*Centro de Saúde*), and health posts (*Posto de Saúde*)—within each municipality targeted for IRS, and one municipality in a non-IRS intervention area. AIRS has established data collection protocols and has been collecting current and retrospective data to better understand malaria's disease burden and note areas that may benefit from future IRS campaigns, and areas where IRS may no longer be necessary.

## 1.2 BENIN

**TABLE 1: AIRS BENIN AT A GLANCE**

Number of districts sprayed by PMI-supported IRS	9
Insecticides	Carbamates (4 districts) Organophosphates (5 districts)
Number of structures sprayed by PMI-supported IRS	228,951
Number of structures targeted by PMI-supported IRS	239,112
Spray coverage	95.8%
Total population protected by PMI-supported IRS in 2013	694,729
Pregnant women protected	19,818
Children under five years old protected	134,045
Dates of PMI-supported IRS campaign in 2013	May 20 through June 26, 2013
Length of campaign	32 days
Number of people trained with USG funds to deliver IRS <sup>1</sup>	804

<sup>1</sup> This is based on the PMI indicator definition. It includes only spray staff such as spray operators, team leaders, supervisors, and clinicians.

### ENTOMOLOGY

PMI/Benin contracted directly with the Entomological Research Center of Cotonou (CREC) to complete surveillance and submit reports. AIRS Benin supervised entomological field activities performed by CREC for this six-month period, with CREC providing entomological data directly to PMI/Benin.

### PROGRAM HIGHLIGHTS

During May and June, AIRS Benin implemented its 2013 IRS spray campaign in all nine districts of the Atacora Region.

Over the 32-day campaign, AIRS Benin sprayed 228,951 structures of the 239,112 structures found by spray operators, thereby achieving a coverage rate of 95.8%. The 2013 IRS campaign also introduced new innovations to IRS campaign planning and implementation, including the AIRS Benin team developing newly designed fencing, built with barbed wire that further limited access to the soak pits by animals. The barbed wire replaced thatch fencing, which proved less durable, was easy for animals move around or knock over, and was commonly removed by community members to use for other purposes. The AIRS Benin team also developed lockable metal covers for its soak pits, which allowed further protection and inhibited access to soak pits. Also in 2013, AIRS Benin used smartphones to complete environmental compliance assessments before, during, and after the IRS campaign. Checklists loaded onto the smartphone allowed AIRS Benin staff to readily monitor operation sites and soak pits to make certain they were in good condition for implementing IRS, and to assure spray operators and other spray campaign personnel followed best management practices for safety while using insecticides.

AIRS Benin also developed an agreement with a local environmental non-government organization (NGO) that received the empty plastic organophosphate bottles after the IRS campaign. The local NGO was able to break down the plastic bottles into pellets, and work with local manufacturers to transform the pellets into protective tubing for electrical wires.

### CHALLENGES AND LESSONS LEARNED

- The 2013 IRS campaign made clear that a detailed IRS micro-plan needs to be developed earlier, and should include more input from the NMCP, regional health staff, and other malaria stakeholders.

Earlier planning will also allow better coordination of IRS activities and improve timely implementation of pre-spray activities.

- AIRS Benin is confident that the NMCP and regional health officials can take a greater role in managing and implementing IRS during future campaigns. Discussions were held during the 2013 IRS campaign about a mentorship program, whereby AIRS Benin staff would work intensively with NMCP staff to build their management and supervision skills over the next six months.

## **I.3 BURUNDI**

### **PROGRAM HIGHLIGHTS**

The NMCP is integrating enhanced entomological monitoring (EEM) into its five-year National Strategic Plan. AIRS Burundi does not have a country office, but has an entomologist working within the NMCP to coordinate EEM activities and build capacity to improve the management of Burundi's insectary.

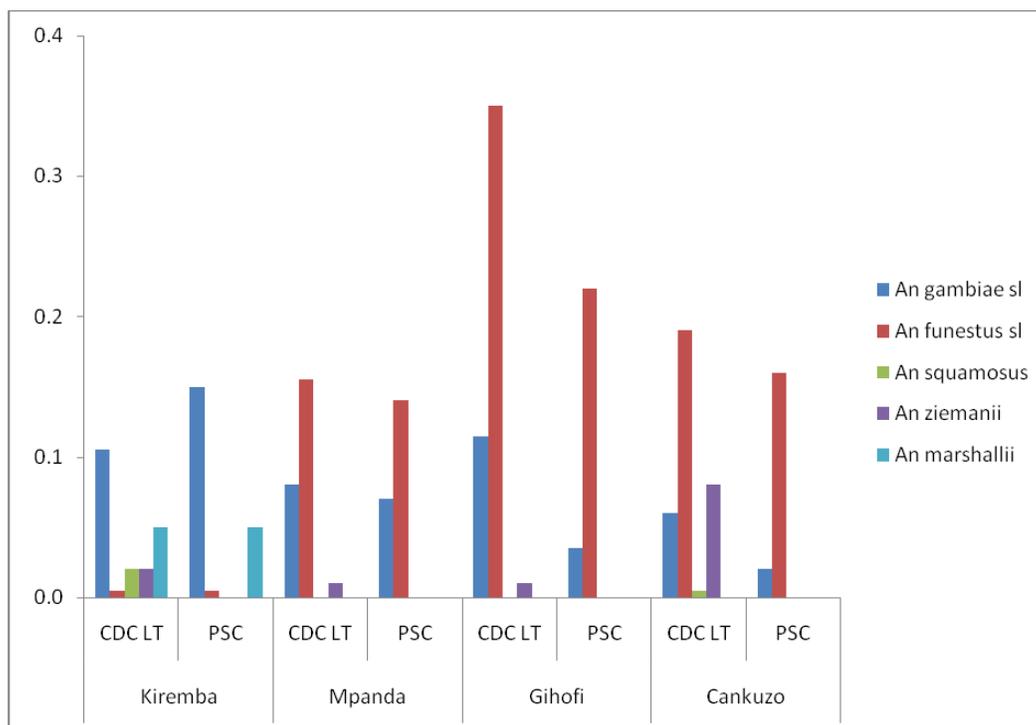
Regarding the insectary, AIRS helped equip the insectary with furniture, microscopes, and supplies for rearing mosquitoes. Additionally, through working with Vector Control Unit (VCU) staff, AIRS helped ensure improved management of the insectary, and that the insectary has become and will continue to be fully operational. Additionally, AIRS helped facilitate the Rwandan NMCP to send a batch of eggs (*An. gambiae* s.s., Kisumu strain) to establish a susceptible colony. Hundreds of pupae are now collected daily, and by the end of September mosquitoes from the susceptible colony were in their fifth generation.

With the arrival of the AIRS Burundi entomologist in April 2013, AIRS collaborated with the NMCP's VCU to establish four sentinel sites for EEM. AIRS also held on-the-job training for the VCU technicians, to assure their ability to complete various entomological surveillance techniques, including the use of CDC light traps, Pyrethrum Spray Catches (PSC), and larval sampling for susceptibility testing. In addition, training on mosquito morphological identification and methods to preserve mosquitoes for molecular analysis was completed.

Given the new training, the AIRS Burundi Entomologist worked with the VCU to complete entomological surveillance activities at all sentinel sites. Thereafter, the AIRS Burundi entomologist entered the entomological surveillance into a database to allow the VCU to complete future entomological data analysis.

Preliminary entomological surveillance data showed that malaria vectors are not evenly distributed throughout Burundi, as *An. gambiae* s.l. were predominant at three of the sentinel sites, and *An. funestus* was predominant at one sentinel site. See Figure 1 for more details.

**FIGURE 1: AVERAGE NUMBER OF MOSQUITOES CAUGHT PER HOUSE PER NIGHT**



## CHALLENGES AND LESSONS LEARNED

- It has proven challenging to regularly secure reliable water and electricity for the insectary, and to establish good security measures to guard the insectary's equipment.
- Although Human Landing Catches (HLC) are the gold standard for measuring mosquito biting behavior, HLC is not approved in Burundi. AIRS is currently drafting a protocol for the use of HLC, which will be submitted to Burundi's Ethics Committee for approval.
- Burundi lacks a facility to carry out molecular analysis, which may limit some EEM-related activities.

## 1.4 DEMOCRATIC REPUBLIC OF THE CONGO

### PROGRAM HIGHLIGHTS

Malaria accounts for about 35 percent of outpatient consultations in health facilities and over 50 percent of hospitalizations for children under five years old in the Democratic Republic of Congo (DRC). Distribution of LLINs is the main method of malaria vector control in DRC.

To evaluate the impact of LLIN use regarding malaria vector density, seasonal distribution, behavior, and species composition, PMI is supporting EEM activities in the DRC. AIRS signed a subcontract with the National Institute of Biomedical Research (NIBR) to implement EEM activities in four sentinel sites.

During this reporting period, AIRS supported the NIBR to conduct a 10-day training for 12 technicians on species identification, larvae and pupae collection from breeding sites, rearing of larvae and pupae to adults, mosquito sampling, techniques for completing cone bioassay and insecticide susceptibility tests, and correct methods for recording and reporting of entomological data. After the training was completed, the technicians were deployed to the four sentinel sites (Tshikaji (Western Kasai Province),

Lodja (Eastern Kasai Province), Kabondo (Eastern Province), and Kapolowe (Katanga Province)) to complete entomological surveillance activities.

An entomological surveillance progress report was submitted to AIRS in September, noting mosquito species composition (gained via the use of pyrethrum spray catches and human landing catches). The key findings of the report included:

- In Western Kasai Province, two malaria vectors were found: *Anopheles gambiae* s.l. (44.3% of all mosquitoes collected) and *Anopheles funestus* (8.8% of all mosquitoes collected). The report noted that more *Anopheles gambiae* s.l. were collected indoors than outdoors.
- In Eastern Kasai Province, two malaria vector species were found: *Anopheles paludis* (51.2% of all mosquitoes collected) and *Anopheles gambiae* s.l. (12.4% of all mosquitoes collected). The report noted the high amount of *Anopheles paludis* was probably due to more favorable breeding sites for *Anopheles paludis* than *Anopheles gambiae* s.l. The report also noted that more *Anopheles paludis* were collected outdoors than indoors.
- In Eastern Province, *Anopheles gambiae* s.l. was the only malaria vector collected and represented 16% of all mosquitoes collected. The report also noted that more *Anopheles gambiae* s.l. were collected outdoors than indoors.
- In Katanga Province, two malaria vectors were found: *Anopheles gambiae* s.l. (49.4% of all mosquitoes collected) and *Anopheles paludis* (1.7% of all mosquitoes collected). More *Anopheles gambiae* s.l. were collected outdoors than indoors. For *Anopheles paludis* approximately the same numbers of mosquitoes were collected indoors and outdoors.

