



PRESIDENT'S MALARIA INITIATIVE



PMI | Africa IRS (AIRS) Project
Indoor Residual Spraying (IRS 2) Task Order Six

GHANA
END OF SPRAY REPORT
2016

SPRAY CAMPAIGN: APRIL 22 – MAY 26, 2016

Recommended Citation: PMI Africa IRS (AIRS) Project, Indoor Residual Spraying (IRS) 2 Task Order Six. August 2, 2016. *Ghana End of Spray Report 2016*, Bethesda, MD, Abt Associates Inc.

Contract: GHN-I-00-09-00013-00

Task Order: AID-OAA-TO-14-00035

Submitted: July 2016

Approved: August 2, 2016

Submitted to: United States Agency for International Development/PMI

Prepared by: Abt Associates Inc.



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

GHANA END OF SPRAY REPORT 2016

SPRAY CAMPAIGN: APRIL 22 – MAY 26, 2016

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

TABLE OF CONTENTS

Executive Summary	ix
1. Introduction	1
2. Pre-Spray Activities	3
2.1 Insecticide Selection.....	3
2.2 Micro-planning.....	3
2.3 Logistical Needs Assessment.....	4
2.4 Procurement.....	4
2.5 Human Resource Requirements	4
2.6 Gender Integration.....	5
2.7 Gender Activity.....	6
2.8 Types of Trainings and Number of People Trained.....	6
3. Information, Education and Communication Activities	11
3.1 Introduction	11
3.2 Pre-Spray Stakeholder Meetings	12
3.3 2016 Spray Campaign Launch.....	13
3.4 World Malaria Day Celebration.....	14
3.5 Community Meetings.....	15
3.6 Community Education.....	16
3.7 Radio Programs and Video Shows.....	17
3.8 House-to-House Mobilization	18
3.9 Collaboration with Peace Corps Volunteers.....	19
3.10 Monitoring of IEC/BCC Activities Using Mobile Phone Based Checklist	19
4. Implementation of IRS Activities	23
4.1 Spray Campaign.....	23
4.2 Supervision of IRS.....	23
4.3 Data Reporting.....	27
4.4 Logistics and Stock Management	27
4.5 Mobile Data Collection, Messaging and reporting.....	27
4.6 Nozzle Tip Test.....	29
5. Post-Spray Activities	31
5.1 Post-Spray Stakeholder Meetings	31
5.2 Demobilization	31
6. Entomology	32
6.1 Sentinel Sites.....	32
6.2 Pre-spray Insecticide Susceptibility Tests.....	33
6.3 Quality Assurance Tests of IRS and Residual Efficacy of the Sprayed Insecticide.....	34
6.4 Indoor Resting Density, Biting Rate, and Parity	38
6.5 Discussion and Conclusions.....	43
7. Environmental Compliance	45
7.1 Pre-Season Assessment.....	45

7.2 Mid-Season Environmental Compliance Assessments.....	46
7.3 Daily SOP Health Checks.....	47
7.4 Incidents	47
7.5 Post-Season Environmental Compliance Assessment.....	47
7.6 Waste Disposal	47
8. Monitoring and Evaluation	49
8.1 Key Objectives and Approach.....	49
8.2 Data Collection and Data Management	49
8.3 Data Entry	52
8.4 Data Cleaning	52
8.5 Results	52
9. Capacity Building of the Ministry of Health	56
10. Challenges and Recommendations	57
10.1 Challenges	57
10.2 Lessons Learned and Recommendations	57
Annex A. Full Inventory of Stock and Quantities Post-Spray.....	60
Annex B. Ghana IRS Environmental Mitigation and Monitoring Report.....	65
Annex C. Data Quality Assurance and Control Methods	71
Annex D. Ghana Monitoring and Evaluation Plan Indicator Matrix	72