## I.5 ETHIOPIA

**TABLE 2: AIRS ETHIOPIA AT A GLANCE**

Number of districts sprayed by PMI-supported IRS in 2013	36 districts in the Oromia region
Insecticides	Carbamates
Number of structures sprayed by PMI-supported IRS in 2013	635,528
Number of structures targeted by PMI-supported IRS in 2013	638,173
2013 spray coverage	99.6%
Total population protected by PMI-supported IRS in 2013	1,629,958
Pregnant women protected	25,211
Children under five years old protected	240,558
Dates of PMI-supported IRS campaign	August 15 through September 27, 2013
Length of campaign	37 days
Number of people trained with USG funds to deliver IRS <sup>1</sup>	2,684

<sup>1</sup>This is based on the PMI indicator definition. It includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

## ENTOMOLOGY

Through the end of September 2013, the AIRS project continued entomological monitoring activities for all PMI primary indicators in Ethiopia. During the spray campaign (August and September), the project conducted wall bioassay tests to assess quality of spraying two to three days after spraying.

Entomological surveillance continues to be of significant importance, as AIRS Ethiopia measures the quality of spraying in the conventional district-based IRS areas, and in the expanded community-based (CB) IRS districts. Overall, AIRS Ethiopia noted mosquito mortality ranged between 99 and 100 percent in all sites, with no difference between the CB and district-based IRS spray areas.

AIRS assessed susceptibility of the main malaria vector in Ethiopia, *An. gambiae* s.l., against nine World Health Organization Pesticide Evaluation Scheme (WHOPES)-approved insecticides for IRS use. Test results suggest that there was little or no change in susceptibility levels as compared to last year, except a slight increase in susceptibility for malathion. The 2013 resistance data from Oromia indicated:

- Complete resistance of the vector to DDT 4% (2-22% test mortality)
- Resistance to all pyrethroids tested (12-51% test mortality)
- Full susceptibility to carbamates except in one site, Omonada district, where 92% test mortality to bendiocarb was noted. In all other sites 100% test mortality were observed for both bendiocarb and propoxur.
- Malathion was least susceptible among the organophosphates tested (60-88% mortality). Pirimiphos-methyl achieved 100% mortality in all sites. Test mortality to fenitrothion was also 100% except one site, which was 97%.

AIRS Ethiopia also collected entomological data regarding:

- Vector emergence from water retention sites;
- Resting preference of mosquitoes post-spray; and
- Residual life of insecticides used during the 2013 IRS campaign.

Currently, the AIRS Ethiopia team is analyzing all entomological surveillance data, and will provide its full analysis of this data in the upcoming AIRS Ethiopia entomological report.

## **PROGRAM HIGHLIGHTS**

AIRS carried out IRS in 36 districts during August and September 2013. Additionally, AIRS Ethiopia provided technical and logistical support to 24 PMI-graduated districts in Eastern Oromia. This support included the training of 55 district, zonal, and regional health staff regarding environmental compliance, and providing personal protective equipment (PPE) and spray pumps.

AIRS Ethiopia expanded CB IRS from one district in 2012 to six districts in 2013. The CB spray model continues to rely on health extension workers (HEWs) who are trained to plan and conduct spray operations. AIRS plans to produce an evaluation report regarding the CB spray operations before the end of 2013.

AIRS Ethiopia also completed, in collaboration with Imperial Health Science, a training for 36 district store keepers to improve their abilities in stock management. AIRS Ethiopia is also costing options for the safe disposal of containers of expired dichlorodiphenyltrichloroethane (DDT) that are currently located in 60 previous district store rooms.

## **CHALLENGES AND LESSONS LEARNED**

- Some operation sites were inaccessible due to heavy rains and bad roads. Farm tractors had to be used to transport spray operator equipment in these areas, or the district chose to not use the inaccessible operation site, and instead concentrated spray teams at other operation sites.
- Competing priorities of district health offices created delays in spray operator training and the start of operations in some districts. This was particularly relevant for the CB IRS districts, as the HEWs were required to complete multiple and competing tasks during the first week of spraying.
- Some spray operators complained about the size of the boots provided for their use during the IRS campaign. To minimize this issue in the future, AIRS Ethiopia will collect boot sizes from the current cadre of spray personnel to help complete more robust forecasting for boot procurements.

- Network connectivity was a problem in several districts, and thereby delayed some of the IRS campaign data reporting.
- A large order of internationally procured items arrived late and caused delays regarding the distribution of equipment from the central warehouse to district store rooms.

## 1.6 GHANA

**TABLE 3: AIRS GHANA AT A GLANCE**

Number of districts sprayed by PMI-supported IRS	4 districts
Insecticides	Actellic CS
Number of structures sprayed by PMI-supported IRS	197,655
Number of structures targeted by PMI-supported IRS	216,876
Spray coverage	91.1%
Total population protected by PMI-supported IRS	534,060
Pregnant women protected	11,617
Children under five years old protected	102,115
Dates of PMI-supported IRS campaign in 2013	April 29 through June 28, 2013
Length of campaign	53 days
Number of people trained with USG funds to deliver IRS <sup>1</sup>	669

<sup>1</sup>This is based on the PMI indicator definition. It includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

## ENTOMOLOGY

Entomological monitoring was conducted in two of the four districts sprayed during the 2013 IRS campaign (Savelugu-Nanton and Bunkpurugu-Yunyoo districts) and in two unsprayed districts (Tolon-Kumbungu and Tamale metropolis). Results from the entomological monitoring conducted by AIRS Ghana, the Ghana Health Service, and the Noguchi Memorial Institute of Medical Research (NMIMR) showed reduced entomological transmission indicators in the IRS districts. Also, monthly insecticide decay rate bioassays conducted so far showed sprayed insecticides remained efficacious in killing local vectors throughout the end of this reporting period. The decay rate will continue to be monitored until mortalities fall below the acceptable threshold (80.0%).

*Anopheles gambiae* s.l. made up 97.8% and *An. funestus* only 1.2 percent of the total *Anopheles* mosquitoes collected.

Results obtained from PSCs done post-IRS showed comparison districts recorded higher vector densities than the aggregate for all IRS districts. The mean density of malaria vectors (*An. funestus* and *An. gambiae*) per room in the IRS areas was relatively lower than in the control districts: average room densities for the two IRS districts, Bunkpurugu-Yunyoo and Savelugu-Nanton, were 0.3 and 0.5 respectively compared to 1.4 and 2.8 for Tolon-Kumbungu and Tamale, the unsprayed districts.

*Anopheles gambiae* s.l. and *An. funestus* collected from the area start biting after 6:00 PM, with the peak biting period between 11 pm and 4 AM. Biting rates of *An. gambiae* s.l. and *An. funestus* were relatively higher for unsprayed districts.

The post-IRS (May – September 2013) biting rate (19.7) recorded for the non-IRS district of Tamale was significantly higher than the mean biting rates of 2.0 recorded for Savelugu-Nanton district and 4.5 for Bunkpurugu Yunyoo district, where IRS was conducted using Actellic CS.

Comparison of the proportions of parous females obtained from each district showed a significant difference between IRS districts (mean of 38.82%) and Tamale metropolis with a mean parity rate of 69.8%, and Tolon-Kumbungu district with a mean parity of 68.1%. No significant difference existed

between mean parity rates of mosquitoes collected from the comparison districts of Tamale (69.8%) and Tolon-Kumbungu (68.1%), where IRS was carried out in 2012, but exempted from IRS in 2013.

World Health Organization (WHO) wall bioassay tests assessed both the quality of spraying during the IRS campaign and the residual life of the insecticide after spraying. Results from the bioassays indicated high-quality spraying and strong performance of the insecticide, with 100% mortalities among the three main types of wall surfaces— wood, cement, and mud within two weeks of spraying.

Data from monthly WHO wall bioassays suggests Actellic CS was effective at killing vector mosquitoes. Cone bioassay tests conducted through September 2013—which exposed susceptible mosquito colonies as well as wild mosquitoes of known ages to the organophosphate-sprayed walls—showed high test mortality rates. Residual life of the sprayed organophosphate insecticides remains higher than the 80% acceptable threshold three to four months after the walls were sprayed. In tests that used a susceptible Kisumu strain of *An. gambiae*, average test mortalities three to four months post-IRS on cement, mud and wood surfaces were 99.7%, 95.3%, and 96.1%, respectively. Bioassays using field-collected wild *An. gambiae* of known ages also recorded average mortalities of 97.2%, 92.8% and 95.6% for cement, mud and wood surfaces, respectively (four months post-IRS). Control mortalities ranged from 0.0 to 20.0%.

## PROGRAM HIGHLIGHTS

In 2013, IRS districts were scaled down from nine districts to four. AIRS Ghana continued to perform targeted Information, Education, and Communication (IEC) activities in the five former IRS districts to encourage people in these districts to continue to use LLINs.

The main features of the 2013 spray campaign compared to the previous year's IRS campaign included the following:

- New management team overseeing spray operations (including a new Chief of Party (COP) and Finance and Administration (F&A) Director).
- Significant downscale of IRS districts from nine to four. All four target districts used a long-acting organophosphate, Actellic CS.
- Spray campaign shortened from 77 days to 53 days, requiring adjustments in the number of spray operators and equipment needed.
- New pressure pump (Goizper pump) was procured and piloted in two districts, Savelugu-Nanton and East Mamprusi.

District temporary staff were recruited and trained for the 2013 campaign well before the start of operations. AIRS carried out logistics and environmental compliance assessments to ensure that staff followed standard operating procedures and best management practices. The project also held stakeholder and partner planning and sensitization meetings to ensure awareness and involvement.

The program sprayed 197,655 structures in all four districts. Spraying began on April 29, 2013 in all four districts. Spraying ended on June 21, 2013 in Bunkpurugu-Yunyoo and East Mamprusi districts. Savelugu-Nanton District ended spray operations on June 22, 2013. West Mamprusi District ended spray operations on June 28, 2013.

In April, AIRS Ghana supported the A&P study led by the Centers for Disease Control and Prevention (CDC), which measures anemia and parasitemia levels among children under five years of age and pregnant women pre and post-IRS and during the rainy and dry season. The CDC and NMIMR carried out the study, with the AIRS program playing a facilitative role.

AIRS also worked with Liverpool School of Tropical Medicine to conduct the IRS scoping study, which summarized relevant literature to identify areas in Ghana where IRS would produce the greatest benefit.

The report concluded that currently there is not enough data to support relocation of IRS to other sites at this time.

AIRS Ghana continued its partnerships with local NGOs and manufacturers to recycle empty plastic organophosphate bottles into paving stones.

## CHALLENGES AND LESSONS LEARNED

A big challenge was the potential for degradation of the active ingredient in organophosphate CS because the shipment spent many weeks in transport to Ghana, and several more weeks at port awaiting customs clearance. When the organophosphate passed customs, AIRS worked with PMI/Ghana, PMI/Washington, and the manufacturer to test the insecticide. In the end, the insecticide met the correct quality specifications, and AIRS was given the green light to proceed with spraying.

Another challenge for AIRS Ghana was the continuing ethnic conflict in Bunkprugu-Yunyoo district, which affected spray operations and halted the campaign for 10 days.

AIRS Ghana also noted that IRS coverage was poor in some areas, but AIRS hired more mobilizers and packers, and the campaign was extended for several days to complete mop-up spraying to improve coverage rates.

Lastly, the campaign recorded five vehicle accidents. In reaction to this issue, AIRS conducted a defensive driver training for all drivers that carry IRS equipment and materials.

## 1.7 LIBERIA

**TABLE 4: AIRS LIBERIA AT A GLANCE**

Number of districts sprayed by PMI-supported IRS	7 districts located in 1 county (Bong)
Insecticide	Organophosphate CS
Number of structures sprayed by PMI-supported IRS	42,708
Number of structures targeted by PMI-supported IRS	44,328
Spray coverage	96.3%
Total population protected by PMI-supported IRS	367,930
Pregnant women protected	16,287
Children under 5 years old protected	63,714
Dates of PMI-supported IRS campaign	March 19 through May 4, 2013
Length of campaign	40 days
Number of people trained with USG funds to deliver IRS <sup>1</sup>	292

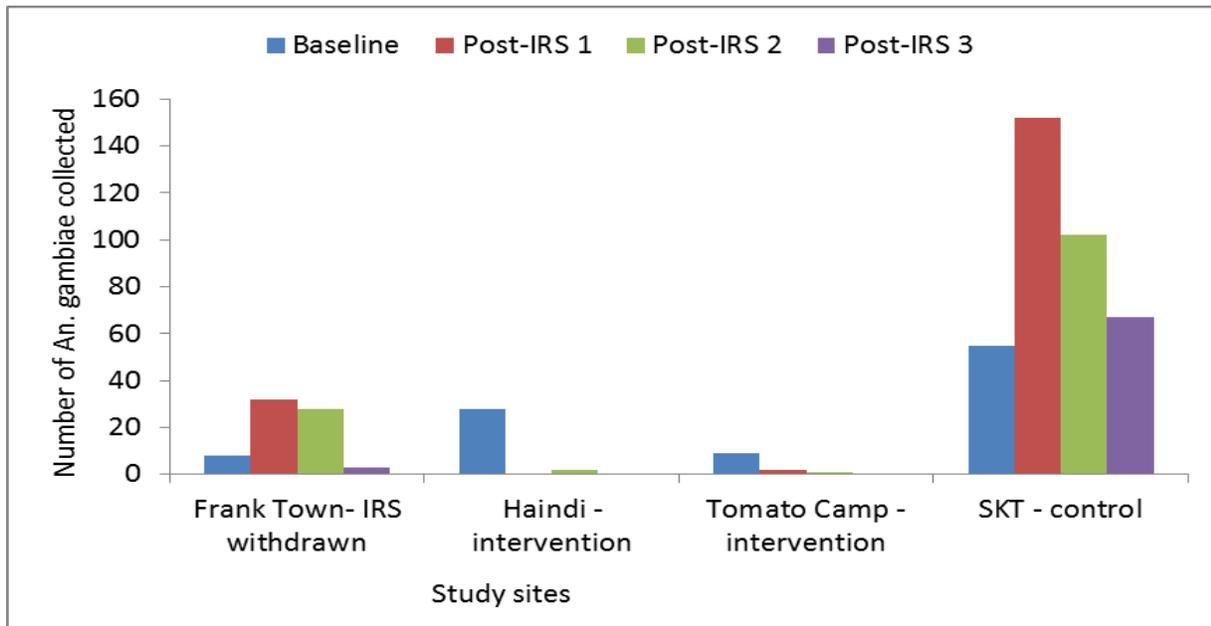
<sup>1</sup>This is based on the PMI indicator definition that includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

## ENTOMOLOGY

The IRS program worked closely with the VCU of the Liberian NMCP, the Liberia Institute for Biomedical Research and county health teams to conduct entomological monitoring of insecticide resistance and assess the quality of spraying. During the 2013 spray campaign, four sentinel sites—two representing IRS areas (Palala town in Panta district and Haindi in Fuamah district), one representing a non-IRS area (Sergeant Kollie Town in Suakoko district), and one representing a former IRS district (Frank Town in Careysburg district)—were selected to monitor mosquito densities, behavior, and insecticide resistance. Before the start of baseline data collection, the AIRS technical manager and one NMCP technician trained two community health volunteers (CHVs) from each sentinel site in adult mosquito collection methods, including PSC, HLC, and the use of CDC light traps.

Baseline collections in 2013 were conducted during the dry season, and PSC continued monthly through the rainy season. The main malaria vector, *An. gambiae* s.l., is primarily endophilic. The number of mosquitoes collected in the control site (Sergeant Kollie Town) during the rainy season was 2.8 times higher than those collected during the baseline period in the dry season, suggesting that malaria vector mosquitoes in Liberia are highly dependent on rain-fed breeding habitats. Both intervention and control sites have similar ecological characteristics; hence similar malaria vectors breeding habitats. The decrease in mosquito population in the two intervention sites compared to the control site (Figure 2) after the onset of the rainy season suggests that indoor residual spraying has a diminishing effect on malaria vector populations.

**FIGURE 2: NUMBER OF AN. GAMBIAE S.L. COLLECTED BY PSC METHOD IN FOUR SITES AT BASELINE AND POST-IRS PERIODS**



The 2013 spray campaign started on March 19 in seven districts located in Bong County. Cone bioassays to assess the quality of spraying were conducted within 24 to 60 hours after spraying in two selected study sites (Palala and Haindi). A total of 222 female mosquitoes were exposed to sprayed mud and cement walls for 30 minutes. Twenty-four hours after spraying, mosquito test mortality rates among local *An. gambiae* s.l. were 100 percent in both study villages, suggesting good-quality spraying.

Cone bioassays conducted at one month (T1) post-IRS showed high mortality in test mosquitoes. However, bioassays conducted at two months (T2) post-spray displayed lower mortality than expected in Palala. AIRS will conduct more studies and observation of house status (ventilation, leaking when it rains) to understand this reduction in residual life. The experiments used wild mosquitoes reared from aquatic stages, and three types of walls were assayed for residual activity as shown in the table below.

**TABLE 5: RESIDUAL ACTIVITY OF THREE TYPES OF ORGANOPHOSPHATE CS SPRAYED WALLS IN LIBERIA**

Site and wall type	T0			T1			T2		
	# of houses	# tested	Test mortality	# of houses	# tested	Test mortality	# of houses	# tested	Test mortality
<b>Palala</b>									
Cement	2	80	100%	3	122	94.2%	3	124	79%
Mud	1	35	100%	-	-	-	-	-	-
<b>Haindi</b>									
Cement	2	70	100%	1	44	100%	2	67	90.54%
Mud	1	37	100%	1	43	100%	-	-	-
Wood	-	-	-	1	45	100%	1	38	90.47%

T0= less than a month after spraying, T1 = 1 month, T2 = 3 months

## PROGRAM HIGHLIGHTS

IRS operations started in five original target districts on March 19, 2013, with a target to spray at least 40,200 structures and achieve at least 85 percent spray coverage. Preliminary calculations showed there might not be enough structures in the initially targeted areas in Bong, so the team sprayed structures in two additional adjacent districts, Zota and Sanoya as well. With these additions, the AIRS Liberia team exceeded the target by spraying a total of 42,708 structures and achieving a reported 96.3 percent coverage. Due to increased resistance against pyrethroids and the shorter residual life of carbamates, organophosphates were used for the 2013 IRS campaign.

AIRS Liberia conducted a post-spray data quality audit (PSDQA) in August to validate spray coverage. Preliminary results indicate 92.4 percent of eligible structures were sprayed compared to the 96.3 percent spray coverage figure in the 2013 End of Spray Report (EOSR). The forthcoming *PSDQA Results Summary Report* for Liberia, which will be completed before the end of 2013, will provide more details.

In addition to spraying, the Liberia team hired a local contractor to create a container insectary modeled after the AIRS Mali insectary-in-a-box.

## CHALLENGES AND LESSONS LEARNED

- During the dry season, it was difficult to capture enough mosquitoes for the pre-spray baseline survey.
- Administrative procedures and permit requirements have significantly delayed the start of the work on the mobile insectary. AIRS continues to coordinate with the NMCP and PMI mission to complete all requirements, such as signing a Memorandum of Understanding (MOU) and getting a permit to construct the insectary.

## I.8 MADAGASCAR

**TABLE 6: AIRS MADAGASCAR AT A GLANCE**

	Central Highlands	Southern Madagascar	Totals
Number of districts sprayed by PMI-supported IRS in 2012	41 communes located in Ambohimahaso, Ambositra, Ankazobe, Anjzorobe, Betafo, and Mandoto districts	103 communes located in Amboasary, Ambovombe, Ampanihy, Bekily, Beloha, Betroka, Tsihombe and Tolagnaro districts	144 communes
Insecticide	Carbamate: Ambatofinandrahana, Anjzorobe, Ankazobe, Betafo, and Mandoto Pyrethroid: Ambohimahaso and Ambositra	Carbamate: Amboasary, Ambovombe, Ampanihy, Bekily, Beloha, Betroka, Tolagnaro, and Tsihombe	Carbamate and Pyrethroids
Number of structures sprayed by PMI-supported IRS	87,081	284,310	371,391
Number of structures targeted by PMI-supported IRS	90,601	289,473	380,074
2012-2013 spray coverage	96.1%	98.2%	97.7%
Total population protected by PMI-supported IRS	522,292	1,259,698	1,787,981
Pregnant women protected	12,835	47,311	60,146
Children under 5 years old protected	83,984	287,717	371,701
Dates of PMI-supported IRS campaign	November 26, 2012 through December 31, 2012	February 4, 2013 through April 29, 2013	November 26, 2012 through April 29, 2013
Length of campaign	35 days	59 days	94 days
Number of people trained with USG funds to deliver IRS <sup>1</sup>	1,284	2,095	3,379

<sup>1</sup>This is based on the PMI indicator definition. It includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

### ENTOMOLOGY

The AIRS Madagascar entomological surveillance teams finished entomological data collection for the 2012-2013 IRS campaign in April 2013. Final results were reported in the annual entomological report, which was approved by PMI in September 2013. Key results noted in the report include:

**Residual Life.** Residual life for carbamates used during the 2012-2013 IRS campaign was two to three months in both the Central Highlands and southern Madagascar. Two months after spraying, T2 mortality rates for mosquitoes fell below 80 percent at one sentinel site in the Central Highlands. In the southern Madagascar sentinel site, mortality rates decreased to 65 percent on mud walls, however residual efficacy continued to be above 85 percent on wood walls after T2.

Residual life for pyrethroid-class insecticide was over five months at the sentinel site in the Central Highlands, with close to 100 percent mortality reported on both mud and wood walls.