LIST OF TABLES

Table ES-I. AIRS Ghana at a Glance	x
Table 1. Number of Districts and Population Protected 2008-2016.....	1
Table 2. Summary of Female-Related Indicators, 2015 - 2016	5
Table 3. Summary of 2016 AIRS Ghana Training.....	6
Table 4. Number of People Trained	8
Table 5. Number and Type of Temporarily Hired People	10
Table 6. Timeline for 2016 IEC Activities.....	11
Table 7. Number of Community Meetings Held and Number of Attendees	15
Table 8. Number of Community Education Events.....	16
Table 9. IRS Radio Programs, Video Shows, and IEC Materials Distributed.....	18
Table 10. House-to-house Mobilization Results	18
Table 11. Objectives Targeted and Activities* Reported	20
Table 12. Number of Mobilization Supervision Visits Conducted.....	21
Table 13. Mobilization Results: Household Awareness of 2016 IRS Campaign.....	22
Table 14. 2016 Structures Sprayed in Five Districts	23
Table 15. Spray Campaign Supervisory Tools.....	24
Table 16. Sample OF 2016 Spray Campaign Job Aid Messages	28
Table 17. Entomological Monitoring Sites.....	32
Table 18. Pre- and Post-IRS Biting Rates of <i>An. gambiae</i> s.l., HLC Method.....	39
Table 19. Total Indoor/Outdoor Biting/Landing Collections of <i>An. gambiae</i> s.l., Pre- and Post-IRS.....	41
Table 20. Pre- and Post-IRS Dissections for <i>An. gambiae</i> s.l., Tamale.....	42
Table 21. Pre and Post IRS Indoor Resting Densities of <i>An. gambiae</i> s.l., PSC Method	42
Table 22. Ghana IRS 2016 Data Collection and quality assurance Tools	49
Table 23. Number of Households/Compounds Visited Using the DCV Form	50

Table 24. Use of DCV Form: Common Issues Found and Corrective Actions Taken	51
Table 25. Summary of 2016 Spray Results	52
Table 26. Reasons for Not Spraying Structures, By District.....	54
Table 27. Number and Usage of Mosquito Nets	55
Table 28. Insecticide Tracking and SOP Performance.....	55
Table A-1. IRS 2016 International Procurement Items	60
Table A-2. IRS 2016 Local Procurement Items	62

LIST OF FIGURES

Figure 1. Number of Red Flags Observed Each Spray Day	26
Figure 2. Distribution of Red Flags by Questions Asked	26
Figure 3. Insecticide Susceptibility Results on <i>An. gambiae</i> s.l. Mosquitoes at Three Sites.....	33
Figure 4. Mortality Rate of <i>An. gambiae</i> s.l./s.s., Exposed to Sprayed Surfaces during Spray Quality Check (T0) and One Month After Spray (T1), 2016.....	36
Figure 5. Airbone Effect (% Mortality of Wild <i>An. gambiae</i> s.l. and Kisumu Strain <i>An. gambiae</i> s.s.) of Actellic 300CS, Cement and Mud Plastered Rooms, 1 Month After Spray, May 2016	38
Figure 6. Biting Rate of Female <i>An. gambiae</i> Mosquitoes, March-May 2016	40
Figure 7. Host-seeking Behavior of <i>An. gambiae</i> s.l. Collected Inside and Outside UNsprayed Houses in Tamale, March-May 2016.....	41
Figure 8. Indoor Resting Densities of <i>An. gambiae</i> s.l. Collected from Sprayed Rooms and Not-sprayed Rooms, PSC Method, March-May 2016	43
Figure 9. Reasons For Not Spraying Structures.....	54

ACRONYMS

AIRS	Africa Indoor Residual Spraying
BCC	Behavior Change Communication
BMP	Best Management Practices Manual
b/p/n	Bites/person/night
BYD	Bunkpurugu-Yunyoo District
CBS	Community-based Surveillance
CDC	Centers for Disease Control and Prevention
COP	Chief of Party
DCV	Data Collection Verification form
DEHO	District Environmental Health Officer
DHMT	District Health Management Team
ECO	Environmental Compliance Officer
DOC	District Operations Coordinator
EC	Environmental Compliance
EE	Error Eliminator form
EMD	East Mamprusi District
EPA	Environmental Protection Agency
GHS	Ghana Health Service
HLC	Human Landing Catch
IEC	Information, Education and Communication
IRS	Indoor Residual Spraying
KD	Kumbungu District
M&E	Monitoring and Evaluation
MaVCOC	Malaria Vector Control Oversight Committee
MBR	Mean Biting Rate
MMD	Mamprugu Moaduri District
MSP	Mobile Soak Pit
NIRMOP	National Insecticide Monitoring Partnership
NMCP	National Malaria Control Program
NMIMR	Noguchi Memorial Institute for Medical Research