**Susceptibility.** AIRS Madagascar used both WHO and CDC bioassay methods to conduct susceptibility tests for the four insecticide classes (pyrethroids, carbamates, organophosphates, and DDT) that could be used for IRS in Madagascar. The tests indicated complete susceptibility of local *An. gambiae* s.l. to pyrethroids (deltamethrin and lambda-cyhalothrin), and carbamates (bendiocarb). However, bioassay data noted possible resistance and full resistance for DDT at various sites. CDC bottle bioassay data indicated possible resistance at four sentinel sites (85 percent mortality rate at Amboasary; 95 percent mortality rate at Soavia-Betafo; 90 percent mortality rate at Soavina-Ambatofinandrahona; and 94 percent mortality rate at Antoetra); and full resistance at one sentinel site (59 percent mortality rate at Kiangara). WHO bottle bioassay data noted susceptibility at one sentinel site (98 percent mortality rate at Amboasary); possible resistance at two sentinel sites (87 percent mortality rate at Soavina-Ambatofinandrahona; and 95 percent mortality rate at Antoetra); and full resistance at two sentinel sites (72 percent at Kiangara; and 36 percent at Soavina-Betafo).

**Vector Behavior.** Vector density was low in all areas so it is hard to make a conclusion based on the data. However, AIRS Madagascar noted that biting rates indoors were reduced from baseline through several months after the IRS campaign.

- In the pyrethroid spray area in the Central Highlands, biting rates were noted as 0.2 bites per person per night indoors before the IRS campaign and less than 0.1 bites per person per night indoors five months after spraying.
- In the carbamate spray areas in the Central Highlands, the baseline biting rate indoors ranged from 2.5 bites per person per night to 0.3 bites per person per night. Five months after spraying, the biting rate indoors decreased, ranging from 1.8 bites per person per night to 0.1 bites per person per night.
- In the south, the baseline biting rate indoors was 1.8 bites per person per night before the IRS campaign, and decreased to 0.3 bites per person per night two months after spraying.

AIRS is currently discussing with the Institut Pasteur about the possibility of using their laboratories for molecular analysis for the 2013-2014 IRS campaign.

Additionally, PMI and the NMCP agreed that for the 2013-2014 IRS campaign, all 10 sentinel sites where AIRS Madagascar will complete entomological surveillance will be located in districts where PMI supports IRS. In previous years, PMI-supported entomological surveillance was completed at several national sentinel sites located in non-PMI supported IRS districts.

## PROGRAM HIGHLIGHTS

The 2012-2013 IRS campaign—the first conducted by the AIRS project in Madagascar—ended on April 29, 2013 in southern Madagascar. AIRS sprayed 371,391 structures and assured high-spray coverage in both the Central Highlands and Southern Madagascar.

Following campaign close-out activities in May, AIRS Madagascar has thoroughly assessed the challenges of this campaign, and devised new strategies and systems to strengthen its IRS program. This includes hiring new staff, including district coordinators in southern Madagascar and a full-time operations manager. AIRS Madagascar hired the operations manager from the AIRS Benin team, as this individual has significant IRS experience and has been lauded for his achievements in Benin.

The AIRS project built over 600 soak pits for the 2012-2013 IRS campaign to ensure that spray teams could dispose of insecticide-contaminated waste water. However, this was far too many soak pits for the AIRS Madagascar Environmental Compliance Officer (ECO) to properly monitor before, during, and after the IRS campaign. To remedy this, AIRS is developing a “mobile soak pit” for the 2013-2014 IRS campaign. This is a small, sturdy plastic box containing the sediments found in a standard soak pit (sawdust, activated charcoal, and sand), a sieve or perforated liner (made of plastic or metal), and a slit cover that locks. The mobile soak pit is small enough for spray teams to carry to remote areas. After

initial testing and data collection by the AIRS Madagascar ECO in August 2013, the portable soak pit is ready for use during the 2013-2014 IRS campaign. Thanks to this innovation, AIRS Madagascar will only need to build 58 soak pits, improving its environmental compliance and reducing the footprint of the project in many remote areas. AIRS Madagascar will continue to build large-scale soak pits in high-density areas.

AIRS Madagascar has begun preparations for the 2013-2014 IRS campaign. Following discussions between PMI, AIRS, and the NMCP, AIRS Madagascar will spray pyrethroids in two districts in the Central Highlands (Ambositra and Ambohimahasoia), carbamates in the other five districts in the Central Highlands, and organophosphates in the seven districts located in southern Madagascar. AIRS Madagascar will receive leftover pyrethroids and organophosphate stocks from AIRS Liberia, which reduces the quantity of insecticide to procure. AIRS Madagascar has also completed the selection of operation sites and developed plans for the refurbishment of soak pits and store rooms.

The EOSR describing the 2012-2013 IRS campaign was accepted by PMI in September 2013.

## **CHALLENGES AND LESSONS LEARNED**

Following the 2013-2014 IRS campaign, AIRS Madagascar noted losses of various PPE stock—especially overalls, gum boots, helmets, and flashlights—as well as 244 sachets of carbamates. After an investigation, the AIRS Madagascar team concluded that most of the losses were due to: 1) limited monitoring and supervision of the inventory management system, especially not ensuring the physical inventory in store rooms matched the store cards; and 2) insufficient management of spray operators at the end of the campaign in southern Madagascar to ensure they returned overalls and gum boots to the project rather than taking these items home. AIRS Madagascar has re-organized under-performing logistics staff, implemented new inventory management controls (including numbering of all insecticide sachets and bottles for better tracking), and developed a new SMS inventory reporting system that all district coordinators and sector managers must complete daily. Finally, AIRS Madagascar will implement a new system whereby seasonal staff will not receive final payments until after all PPE and insecticide has been returned and accounted for.

Several incidents occurred during the IRS campaign in the south, including the death of several geese after eating insects from an IRS-sprayed structure; a motorcycle accident involving a seasonal staff member; and two instances of seasonal staff exposure to insecticide-contaminated water due to improper use of PPE. AIRS Madagascar regrets the late reporting of these incidents. During the 2013-2014 campaign, AIRS Madagascar will report incidents to PMI within 48 hours after the incident.

The IRS campaign in the south was originally scheduled to be completed by April 24, 2013. However, a national mother-child health week implemented by the Ministry of Health from April 21 to 26 delayed completion until April 27, 2013.

The Adonis2 Incinerator in Antananarivo, contracted to complete the incineration and disposal of solid wastes from the 2012-2013 IRS campaign, went through a series of refurbishments and repairs, leading to delays in completing solid waste disposal for the campaign until September 2013.

## 1.9 MALI

**TABLE 7: AIRS MALI AT A GLANCE**

Number of districts sprayed by PMI-supported IRS	3
Insecticides	Carbamates
Number of structures sprayed by PMI-supported IRS	228,985
Number of structures targeted by PMI-supported IRS	233,789
Spray coverage	97.95%
Total population protected by PMI-supported IRS in 2013	850,104
Pregnant women protected	22,405
Children under five years old protected	153,962
Dates of PMI-supported IRS campaign in 2013	August 1 through September 19, 2013
Length of campaign	46 days
Number of people trained with USG funds to deliver IRS <sup>1</sup>	853

<sup>1</sup>This is based on the PMI indicator definition. It includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

### ENTOMOLOGY

Since most entomological surveillance results for the 2013 IRS campaign will be reported in the final entomological report in December, this section briefly explains surveillance completed before and during the IRS campaign.

**Entomological Surveillance Baseline.** In July, baseline data was collected by AIRS Mali at four sentinel sites: Koulikoro and Kati districts in Koulikoro region; and Bla and Baroueli districts in Segou region. Key results from the baseline data collection showed that, *An. gambiae* s.l. are still susceptible to carbamates with 100 percent mortality in Koulikoro district and 98 percent mortality rates in Bla and Baroueli.

**Quality Control Testing and Monitoring.** At the beginning of the IRS campaign, a quality control assessment was carried out at four sentinel sites (Tienfala and N'Dentila in Koulikoro district, Tigui in Baroueli district, and Touna in Bla district). Test mortality rates of susceptible mosquitoes exposed to carbamate-sprayed walls ranged from 99 to 100 percent in all three districts (100 percent in Koulikoro and 99 percent in both Bla and Baraouéli districts) – indications of good and consistent quality of spraying in these locations.

### PROGRAM HIGHLIGHTS

During this reporting period, AIRS Mali prepared and carried out the 2013 IRS spray campaign in the program's three targeted districts, over 46 days. Although initially concerned about a delay to the IRS campaign due to the Presidential elections, the AIRS Mali team prepared thoroughly for the IRS campaign, and was able to start the IRS campaign on-time, spraying 228,985 structures and protecting 850,104 persons. AIRS Mali also confronted spray scheduling issues concerning Ramadan, but through careful planning, AIRS Mali was able to keep the IRS campaign moving forward and completed the IRS campaign on-time. Due to a change in US government regulations, AIRS Mali conducted all activities before, during, and after the 2013 IRS campaign with the Malian government. Thereby, AIRS Mali worked to develop local capacity at the community, district, regional and national levels. The 2013 IRS campaign also marked the first time that AIRS Mali conducted the pre-campaign environmental compliance inspections using smartphones. AIRS Mali also continued to use an innovative insecticide tracking system, which included adhering an identification number on each sachet of insecticide and cataloging the sachet identification number in an electronic database. During the IRS campaign, AIRS Mali kept track of when and where each insecticide sachet was given to a spray operator via the identification number and when the empty sachet was returned after spraying. This allowed AIRS Mali to

accurately keep track of where each sachet was used for spraying in case of inappropriate use, theft, or intoxication.

## **CHALLENGES AND LESSONS LEARNED**

- The 2013 campaign successfully achieved objectives despite interruptions due to heavy rains and presidential elections.
- Spray operators did not mark structure walls or doors as sprayed, which made it difficult for them to find unsprayed structures and slowed down progress. In 2014, spray operators will use markers to mark sprayed structures at the time they fill out their form.
- Mosquito density was already high in spray communities at the time of the IRS campaign; communities proposed the IRS campaign start at least one month earlier.

## **1.10 MOZAMBIQUE**

### **ENTOMOLOGY**

Entomological activities conducted from April through September 2013 include the following:

- During an entomological short term technical assistance trip conducted in June by the AIRS Technical Director, AIRS Mozambique staff and insectary management staff in Quelimane were trained on correct morphological identification of malaria vectors.
- In July, AIRS Mozambique began baseline entomological surveillance data collection, by completing Pyrethrum Spray Catches (PSC) and Human Landing Catches (HLC). This data allowed AIRS Mozambique to identify mosquito density and behavior, and will enable AIRS to understand the impact of the upcoming IRS campaign, which will start in early October.
- The final report for entomological monitoring, covering September 2012 to February 2013 was submitted to PMI on August 9.

### **PROGRAM HIGHLIGHTS**

District selection for the 2013 IRS campaign was completed in April, with PMI and the NMCP agreeing to reduce the number of districts for the 2013 spray campaign from six to four: Milange, Morrumbala, Mocuba and Quelimane districts. AIRS Mozambique primarily spent this period, completing pre-spray and IRS campaign set-up activities. On June 20, 2013, AIRS Mozambique established an MOU with the Ministry of Health regarding the 2013 IRS campaign. The MOU established that the NMCP would assist with IRS campaign seasonal staff hires, and also provide training and supervision for the seasonal staff. Additionally, AIRS Mozambique also completed quantification of IRS campaign equipment and materials, organized a provincial-level IRS campaign planning meeting, completed pre-spray environmental inspections at 20 operation bases, carried-out local and international procurements, and trained over 1,000 seasonal staff. Insecticide was donated from the NMCP to the 2013 IRS campaign, resulting in major cost savings.

AIRS Mozambique also underwent a few full-time project staff changes, as the project's COP resigned and was replaced by the project's Deputy Chief of Party (DCOP) after an external and internal candidate search.

The highly anticipated approval for vehicle auctions, to allow for the sale of older project vehicles was provided by PMI to AIRS on September 30. The AIRS Mozambique team will work on the auction after the 2013 IRS campaign is completed.

## CHALLENGES AND LESSONS LEARNED

- Following an inspection by the Ministry of Labor after the 2012 spray campaign, AIRS Mozambique implemented several changes to its recruitment and hiring of seasonal staff to ensure the project is compliant with local labor laws. Thus seasonal staff was contracted via two mechanisms: a local temporary employment agency, and via an MOU, the Ministry of Health also hired seasonal staff on behalf of AIRS Mozambique.
- Due to budget constraints, the 2013 IRS campaign was reduced to cover only four districts. The insecticide donated by the NMCP for the AIRS Mozambique project was not enough to meet the best practice put in place for insecticide buffer stock. Abt's IRS best practice is to achieve as close as possible to 100% coverage rate with a 20% insecticide buffer stock to account for any issues that can arise in the midst of implementation. After several discussions with the Provincial Health Directorate (DPS) in Quelimane, it was determined that AIRS would have to try and make do with a 5% buffer stock.
- Following an internal review on various project expenditures, AIRS Mozambique, in conjunction with the AIRS Core team noted several spending irregularities. Due to these irregularities some staff was let go, and AIRS put-in-place several tighter financial controls on the project's spending. AIRS Mozambique also worked with USAID's Regional Inspector General's office to further investigate the situation and recommend further action to prevent future issues.

### 1.11 NIGERIA

**TABLE 8: AIRS NIGERIA AT A GLANCE**

Number of local government areas sprayed by PMI-supported IRS in 2013	2 (Doma and Nasarawa Eggon)
Insecticide	Pyrethroids
Number of structures sprayed by PMI-supported IRS in 2013	62,592
Number of structures targeted by PMI-supported IRS in 2013	64,191
2013 spray coverage	97.5%
Total population protected by PMI-supported IRS	346,798;
Pregnant women protected	16,733
Children under five years old protected	67,204
Dates of PMI-supported IRS campaign	April 11 through May 18, 2013
Length of IRS campaign	33 days
Number of people trained with USG funds to deliver IRS <sup>1</sup>	381

<sup>1</sup>This number includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

### ENTOMOLOGY

Following baseline entomological data collection in March, AIRS Nigeria conducted quality spray tests and monthly IRS monitoring. The spray campaign began in early April in two intervention areas (Nassarawa Eggon and Doma) and one control area (Lafia). Cone bioassay tests for spray quality residual efficacy with deltamethrin recorded 100 percent 24-hour mortality with Kisumu strains in April and May, and 98.7 percent in June, two months after spraying. Residual efficacy of the insecticide gradually decreased to 97.9 percent in August and 91.6 percent in September with susceptible mosquitoes.

At baseline, the mean number of bites per person per night between indoor and outdoor biting *Anopheles gambiae* s.l. mosquitoes was not significantly different in the two intervention areas versus the control area. Data from mosquitoes collected during post-spray monitoring in the intervention areas demonstrated lower indoor densities and biting rates than the control area.

Using WHO-recommended techniques for parity, the team found the longevity of the vector significantly declined post spraying in May in the intervention villages (17.69 and 27.98 percent) compared to the control area (68 percent). The observed reduced life expectancy of the vector in the intervention villages, signified a positive impact of the 2013 IRS campaign.

## **PROGRAM HIGHLIGHTS**

The project conducted the 2013 IRS campaign between April 11 and May 18. The 2013 IRS campaign was marked by the inclusion of government officials from the NMCP, National Environmental Standards and Regulations Enforcement Agency (NESREA), state MOH, and local authorities to complete comprehensive supervision of the IRS campaign. AIRS Nigeria gave these government officials the project's supervisory checklists and data collection verification forms, and assigned various spray areas to the government staff for observing and monitoring the 2013 IRS campaign. Staff from the Anambra State Malaria Control Program observed the 2013 IRS campaign in order to understand how to implement World Bank funded IRS in their state.

The AIRS Core team's M&E Specialist, along with the AIRS Nigeria M&E manager and database manager, facilitated a three-day meeting in June with the Integrated Vector Management (IVM) and M&E branches of the NMCP, to familiarize them with the AIRS M&E system and build local capacity in IRS monitoring and evaluation.

As part of the project's objective to establish a model IRS program for government staff to learn how to complete IRS, the AIRS Nigeria team carried out a national training on IRS best practices in collaboration with NMCP. This three-day training attracted representatives from all 36 Nigerian states and the Federal Capital Territory.

## **CHALLENGES AND LESSONS LEARNED**

- AIRS Nigeria staff used SMS regularly to provide mass messaging to the seasonal staff to make sure they understood key IRS campaign policies and guidelines, answer common IRS campaign management questions, and provide feedback to the seasonal staff on how the IRS campaign was progressing. This proved to be effective in organizing IRS campaign seasonal staff, and assuring open communication between seasonal and full-time staff.

## I.12 RWANDA

**TABLE 9: AIRS RWANDA AT A GLANCE**

Number of districts sprayed by PMI-supported IRS	3 districts (Bugesera, Gisagara, and Nyagatare)
Insecticide	Pyrethroids in Bugesera and Gisagara; Carbamates in Nyagatare
Number of structures sprayed by PMI-supported IRS	224,708
Number of structures targeted by PMI-supported IRS	229,039
Spray coverage	98.1%
Total population protected by PMI-supported IRS	957,027
Pregnant women protected	16,023
Children under five years old protected	147,531
Dates of PMI-supported IRS campaign	September 2 through October 12
Length of campaign	30 days
Number of people trained with USG funds to deliver IRS <sup>1</sup>	1,875

<sup>1</sup>This is based on the PMI indicator definition. It includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

### ENTOMOLOGY

Monthly WHO cone bioassay tests following the February 2013 IRS campaign continued into April, May, June, and July 2013. Test mortality rates remained high two to five months after spraying, noting results that were greater than the 80 percent threshold needed to provide maximum protection. At six months post-spray (August, 2013), the average mortality rate was 72.5 percent for the susceptible *Anopheles gambiae* s.l. This marked the first time that the insecticide that was sprayed in February was noted as dropping below the 80% threshold.

Further entomological surveillance work completed during the reporting period showed a predominance of *Anopheles gambiae* s.l. in the three IRS districts. Molecular identification noted that *An. arabiensis* was the dominant species (76 percent). Human biting rates (HBR) remained relatively high despite IRS intervention, recording averages (for the months March- August) of 15.8 (indoor) and 25.4 (outdoor), 3.5 (indoor) and 9.3 (outdoor), and 40 (indoor) and 41.8 (outdoor) bites/person/night for Bugesera, Gisagara and Nyagatare sentinel sites respectively. This could be due to the presence of breeding sites in the wetlands/swamps that are often within or neighboring most areas covered by the IRS campaign. Through the night vector biting was observed to increase starting at 10:00 PM, peaking at 2:00 AM.

During the September 2013 IRS campaign, WHO cone bioassays were used to conduct quality assurance testing. Results showed mortality rates of 96 to 100 percent using susceptible *An. gambiae* s.l., indicating good spray quality for both pyrethroids and carbamates.

### PROGRAM HIGHLIGHTS

The September-October 2013 IRS campaign (second spray round for the year) began implementation on September 2, and is scheduled to end around October 12. Pyrethroids are being used in Bugesera and Gisagara districts, and carbamates are being used in Nyagatare district. Initial data from the IRS campaign notes high spray coverage of 98.1 percent.

In addition to the targeted structures in the three campaign districts of Nyagatare, Gisagara and Bugesera, AIRS Rwanda supported spray activities by special IRS teams in prisons, as well as police and military camps located throughout the country. These additional IRS campaigns covered 5,865 structures and protected 33,353 people.

## CHALLENGES AND LESSONS LEARNED

- During the last three spray rounds, the project has learned the importance of incorporating IRS into district annual work plans for proper coordination with local authorities on IRS planning, implementation, and supervision.
- Community health workers in charge of IEC coordination in the sectors must be engaged to enhance coordination and acceptability of IRS at the community level. Further, while local leaders are critical in mobilizing and enhancing IRS acceptability, their role and engagement in IRS needs to be re-evaluated to maximize their involvement.

### I.13 SENEGAL

**TABLE 10: AIRS SENEGAL AT A GLANCE**

Number of districts sprayed by PMI-supported IRS in 2013	2 districts, Malem Hodar and Kounguel, in Kaffrine region 1 district, Koumpentoum, in Tambacounda region 1 district, Velingara, in Kolda region
Insecticide	Carbamates
Number of structures sprayed by PMI-supported IRS in 2013	207,116
Number of structures targeted by PMI-supported IRS in 2013	212,979
Spray coverage	97.2%
Total population protected by PMI-supported IRS	690,029
Pregnant women protected	15,592
Children under five years old protected	126,888
Dates of PMI-supported IRS campaign	July 15 through September 3, 2013
Length of IRS campaign	49 days
Number of people trained with USG funds to deliver IRS <sup>1</sup>	933

<sup>1</sup>This is based on the PMI indicator definition. It includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

## ENTOMOLOGY

The vector and parasite ecology laboratory of Université Cheikh Anta Diop (UCAD) in Dakar supports entomological monitoring for the IRS program. UCAD began bioassay tests for the 2013 IRS campaign in August and will continue monitoring residual life for the next six months. Tests during spraying in August and September showed 100 percent mortality rates of susceptible colonies in two intervention areas, after a 30-minute exposure and 24-hour holding period, indicating good-quality spraying.

## PROGRAM HIGHLIGHTS

Considering the lessons learned from the 2012 spray campaign, AIRS Senegal ensured early preparation of operational sites, distribution of equipment and materials, and training, to allow time for any readjustment before the start of the campaign. The project also hired four full-time district coordinators to help with setting-up the IRS campaign early and to provide more supervision within each IRS campaign district.

The 2013 IRS campaign started July 15 in Malem Hodar district and on July 17 in Kounguel, Koumpentoum and Velingara districts. AIRS Senegal completed IRS campaign supervision jointly with representatives from the National Hygiene Service, NMCP and district health offices. All IRS campaign supervision focused on improving the quality of the IRS campaign and adherence to environmental compliance protocols. USAID/Senegal's Director of Environment and USAID Health Team

representatives also were active in observing spray operations and making certain that inventory management issues improved.

AIRS Senegal successfully negotiated with a local cement factory to incinerate 1,350 kg of contaminated solid waste (masks, empty pesticide sachets) collected during the spray campaign. Plastic solid waste was decontaminated and cut into small pieces, which will be given to local companies for recycling or disposed of in public waste disposal sites.