OKD	Open Data Kit
PMI	President's Malaria Initiative
PMT	Performance Monitoring Tool
PPE	Personal Protective Equipment
PSC	Pyrethrum Spray Catch
PSECA	Pre-Season Environmental Compliance Assessment
SEA	Supplemental Environmental Assessment
SND	Savelugu-Nanton District
SOC	Spray Operations Coordinator
SOP	Spray Operator
TD	Tolon District
TML	Tamale Metropolis
TOT	Training of Trainers
USAID	United States Agency for International Development
WHO	World Health Organization
WMD	West Mamprusi District

EXECUTIVE SUMMARY

The President's Malaria Initiative (PMI) has been funding indoor residual spraying (IRS) in Ghana since 2008 with the aim of reducing the malaria burden, especially among children under five years and pregnant women.

In August 2011, Abt Associates was awarded a three-year Africa IRS (AIRS) project, funded by the United States Agency for International Development under PMI. In September 2014, Abt Associates was awarded a three-year follow on project called The PMI AIRS Project to support the implementation of IRS in up to 20 African countries, including Ghana.

Ghana started spraying in five districts in 2008 and gradually scaled up to nine districts in 2011. In 2013, the number of IRS districts was reduced to four (East Mamprusi, West Mamprusi, Savelugu-Nanton, and Bunkpurugu-Yunyoo) as a result of increased vector resistance to pyrethroids, which necessitated the use of a significantly more expensive long-lasting organophosphate (Actellic 300 CS). Nevertheless, behavior change communication activities continued in 2013 in the five dropped districts to ensure that residents continued to use other forms of malaria prevention, especially long-lasting insecticide-treated nets, in the absence of IRS. These same four districts were sprayed again in 2014. In 2015, Savelugu Nanton was dropped primarily due community fatigue that drove spray coverage level below the WHO recommended 85 percent. Also, while there was an absence of sporozoites in mosquito samples. There was genotypic evidence of vector resistance, and Savelugu was replaced by Kumbungu. Also, West Mamprusi was divided into two: West Mamprusi and Mamprugu Moaduri. As a result, Ghana has been spraying five districts since 2015.

Implementation of Ghana's PMI IRS program has been built upon lessons learned in the country's eight years of spraying. In 2016, AIRS Ghana implemented IRS in the same five districts as in 2015: East Mamprusi, Bunkpurugu-Yunyoo, West Mamprusi, Mamprugu Moaduri, and Kumbungu. The 2016 IRS campaign lasted for 30 working days between April 22 and May 26.

The project recruited and trained temporary staff for the spray operations before the start of the campaign. The AIRS Ghana team carried out logistics and environmental compliance assessments to ensure that the standard operating procedures were in compliance with the PMI's Best Management Practices Manual. The AIRS Ghana team submitted a letter report prior to the campaign's start, which documented notable changes from previous years as well as key environmental compliance aspects of the spray campaign. The project held stakeholder, partner planning, and community sensitization meetings in order to create the necessary awareness and effective involvement of all participants for successful spray operations.

By the end of IRS operations, AIRS Ghana had found 227,857 structures and sprayed a total of 211,283 structures yielding spray coverage of 92.7 percent. With IRS, the project protected a total of 570,871 people including 10,881 pregnant women and 96,150 children under the age of five years (Table ES-1).

TABLE ES-I. AIRS GHANA AT A GLANCE

Number of districts covered by PMI-supported IRS in 2016	5 districts: Bunkpurugu-Yunyoo, East Mamprusi, Kumbungu, Mamprugu Moaduri, West Mamprusi
Insecticide	Organophosphate (Actellic 300 CS)
Number of structures sprayed by PMI-supported IRS in 2016	211,283
Number of structures targeted for 2016 spray (2015 found)	224,592
Number of structures found by spray operators during 2016 PMI-supported IRS spray season	227,857
2016 spray coverage	92.7%
Population protected by PMI-supported IRS in 2016	570,871 (including 10,881 pregnant women and 96,150 children under 5 years old)
Dates of PMI-supported IRS campaign	April 22 to May 26, 2016
Length of campaign	30 days
Number of people trained with U.S. Government funds to deliver IRS*	694

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

The main challenge AIRS Ghana faced during the 2016 operations was attaining target coverage in some, mostly urban, areas. AIRS Ghana worked very closely with community leaders (local chiefs, opinion leaders, and assembly men and women) to tackle relevant issues in low-coverage communities. The project collaborated effectively with the regional and district health directorates for a successful implementation.