## CHALLENGES AND LESSONS LEARNED

- Spray operations did not begin in Medina Gounass, an area within Velingara, until August 12 due to Ramadan and local politics. To expedite the spray campaign there, the project transferred spray operators from other districts where spraying was already completed.
- Implementing the spray campaign during the rainy season and during the month of Ramadan provided AIRS with a better understanding of the unique challenges of hard-to-reach areas, and the need to readjust the spray calendar to better accommodate the local population.
- By collaborating with NMCP for IEC activities, the program was able to leverage roles and responsibilities of IEC staff. The IEC experience gained during the 2013 campaign will be very helpful for next year's operations.
- Involvement of local authorities has been crucial to properly conduct mobilization campaigns and help resolve difficult refusal cases during the IRS campaign.
- Use of the smartphone for environmental inspections helped transmit results faster and obtain work sheets with the action items required for site and soak pit refurbishments.

## 1.14 ZAMBIA

**TABLE 11: AIRS ZAMBIA AT A GLANCE**

Number of districts sprayed by PMI-supported IRS in 2013	12 districts in Muchinga and Northern provinces
Insecticide	Carbamates
Number of structures sprayed by PMI-supported IRS	169,660
Number of structures targeted by PMI-supported IRS	224,353
Spray Coverage	75.6%
Population protected by PMI-supported IRS	715,828
Dates of PMI-supported IRS campaign	March 18 to May 18, 2013
Number of people trained with USG funds to deliver IRS <sup>1</sup>	450

<sup>1</sup>This is based on the PMI indicator definition. It includes only spray staff such as spray operators, team leaders, supervisors, and clinicians. It excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

Note: The table presents results of the second spray round with carbamate that PMI conducted in the spring of 2013. AIRS provides technical assistance but does not lead IRS operations or collect IRS data in Zambia.

## ENTOMOLOGY

AIRS does not provide entomological monitoring for the Zambia IRS campaign.

## PROGRAM HIGHLIGHTS

The USAID Bureau Environmental Officers for Africa and for Global Health approved the use of long-lasting organophosphate in all 20 target districts for the 2013 spray season. AIRS procured and delivered insecticides and other IRS commodities well ahead of the spray season. However, while in transit from South Africa to Zambia, a shipping agent's vehicle was ransacked, and consequently 12 boxes of

organophosphate CS were stolen. The value of the inventory that was stolen was refunded to the project/PMI by the manufacturer.

AIRS Zambia conducted the 2012 post-spray inspection in February 2013 for districts that sprayed organophosphates and in May 2013 after the districts using carbamate completed the second round of spraying. In August and September 2013, AIRS completed pre-spray inspections for the 2013 season in 17 districts. Only a few districts needed minor refurbishments of IRS facilities before the campaign.

Following the first round of the 2013 IRS campaign, AIRS Zambia, with support from Zambia Environmental Management Agency (ZEMA) and Zambia Integrated Systems Strengthening Program (ZISSP), incinerated empty sachets in 12 districts that sprayed carbamate class insecticides. AIRS Zambia is currently in discussions with ZEMA, the National Malaria Control Center, and private companies to discuss options for recycling the empty plastic organophosphate bottles left-over from the IRS campaign.

AIRS Zambia trained 365 spray operators (125 female and 240 male) on the material safety data sheet for using organophosphates, as well as on insecticide safety requirements from PMI's Best Management Practices Manual. AIRS also funded logistics training—administered by ZISSP—of 59 store keepers, three provincial medical officers, 20 district medical officers and three chief environmental health officers.

## CHALLENGES AND LESSONS LEARNED

- Disposal of the empty plastic organophosphate bottles is proving to be difficult. AIRS Zambia has noted that there is a high-cost for recycling plastics in Zambia as compared to other AIRS countries.
- Lack of sufficient storage space in some districts has resulted in insecticide boxes being stacked too high, and store rooms are sometimes crowded with non-IRS items.
- Government funding for districts is inadequate to implement some recommendations made during environmental inspections, so some compliance issues remain unresolved. For example, some districts need to construct storerooms that meet required PMI standards.

## 1.15 ZIMBABWE

### ENTOMOLOGY

AIRS Zimbabwe completed its final entomological surveillance data collection for the 2012 IRS campaign in April 2013 at the Murara sentinel site (Mashonaland East) and Kasimure sentinel site (Mashonaland West). AIRS Zimbabwe intended to collect data from its control site in Goromonzi district. However, after a malaria outbreak at the control site and a decision by the NMCP to spray the area around the control site, AIRS Zimbabwe cancelled its April data collection.

The final bioassay results for the 2012 IRS campaign, five months after spraying, showed mosquito mortalities after the 24-hour observation period declined below 90 percent in Mashonaland East Province (86.67 percent on mud walls, 73.33 percent on paint and 38.34 percent on cement surfaces).

AIRS Zimbabwe presented its entomological surveillance results during provincial IRS review meetings in May and June 2013. AIRS Zimbabwe's final entomological report for the 2012 IRS campaign was finalized in July 2013.

In September 2013, AIRS Zimbabwe began baseline (pre-spray) entomological data collection at its sentinel sites: Kasimure in Mashonaland West Province, Kawere in Mashonaland East Province, and Burma Valley in Manicaland Province. AIRS Zimbabwe will use Chabwino Farm in Mashonaland East Province as its control site. Preliminary results for indoor resting density have noted low numbers of *Anopheles* mosquitoes collected (1 at Kasimure, 0 at Kawere, 18 at Burma Valley, and 1 at Chabwino Farm). Light trap collections have noted mostly exophagic behavior, as 61 anopheline mosquitoes were caught in traps set outdoors compared to 33 indoors.

AIRS Zimbabwe has improved the entomological surveillance capacity of the NMCP and other malaria stakeholders. In June 2013, AIRS Zimbabwe assisted two CDC entomologists to complete a PMI-led entomological training to build the capacity of the NMCP and other malaria partners to collect and analyze data on insecticide resistance. Sixty-one people participated in the trainings from the Ministry of Child Health and Welfare, including the NMCP, the National Institute of Health Research (NIHR), staff from the provincial health offices and key malaria stakeholders. Specific skills and techniques covered during training included: techniques to measure mosquito resistance to insecticides (particularly via CDC bottle bioassay), molecular analysis to identify malaria vector species and mechanisms of insecticide resistance, and best insectary management practices to raise adult mosquitoes for insecticide resistance testing and other research.

In July 2013, AIRS Zimbabwe completed training with the NMCP and NIHR for all 16 insectary managers in Zimbabwe along with eight provincial field officers, two provincial environmental health officers, and three district environmental health officers on basic mosquito morphology, identification of vector species, mosquito behavior, techniques to conduct insecticide resistance data collection and analysis (using CDC and WHO techniques), and using cone bioassay tests to assess insecticide residual life.

## **PROGRAM HIGHLIGHTS**

AIRS Zimbabwe provided logistics and organizational support for provincial IRS review meetings in Mashonaland East, Mashonaland West, and Manicaland provinces in May and June 2013. At the meetings, the NMCP, provincial and district health offices, PMI, AIRS Zimbabwe and other malaria stakeholders presented results of the 2012 IRS campaign, and began planning for the 2013 IRS campaign.

During the “off-season,” AIRS Zimbabwe worked to improve the capacity of the NMCP and other malaria stakeholders. In August 2013, the project led environmental compliance training for 75 people from the provincial and district health offices, environmental health directorate, NMCP, NIHR, and the Environmental Management Agency. The training covered the insecticides used for IRS, soak pit construction, completing pre-IRS campaign assessments, supervising environmental compliance during the IRS campaign, methods for safely disposing liquid and solid wastes from the IRS campaign, and safely transporting insecticide.

AIRS Zimbabwe completed first-aid training in collaboration with the Zimbabwean Red Cross for 57 personnel from district health offices and NMCP in September 2013 to ensure understanding of how to manage insecticide intoxication, insecticide burns, and how to deal with a vehicle accident.

AIRS Zimbabwe also supported the NMCP-led M&E system training that re-introduced an IRS campaign data collection system using mobile phones. The M&E system training was attended by 45 data managers from each district who will conduct IRS in 2013, plus field officers from all eight provinces.

Finally, AIRS Zimbabwe supported the NMCP to facilitate a spray-pump repair training in September 2013, building capacity within spray teams to repair spray pumps on-site. Fifty-seven people attended this training, including IRS coordinators and district environmental health officers.

In March 2013, AIRS Zimbabwe completed an evaluation that determined that provincial incinerators did not meet appropriate standards to safely dispose of IRS campaign solid waste. AIRS Zimbabwe then worked with the NMCP and provincial health officers in Manicaland, Mashonaland East, and Mashonaland West to transport IRS campaign solid waste from the provinces to the Bromar and Bytes International Plant in Harare. This incinerator is one of the country’s few incinerators licensed by the Zimbabwean Environmental Management Agency to incinerate hazardous substances. Overall, 340 kg of IRS campaign solid waste were safely disposed of at the Bromar and Bytes International Plant.

AIRS Zimbabwe also helped prepare for the 2013 IRS campaign that began in October. This includes construction of 48 additional soak pits in districts that will spray pyrethroids. AIRS Zimbabwe also procured PPE and spray pump spare parts. During the pre-IRS campaign training for national and

provincial IRS campaign staff and supervisors, AIRS Zimbabwe gave presentations on environmental compliance/safety issues and entomological surveillance activities (particularly conducting bioassay tests to monitor the quality of spraying during the first week).

The final 2012 AIRS Zimbabwe EOSR was approved on September 19, 2013.

## **CHALLENGES AND LESSONS LEARNED**

AIRS Zimbabwe has worked to build a good relationship with the NMCP and other malaria stakeholders, including regular meetings to ensure they are fully aware of AIRS activities, and where possible having NMCP and provincial health staff accompany AIRS Zimbabwe to complete project work. AIRS Zimbabwe and the NMCP also signed an “Outline of Agreed Activities” in September to describe expectations of both organizations to support each other’s work during the 2013 IRS campaign.

The NIHR could not provide mosquitoes from its susceptible colony for entomological surveillance work during the 2012 IRS campaign due to the low population of the colony. This led the AIRS Zimbabwe entomologist to work with resident insectary managers at each sentinel site to raise adult *An. gambiae* s.l. from larvae and pupae collected from the field. This process took several days and led to delays in completing entomological surveillance activities. To remedy this issue, AIRS Zimbabwe has provided technical assistance to the NIHR to bolster its susceptible colony. AIRS Zimbabwe is also working with the NIHR to refurbish insectaries in Chiredzi and Harare to ensure better conditions for breeding susceptible mosquito populations.

Initially, PMI requested that AIRS Zimbabwe provide technical assistance nationally, and expand the project’s scope to include all districts that complete IRS (24 districts use pyrethroid-class insecticides, and 22 districts use DDT). AIRS was thus required to amend the current Supplemental Environmental Assessment, as it did not provide an environmental mitigation plan regarding DDT. However, the NMCP declined to support completion of the SEA Amendment in May 2013 and postponed the activity to the first or second quarter of 2014. PMI and AIRS Zimbabwe have decided to revisit their support for the DDT districts following the 2013 IRS campaign.