I. INTRODUCTION

Indoor residual spraying (IRS) is a major component of Ghana's current National Malaria Control Strategy. Ghana's latest National Strategic Plan for Malaria Control (2014-2020) aims to protect at least 80 percent of the population at risk by 2020 through a combination of universal coverage of insecticide-treated nets, IRS in areas with high parasite prevalence, (i.e., >40 percent parasitemia prevalence), larviciding, seasonal malaria chemoprevention, and prevention of malaria in pregnancy. The President's Malaria Initiative (PMI) has been supporting the National Malaria Control Program (NMCP) to achieve these goals through IRS since 2008. Table I lists the number of districts PMI supported with IRS and population protected each year for the past nine years.

TABLE I. NUMBER OF DISTRICTS AND POPULATION PROTECTED 2008-2016

Year	Number of Districts	Population Protected
2008	5	601,000
2009	6	708,103
2010	8	849,620
2011	9	926,699
2012	9	941,240
2013	4	534,060
2014	4	570,572
2015	5	553,954
2016	5	570,871

In 2016, the PMI Africa Indoor Residual Spraying project (AIRS) Ghana team worked in partnership with the Ghana Health Service (GHS) and NMCP to plan and implement IRS operations in the targeted five districts (Bunkpurugu-Yunyoo, East Mamprusi, Kumbungu, Mamprugu Moaduri, and West Mamprusi), all in the Northern Region. A total of 224,592 structures were targeted for spraying, which began on April 22 and ended on May 26 in all five districts.

By the end of IRS operations, AIRS Ghana found 227,857 structures and sprayed a total of 211,283 structures yielding spray coverage of 92.7 percent. In addition, the project achieved the following specific results during 2016 IRS operations:

- All districts achieved the 85 percent or more PMI spray coverage target. Four of the five districts also achieved the 90 percent or more NMCP/ GHS spray coverage target.
- A total population of 570,871 (including 10,881 pregnant women and 96,150 children under five years old) was protected.
- The spray quality was good with 100% mosquito mortality across all four sites, 1-3 days and one month after spray.
- Tests proved that the vector in project districts is fully susceptible to pirimiphos methyl, the insecticide used for the IRS campaign;

- As part of capacity building target, government staff from the Environmental Protection Agency (EPA), district health offices and district assemblies participated in the training, mobilization, and supervision activities of the campaign.
- PMI AIRS Ghana through the Noguchi Memorial Institute for Medical Research (NMIMR) provided financial support to the NMCP for entomological monitoring activities with a focus on insecticide resistance mapping and monitoring. In addition, NMIMR has provided quarterly supervision to field entomological evaluations conducted by trained field technicians coordinated by the AIRS Entomologist. NMIMR provided quality control to the field-level mosquito identification, dissection, and parity determination activities and insecticide monitoring tests. NMIMR also performed advanced molecular evaluations on the samples of mosquitoes collected by AIRS Ghana.
- AIRS Ghana provided the National Malaria Vector Control Oversight Committee (MaVCOC) technical support by sharing entomological data on insecticide resistance and mosquito behavior. AIRS Ghana also funded quarterly meetings of the committee. MAVCOC provides guidance on malaria vector control issues in Ghana. MaVCOC is chaired by and under the purview of the NMCP. Its members are the GHS, NMCP, and partners (including AIRS) working on malaria vector control in the country.

2. PRE-SPRAY ACTIVITIES

2.1 INSECTICIDE SELECTION

As in 2015, the members of MaVCOC, which includes the AIRS Ghana team, NMIMR, PMI, GHS, NMCP, and Anglo Gold Ashanti Malaria Control Ltd, used findings on susceptibility of the local vectors and residual efficacy to decide on the class of insecticide to use for the 2016 spray campaign. All agreed that the long-lasting organophosphate Actellic 300 CS is still effective and would be most appropriate for the 2016 IRS campaign. (See Section 6.2 for susceptibility results.)

2.2 MICRO-PLANNING

To effectively plan for a successful IRS campaign along with strengthening local ownership, the AIRS Ghana team conducted micro-planning meetings with the government stakeholders just before the start of the spray season. Planning meetings were held with stakeholders at the district and community levels, particularly with district health directorates and district assemblies. The purpose of the meeting was to review the operational plan and target for the 2016 operations and to renew stakeholder roles and commitments. The following agenda items were discussed:

- Spray campaign length
- Information, Education and Communication (IEC) and behavior change communication (BCC) plans and strategies
- Insecticide selection (particularly with the NMCP)
- International and local procurement
- Performance and target setting
- Monitoring and supervision plan including attachment of GHS staff to 2016 IRS operations
- Recruitment of spray operators (SOPs)
- Official launch of the 2016 spray campaign and commencement date for spray operations
- Partner roles and commitments
- Spray coverage targets and data quality
- Dissemination of weekly reports to stakeholders
- Provision/ maintaining offices and storage facilities for AIRS Ghana district team (especially in Kumbungu and East Mamprusi Districts)

2.3 LOGISTICAL NEEDS ASSESSMENT

The purpose of the logistical needs assessment was to carry out an inventory of supplies and materials required for the implementation of a cost-effective and efficient IRS campaign in 2016. The process involved visits to all district operational sites as well as the central warehouse. The project carried out the following activities:

- District-level assessments: AIRS Ghana held meetings with the district health management teams (DHMTs) and officials from the district assemblies to discuss readiness for the campaign and their role in providing facilities that will be used as site offices. Apart from the facilities at the operational sites in Kumbungu District and the Bunkpurugu Binde site, district assemblies or DHMTs provided space and facilities for the operational sites. The district health directorate in Kumbungu provided space for the data center free of charge in 2015 and made it available again in 2016.
- Quantification of IRS commodities: This was based on the number of structures found in 2015 and targeted for spraying in 2016, number of days of spray operations, number of SOPs, and number of other supporting staff to be hired.

The project used results from the assessments and quantification to develop a logistics distribution plan and make decisions about international and local procurements and human resources and hiring.

2.4 PROCUREMENT

AIRS Ghana separated the procurement of commodities into international and local procurements to ensure cost effectiveness and timely delivery of commodities. The AIRS Ghana team procured local supplies that included washers' aprons, stationery, detergents, and production of IEC/ BCC materials (posters). The team completed all local procurements by the end of February 2016. It gave the team about two months of buffer period before the start of spray.

A major component of international procurement was the purchase of Actellic 300 CS. A total of 11,347 bottles of Actellic 300 CS were left over to be used for the 2016 IRS campaign. Using 224,592 structures as the 2016 spray target, AIRS Ghana calculated that a total of 49,909 bottles of Actellic 300 CS would be required for the 2016 spray campaign. With 11,347 bottles available from 2015, the project needed to procure 38,560 bottles. Because of product packaging of 12 bottles per box, the project procured 3,214 boxes (38,568 bottles). Therefore, the beginning balances of Actellic 300CS for the 2016 campaign was 49,915 bottles.

Other international consignments included Hudson repair kits and parts for Goizper pumps, nose masks, hard hats, coveralls, boots, and hand gloves. The country team received both local and international procurement items and distributed to various operational sites before the start of the 2016 spray operations. Annex A lists all materials procured and quantities remaining after the spray campaign.

2.5 HUMAN RESOURCE REQUIREMENTS

The district human resource requirements consisted of two groups: 1) full-time staff (AIRS District Operations Coordinators (DOCs), and 2) temporary staff: Monitoring and Evaluation (M&E) Assistants, IEC Assistants, Data Entry Assistants, Logistics Assistants, Site Managers, Field Supervisors, Team Leaders, SOPs, Store Assistants, Washers, Water Fetchers, and Security Guards. In addition, AIRS Ghana engaged some GHS officers, community-based surveillance (CBS) volunteers, and individuals who could read and write to carry out house-to-house mobilization activities. The project also engaged Mosquito Collectors and Supervisors to carry out entomological activities.

2.6 GENDER INTEGRATION

In 2016, AIRS Ghana continued using the two approaches it adopted in 2015 to increase the number of women participating in the IRS campaign.

The first approach was to encourage more women to apply for various positions. This was done through advertisements in local papers and on the radio promoting that women apply for higher level positions (supervisors and site managers). Advertisements were also posted at churches, mosques, health facilities and assembly boards for female team leaders and spray operators, and the message was further spread through women who had previously worked for the project. The project made community leaders aware of the importance of balancing the gender of the spray teams and to encourage women to apply. With this effort, AIRS Ghana increased the number of female participants for the 2016 spray campaign. In 2016, the project hired 176¹ females to deliver IRS compared to the 158 hired in 2015. In addition, the number of women hired to fill supervisory roles (Team Leaders, Field Supervisors, Site Managers, Logistics Assistants, IEC Assistants, and M&E Assistants) increased from 27 in 2015 to 33 in 2016. Table 2 lists indicators of female participation.