## 2. CORE ACTIVITIES

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### 2.1 PROJECT RETREAT

Each year, Abt Associates sponsors a COP Conference, bringing to Abt Associates' corporate offices in Bethesda, Maryland, USA all project COPs from its international divisions. AIRS took advantage of this conference, which included all AIRS COPs, to hold an additional AIRS retreat over 2.5 days from June 10 to 12 in Richmond, Virginia, USA. AIRS also invited the COP for Abt Associates' bilateral ZISSP project, which manages IRS activities in Zambia. The retreat, entitled "Technical and Managerial Accountability," was structured around presentations and breakout sessions on the use of existing and new tools to improve supervision and increase accountability at the country level for each technical/functional component of IRS. Presentations included:

- Operations and Logistics Management (introduction of AIRS Supervisory Toolkit and the Warehouse Pocket Guide)
- Environmental Compliance (introduction of smartphones for environmental compliance assessments and completing pre-IRS campaign "green-light" checklists)
- Monitoring and Evaluations (introduction of supervisory tools to improve spray data quality and tools for completing a Post-spray Data Quality Audit)
- Entomological Monitoring (introduction of the AIRS entomology database)

During breakout sessions, participants brainstormed how three groups—COPs, district coordinators and government supervisors—can best use these tools for furthering their supervision and involvement in the IRS campaigns to ensure the quality of the IRS campaigns. Other topics included implementation of the Country Capacity Assessments, discussion of the initial results of the draft costing analysis, finance and contract issues, and project communications and knowledge management. Innovation working groups also met to catalyze in-process and new innovations, such as right-sizing soak pits, community-based IRS, and spray quality assurance techniques that AIRS looked to begin implementing during the IRS campaigns in southern Africa, and during various IRS campaigns in 2014.

### 2.2 CAPACITY ASSESSMENT

The AIRS project continues to work on assessing the capabilities of local stakeholders to take greater ownership of IRS programming. During this reporting period, the project made significant progress towards completion of the CAP, with most AIRS countries presenting findings from the CAPs to PMI, and some countries able to also share the results with some local stakeholders. AIRS Rwanda is at the most advanced stage after finalizing its CAP report, and convening a stakeholder meeting to go over the results of the CAP. The stakeholder meeting also produced a draft national capacity building plan, outlining activities in the short- and long-term to assure local stakeholders begin the implementation and management of IRS activities. See Table 12, to gain an update on the status of the CAPs in each AIRS project country.

**TABLE 12: AIRS COUNTRY CAPACITY ASSESSMENT PROGRESS**

<b>Country</b>	<b>Status as of September 30, 2013</b>
Angola	AIRS presented CAP to PMI Washington and the Mission; waiting for guidance on how (if at all) to present the results to country stakeholders.
Benin	AIRS is finalizing the framework scoring; and will complete a meeting with PMI-Washington and PMI-Benin regarding the results of the CAP in October/November.
Ethiopia	AIRS presented CAP to PMI-Washington and PMI-Ethiopia, which agreed on scoring. AIRS will present to FMOH and regional health office in October/November.
Ghana	AIRS presented CAP to PMI-Washington and PMI-Ghana, and to country stakeholders. AIRS is currently developing a summary report.
Liberia	Due to downsizing program scope to entomology only, PMI agreed to only have AIRS submit the framework for the CAP.
Madagascar	Because AIRS is not allowed to work with the NMCP, the capacity assessment is not required.
Mali	AIRS presented CAP to PMI Washington and PMI-Mali; the project is planning a meeting with NMCP.
Mozambique	AIRS presented CAP to PMI-Washington and PMI-Mozambique; waiting for PMI-Mozambique to arrange a meeting with NMCP Director to share findings.
Nigeria	Due to downsizing the scope of the program to entomology only, PMI agreed to only have AIRS submit the framework.
Rwanda	Presented to PMI-Washington, PMI-Rwanda, and the NMCP. Assessment completed. Summary report approved. Draft CAP building plan is being developed.
Senegal	AIRS presented CAP results to PMI-Washington, PMI Senegal, and NMCP. The latter is reviewing the assessment results. A meeting is planned to harmonize both NMCP and AIRS results before making final recommendations for a capacity building plan.
Zambia	AIRS will present CAP to PMI-Washington, and PMI-Zambia in October; a meeting with NMCP to share results will be planned within next two months.
Zimbabwe	AIRS shared the results of the CAP with PMI-Washington and PMI-Zimbabwe in August. PMI advised AIRS not to disseminate the CAP to the NMCP at this point.

## 2.3 COST STUDY

In April, the AIRS Core team presented the initial draft of its cost analysis study. The objective of this study is to quantify the overall and country-level costs of implementing IRS in year one of the project, and explore why costs differ across countries. AIRS has received several rounds of comments and feedback from PMI leadership, and aims to finalize the report in October/November. Thereafter, AIRS will disseminate the report as requested by PMI.

## 2.4 TESTING RESIDUAL LIFE OF CARBAMATES

The residual life of carbamates was studied as part of IRS program monitoring during year one in Mali, Ethiopia, Senegal, Benin and Burkina Faso, all countries where carbamates were sprayed. Study data indicated a shorter residual life of the insecticide than expected—one to three months. These results triggered discussion among AIRS, PMI, and a carbamate manufacturer which generated recommendations for two additional studies, discussed below.

### *1. Study residual life of carbamates in experimental huts in Ethiopia*

This study measured the residual efficacy of two carbamates, bendiocarb and propoxur, which were sprayed in experimental huts with four different types of walls (mud, painted, dung-plastered, and a

specially treated mud wall). The huts were monitored monthly between April and September 2013. One of the treatments studied was an experimental hut with mud walls that were pre-treated with water, testing a hypothesis that this pre-treatment will reduce the amount of insecticide absorbed by the surface and improve bio-availability of insecticide after spraying, potentially increasing the residual life of bendiocarb. While residual efficacy of bendiocarb was significantly longer on painted surfaces compared to mud or dung walls, the pre-treated mud surfaces with water did not improve the residual life (see Table 13). AIRS did note that propoxur remained effective in all four treatment groups for six months.

**TABLE 13: RESIDUAL EFFICACY OF CARBAMATES SPRAYED ON DIFFERENT SURFACES**

Sprayed with	Types of walls	Time post spray						
		24 hours	1 months	2 months	3 months	4 months	5 months	6 months
Bendiocarb	Painted wall	100	100	100	100	100	100	100
	Dung plastered	100	63.3	55.6	22.2	7.1	0.4	1.3
	Mud wall pre-treated with water	100	66.7	0	15.2	2.2	6.7	9.4
	Mud wall without pre-treatment with water	100	66.7	4.4	4.4	6.7	16.3	9.7
Propoxur	Painted wall	100	100	100	100	100	100	100
	Dung plastered	100	100	100	100	100	92.8	92.9
	Mud wall pre-treated with water	100	93.3	100	100	100	100	100
	Mud wall without pre-treatment with water	100	81	100	100	100	95.3	100

## 2. Study interaction between bendiocarb and soil from intervention areas

AIRS sent mud samples from Ethiopia and Benin to Bayer’s laboratory facility in Germany. The mud samples sent to Bayer are the exact type of building material normally used in structures sprayed during an IRS campaign in Ethiopia and Benin. Bayer experimented with various pre-treating options—including water and other chemicals—to see if they increased residual life of Bayer’s carbamate-class insecticide, bendiocarb. Bayer’s results agreed with the AIRS field finding: pre-treating mud surfaces with water indicated no effect on residual life of bendiocarb. Bayer will continue to research other options for prolonging bendiocarb’s residual life on mud walls, including incorporating a polymer into the bendiocarb solution.

## 2.5 OPERATIONS, PROCUREMENT, LOGISTICS, AND FRAUD TRAINING

Abt Associates’ project and company staff held a three-day training in Bethesda, Maryland on April 10 through 12 to review procurement management principles, fraud awareness and protection strategies. Led by a compliance specialist, this workshop trained Finance and Administration Managers from eight AIRS project teams in procurement compliance, including consultant contracts, local vehicle procurement and rentals, international procurement processes and managing competitive procurements. Other topics included timesheets, local staff overtime policies, and local benefits compensation, as well as a detailed training by an audit specialist on fraud awareness and prevention. Attendees also discussed seasonal worker contracts and the best systems for paying seasonal staff. This training session was also

attended by home office finance and contract administrators, technical coordinators and project management.

## **2.6 M&E DATA CLEANING AND REPORTING TOOLS**

In 2013, the AIRS Ghana M&E Manager designed the AIRS Access Database Cleaning/Reporting Tool, which links to the AIRS database backend (i.e., the spray data) for two purposes: local reports and data cleaning. The set of push-button local reports (i.e., reports run on data at the district level) provide updated spray progress reports—per day, per week, per spray team, per sub-district level, per spray operator, etc.—and can be used by AIRS operations team members or government supervisors to get spray campaign updates and respond quickly to issues. The M&E team and spray supervisors (district coordinators, government supervisors, and operations managers) can use the cleaning tool to verify data (looking up the spray data for a specific day, spray operator, or structure), while Data Entry Clerks (DECs) use it to clean data daily. Countries are now able to clean and finalize data faster and have avoided pitfalls due to accumulated data entry errors.

Though originally developed for local use in Ghana, the database tool links to the backend designed by Abt Associates' Client Technology Center (CTC) and has been easily transferable to other countries, and can be customized and expanded. For project offices without the capacity to customize the tool themselves, CTC worked with the M&E teams to customize and expand the functionality of the tool per specific country requests.

## **2.7 MOBILE SOAK PIT**

AIRS has built and/or refurbished hundreds of soak pits over the past two years of project implementation. These soak pits use carbon absorption to filter out the pesticide in IRS wash waters resulting from the daily washing of PPE and rinsing of spray tanks. AIRS has generally used PMI standards to build soak pit structures, and on average has built soak pits that handle around 30 to 35 spray operators, and can be used for about 40 days. These large soak pits are generally placed near the center of a large densely populated area that can be easily reached by spray teams, and are often long-term structures with cement wash basins that are re-used during subsequent IRS campaigns.

However, in sparsely populated spray areas, teams may travel hours to reach targeted communities, and they may not be able to return to the location of the soak pit before the end of the day. Additionally, some remote communities may only be accessed via footpath, and/or require spray operators to travel on foot or cross rivers. In these areas it is more efficient for spray teams to stay in the field for up to three days to access multiple targeted villages. In these situations, building a standard soak pit in a hard to reach area is too resource-intensive, especially with regard to transporting construction materials. In addition, a standard soak pit in a remote area would be difficult to monitor before, during, and after the IRS campaign to guard against theft and inappropriate usage of soak pit components, and they may be too large, given that a spray team may be in the area for only a few days.

As a solution to this issue, AIRS is pilot-testing a mobile soak pit that consists of a filter which is a 27-quart plastic container, measuring 40 cm x 28 cm x 24 cm, and weighing about 15 kg when fully loaded. Inside the plastic container are placed stone pre-filter layers, highly adsorptive activated carbon and sawdust, which helps retain the activated carbon, and regulates flow through the filter. The filter has the capacity to treat contaminated wash waters from one to two teams of spray operators at a time.

The expected procedure for using the mobile soak pits is as follows. The spray team carries the filter, a specially prepared tarpaulin (plastic sheeting), and four progressive rinse barrels to a remote community targeted for spraying. The team works with the community to prepare in advance a sloped wash site with a properly-sized hole in the center where the filter is placed. The team lays the tarpaulin over the sloped area so that wash water flows to the mobile soak pit for treatment. When work is complete, the

team washes and rolls up the tarpaulin, pulls the mobile soak pit out of the ground, refills the hole, and carries the soak pit to the next site.

Advantages of this mobile soak pit include a marked reduction in the time that spray operators spend traveling from site to site, better absorption of the pesticide due to the activated charcoal, retention of soak pit materials that have sometimes been stolen from the fixed soak pits, and better protection of the community because contamination is taken away in the filter.

The AIRS environmental compliance manager built several prototypes of the mobile soak pit, and the AIRS Madagascar team has completed initial testing and analysis of several locally built mobile soak pits. Initial testing has proven promising, with AIRS Madagascar planning to pilot use of the mobile soak pit during its spray campaign in the Central Highlands, November to December 2013.

## **2.8 SMARTPHONES FOR ENVIRONMENTAL COMPLIANCE ASSESSMENT**

As described in the October 2012-April 2013 semi-annual report, AIRS is using smartphones in all project countries to complete environmental compliance assessments and inspections before, during, and after the IRS campaigns. The smartphones, pre-loaded with standardized questionnaires, easily and accurately collect and convey site environmental compliance information, including photos, to note the condition of soak pits, store rooms, and pesticides—all with a date/time/geographic positioning stamp.

From April to September 2013, smartphone trainings were held in seven countries (Benin, Mali, Senegal, Ethiopia, Rwanda, Zimbabwe, and Madagascar), and all AIRS countries have used smartphones to various extents for collecting environmental compliance monitoring data during their IRS campaigns. AIRS has found smartphone data collection to be a significant work-saver by avoiding the generation of large volumes of paper checklists and delays in distribution of information. It maximizes the efficiency of pre-spray preparations by eliminating days of travel time, and produces a permanent record of environmental compliance. It has allowed pertinent in-country and headquarters staff to closely follow preparations for the spray season and to focus attention and quickly correct troublesome situations before they reach crisis condition.

## **2.9 STORE KEEPER POCKET GUIDES**

In September, AIRS finalized a 15-page pocket guide to help seasonal store keepers and full-time project warehouse managers improve quality control for inventory management, and provide direct messaging on how to handle and store PPE and insecticide used for IRS. The guide distills key IRS guidance from PMI's Best Management Practices and the WHO's best practices for store keeping. The guide also describes project standards for PPE and insecticide storage, and includes a day-to-day guide for inventory management during an IRS campaign. The pocket guide can also be used as a basis to supervise store keepers and inventory management systems before, during and after the IRS campaign. The store keeper guide was translated into French and Portuguese, with both electronic and hard-copy versions provided to all AIRS project countries in September.

## **2.10 CARBAMATE INSECTICIDE QUANTIFICATION KIT**

AIRS, in collaboration with IVCC and Avima, implemented a pilot study in Ethiopia, August 19 to 30, 2013, which field tested an Insecticide Quantification Kit (IQK) to assess the amount of active ingredient of carbamate deposited on sprayed surfaces—and hence, the quality of spraying. The pilot was carried out in PMI-supported IRS program areas in two districts of Jimma zone, including community-based and district-based IRS operations models. Lot quality assurance sampling (LQAS) was employed that included the spray squad in the community-based IRS and the spray team in the district-based IRS model. Three lots were chosen from each IRS model (six lots in total) and 19 houses were randomly selected for testing from each lot.

Prior to the pilot, IVCC and Avima trained the Abt Ethiopia entomologist and two government staffers selected to take part in the IQK pilot. The training included step-by-step demonstrations of the sampling and methodology, which involves collection of the insecticide sample from the sprayed wall and chemical extraction of the insecticide followed by vial test with a sensor unit. Preliminary IQK testing ensured that the IQK method worked on the local surface substrates: typical surfaces already sprayed with known concentrations of insecticide. The IQK kit proved effective during preliminary testing except for minor issues.

AIRS assessed around 114 houses randomly selected from six lots, using the IQK kits to evaluate the quality of spraying. Over all, IQK tests showed that the performance of the spraying was good, with sufficient spray quality indicated in 88 percent of the sampled houses.

Some challenges were observed at the start of the pilot. The test was not able to produce the expected color indicator that matches the test control and insecticide concentration. With additional efforts from Avima and IVCC, the problem was partially fixed, and the IQK was able to identify teams with the required quality of spraying and teams for whom the quality needed further investigation or corrective action. It was also used successfully to test for various “failure modes” (a condition that increases the likelihood of under-spraying). This application yielded useful intelligence about the variability of spray performance across the selected failure modes. For example, testing clearly indicated that parts of walls obstructed by temporary storage units are more likely to be under-sprayed.

The carbamate IQK demonstrated its potential for use to assess the quality of spraying in an operational setting. However, the field pilot also revealed a number of opportunities for the study team to learn IQK’s strengths and areas for improvement. As mentioned, the color indicator at the end of each test didn’t appear distinct for samples collected from surfaces sprayed at different dosages and also didn’t match the control color indicator. AIRS recommends this be fixed before the IQK is ready for use, and field studies of the improved product will also be needed.

## 2.11 NEW EMPLOYEES

**Alledia Adams**, senior finance and contracts analyst, provides financial management and contractual, administrative, and operational support to the AIRS Mali and Mozambique projects.

**Pamela Dasher**, project assistant, contributes to all AIRS project countries with administrative support, including writing and formatting of project reports, tracking of AIRS project initiatives, maintaining project files, and providing general support to AIRS country offices.

**Djenam Jacob**, senior finance and contracts analyst, provides financial management and contractual, administrative, and operational support to the AIRS Burundi, DRC, Ghana, and Senegal projects.

**Paula Wood**, senior contract and administration manager, provides overall management support for home office and in-country procurements, develops consent submissions and approvals requests to USAID, serves as the project’s security liaison, reviews all subcontract and consultant contracts, and is the project contact to Abt Associates’ Procurement Contracts division.

## 2.12 COMMUNICATIONS

The AIRS website ([www.africaairs.net](http://www.africaairs.net)) received 4,382 website visits from April 1, 2013 to September 30, 2013, a 20 percent increase from the previous six months (October 1, 2012 to March 31, 2013). During this period, 10 success stories were written, posted on the website, shared on Abt Associates’ Facebook and Twitter pages, and distributed via the AIRS quarterly e-letters. AIRS distributed two e-letters (in June and September) and two e-alerts to more than 4,200 global health professionals. The e-letter and periodic e-alerts are the most powerful drivers of traffic to the AIRS website. A visual story about AIRS work in Ghana generated an all-time high in daily website visits during the reporting period, proving that strong visuals are critical to engaging an online audience. Four videos highlighting AIRS

innovations were produced in Ghana, Ethiopia, Mali, and Rwanda, and have been posted on the AIRS, USAID, PMI, and Abt Associates websites (the Ethiopia video is still being finalized). Further analysis of the AIRS website, e-letter, and other communications materials can be found in the quarterly communications analytics reports.

## 2.13 WORLD MALARIA DAY

AIRS put considerable resources into developing content to increase project and IRS visibility around World Malaria Day. This included 10 country presentations (often at NMCP-hosted events), a website feature, an e-alert opened by 830 people, an interactive online map, an op-ed by the Ethiopia COP published in Devex, and a social media campaign seen by approximately 2,700 people.

## 2.14 KNOWLEDGE MANAGEMENT

AIRS is using a simple, online document sharing tool called Onehub to allow staff from all 16 country offices to share materials such as work plans, end-of-spray reports, trainings, and photos. During this reporting period, the workspace was accessed nearly 500 times, with more than 900 files shared with staff from all project countries. This includes 350 files that were downloaded by AIRS project staff to use as references and tools for IRS campaign development.

## 2.15 SOUTH-SOUTH EXCHANGES

**Evelyne Alyko Chaffa**, AIRS Benin Technical Manager, traveled to DRC in June 2013 to meet with stakeholders and partners to assess the current entomological and vector control field activities in DRC, and provide recommendations to enhance the implementation of this work. She also led a training session on insecticides used in public health vector control for staff at the National Institute for Biomedical Research (INRB).

**Ranjith de Alwis**, entomology specialist formerly with Abt Associates' Uganda and Kenya IRS programs, traveled to Mozambique in June 2013 to support and train the AIRS Mozambique entomology coordinator and insectary staff in species identification, entomological data analysis, and the development of entomological monitoring reports. Mr. de Alwis also conducted a detailed assessment of the insectary, made recommendations on the design and location of the animal house, and performed a rapid assessment of enhanced epidemiological surveillance activities.

**Ernest Fletcher**, AIRS Ghana M&E Manager, traveled to Mozambique in September 2013 to support the M&E Manager there prior to and during the first days of the spray campaign. AIRS Mozambique has an understaffed M&E team and lacks a database manager. Mr. Fletcher helped set up the data centers and train the data entry clerks. He also provided technical assistance to the M&E assistants and database coordinators on data collection and quality assurance protocols both in the field and at the data centers.

# ANNEX A: M&E RESULTS SUMMARY

Country	Number of Structures Targeted	Number of Structures Sprayed	Spray Coverage	Total Population Protected	Children under Five Protected	Pregnant Women Protected	Number of People Trained**
Angola	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Benin	239,112	228,951	95.8%	694,729	134,045	19,818	804
Burundi	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DRC	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ethiopia	638,173	635,528	99.6%	1,629,958	240,558	25,211	2,684
Ghana	216,876	197,655	91.1%	534,060	102,115	11,617	669
Liberia	44,328	42,708	96.3%	367,930	63,714	16,287	292
Madagascar	380,074	371,391	97.7%	1,787,981	371,701	60,146	3,379
Mali	233,789	228,985	97.9%	850,104	153,962	22,405	853
Mozambique	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nigeria	64,191	62,592	97.5%	346,798	67,204	16,733	381
Rwanda	229,039	224,708	98.1%	957,027	147,531	16,023	1,875
Senegal	212,979	207,116	97.2%	690,029	126,888	15,592	933
Zambia	224,353	169,660	75.6%	715,828	N/A	N/A	450
Zimbabwe	N/A	N/A	N/A	N/A	N/A	N/A	N/A
<b>AIRS TOTAL</b>	<b>2,482,914</b>	<b>2,369,294</b>	<b>95.4%</b>	<b>8,574,444</b>	<b>1,407,718</b>	<b>203,832</b>	<b>12,320</b>