The second approach was to mentor women in 2015 so that if they applied to work for the 2016 spray campaign, they could be considered for supervisory roles. Not all females who worked for the 2015 campaign returned in 2016. Those who returned in 2016, and were promoted to Team Leader positions in 2015, were further promoted to Field Supervisors in 2016 thus continuing and strengthening the project's gender integration strategy.

TABLE 2. SUMMARY OF FEMALE-RELATED INDICATORS, 2015 - 2016

Female-related indicators	2015		2016	
	#	%	#	%
Females trained to deliver IRS ²	194	27.8%	210	30.3%
Females trained to support IRS ³	292	18.9%	308	18.5%
Females hired to support IRS	306	20.8%	319*	21.4%
Females hired in supervisory roles ⁴	27	15.5%	33	18.9%
Female SOPs hired	135	30.3%	147	33.3%
Female Team Leaders hired	20	22.7%	24	27.3%

*Some washers are hired but not trained

To improve the work environment for females on spray teams, facilities were refurbished to accommodate the needs of female workers. This included provision of separate changing and washing rooms. In addition, based on suggestions from female SOPs in 2015, the project provided sanitary pads for female SOPs at each site to use when needed.

Also, to create a safe work environment, free from any form of harassment, the project management team frequently sent out gender-related SMS messages (Table 16, in Section 4.5) during the spray campaign to reinforce the PMI AIRS Anti-sexual Harassment Guidelines posted at each operational site.

¹ 147 SOPs, 24 Team Leaders; and 5 field supervisors

² 179 SOPs, 23 TLs, 5 Supervisors, 3 Medical Assistants

³ All cadre of temporary female workers trained, including those trained to deliver IRS (Table 4)

⁴ 24 TLs, 5 supervisors, 2 IEC assistants, 1 M&E assistant and 1 logistics assistant

2.7 GENDER ACTIVITY

Because of advanced work in gender integration, the PMI Washington team together with the PMI AIRS Project agreed that AIRS Ghana gender work can provide further insights into the overall PMI efforts to enhance the role of local women in malaria control efforts. The PMI AIRS project has developed a gender activity in collaboration with the University of Arizona. The overall aim of this activity is to assess the effect of women's participation in IRS operations in selected districts in Ghana. In preparation for the study, AIRS Ghana set up the following categories of spray teams to operate during the campaign:

1. Female-only spray team with a female Team Leader.
2. Female-only spray team with a male Team Leader
3. Male-only spray team with a female Team Leader
4. Male-only spray team with a male Team Leader
5. Mixed spray team (3 males and 2 females) with a female Team Leader
6. Mixed spray team (2 males and 3 females) with a male Team Leader.

These groups were created at different sites across the five targeted districts. The data collection for this activity is scheduled for late June 2016. A separate report will be submitted to provide details of the procedure and the findings.

2.8 TYPES OF TRAININGS AND NUMBER OF PEOPLE TRAINED

IRS is a highly technical process and demands vigorous and thorough training of all personnel in order to achieve the intended impact. The trainings provide specific skills to personnel so that they are able to perform assigned tasks correctly. AIRS district staff train SOPs annually before spray operations begin. In all, AIRS Ghana organized 10 types of training in preparation for the 2016 spray campaign (Table 3).

TABLE 3. SUMMARY OF 2016 AIRS GHANA TRAINING

Type of Training	Dates	Length (days)	Location	Brief Description
IEC Training of Trainers (TOT)	26-28/01/16	2	Tamale	IEC and mobilization strategies, including sensitization techniques, structure identification, and household mobilization data collection. Participants were trained to offer training to mobilizers at the district level.
Mobilizer Training	01/03/16	1	All sub-districts	AIRS IEC strategy. Participants were to go back to their communities to sensitize and mobilize households prior to the spray campaign.
Logistics and Store Management	21-23/03/16	3	Tamale	Record and stock keeping of all inventories.
Spray Operations TOT	04-08/04/16	5	Walawale	Spraying techniques, compliance, and data capture. Gender training was also part of the TOT for seasonal workers that included site managers and supervisors.
Training for SOPs	16-20/04/16	5	All 5 districts	Spraying techniques, compliance, and data capture.

Type of Training	Dates	Length (days)	Location	Brief Description
AIRS Database Training	14-16/03/16	3	Tamale	Introduction to and use of the 2016 AIRS database for mobilization and spray data entry. Participants were also trained on the data cleaning system, data storage, and security systems.
Health Worker/ Poison Management	03/03/16	1	Tamale	Managing insecticide poisoning at the health facility.
Fire/ Security Training	05-09/04/16	0.5 day (conducted a few times)	All 5 districts	Handling fire at the operational site and best basic security management practices at the operational site.
Driver training	21/04/16	2	Tamale	Defensive driving techniques, safety requirements while driving a vehicle with insecticides.
Entomology training	18/02/2016	1	Tamale	Methods of mosquito collection, packaging and shipment

Overall, the project trained 1,667 people (1,359 males, 308 females). The yellow-highlighted cells in Table 4 indicate trainees who qualify under the PMI indicator definition “number of people trained with USG [U.S. Government] funds to deliver IRS.”⁵ In 2016, AIRS Ghana trained 694 people (484 men and 210 women) to deliver IRS under this definition.

⁵ These figures include only spray personnel such as SOPs, team leaders, supervisors, and clinicians. They exclude data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, and security guards.

TABLE 4. NUMBER OF PEOPLE TRAINED

Categories of Persons Trained	Training on IRS Delivery										Other Trainings										Total			
	TOT: Spray Ops		Spray Operations		Data Entry		Logistics & Store Mgt		IEC TOT		IEC Mobilizers		Medical Treatment Intoxicatio		Fire/ Security		Drivers'		Entomology					
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	TOTAL	
DOC	5	0																				5	0	5
Disease Control Officers	5	0																				5	0	5
District Environmental Health Officers	5	0																				5	0	5
EPA Representatives														1	0							1	0	1
SOPs			311	179																		311	179	490
Team Leaders			69	23																		69	23	92
Data Assistants					14	9																14	9	23
District M&E Assistants					4	2																4	2	6
Logistics Assistants							4	1								1	0					5	1	6
Store Assistants							5	12														5	12	17
Medical Assistants/ Prescribers														29	3							29	3	32
IEC Assistants									14	2												14	2	16
IEC Implementers, Mobilizers											677	70										677	70	747
Field Supervisors (Spray Ops)	43	5																				43	5	48
Site Managers	16	0																				16	0	16
Drivers																	41	0				41	0	41
Administrative Assistant																1	2					1	2	3
Mosquito collectors																				82	0	82	0	82
Guards															32	0						32	0	32
TOTAL M/F	74	5	380	202	18	11	9	13	14	2	677	70	30	3	34	2	41	0	82	0	1,359	308	1,667	
TOTAL/ training	79		582		29		22		16		747		33		36		41		82		1,667			

2.8.1 NUMBER OF PEOPLE HIRED

A total of 1,491 temporary staff were hired to deliver services during the 2016 IRS campaign. Of these, 319 were females and 1,172 were males, with the percentage of hired females at 21.4 percent. This is slightly above the 2015 figure of 20.8 percent in 2015.

Temporary staff hired in 2016 included 441 SOPs. The number of females hired for the position of SOP in 2016 increased to 147 (33.3 percent of total SOPs) from 135 (30.3 percent) in 2015. AIRS Ghana team will continue to implement strategies to further increase the participation of women in future spray campaigns.

In addition to the positions listed in Table 5, some community-based surveillance (CBS) volunteers from the various communities were engaged for one or two days (depending on the length of spraying in the volunteer's community) to help with announcements in the evening before the day of spray and on the actual day of spray. CBS volunteers also took part in stakeholder meetings at the sub-district level where they learned about IRS and about their mobilization roles.⁶

⁶ CBS volunteers did not receive formal IEC training nor were they hired by the project; therefore, they are not captured in Tables 4 and 5.

TABLE 5. NUMBER AND TYPE OF TEMPORARILY HIRED PEOPLE

Category	Bunkpurug Yunyoo		East Mamprusi		Kumbungu		Mamprugu Moaduri		West Mamprusi		Tamale		All			
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Total	% Female
Data Entry Assistants	1	3	5	0	0	4	3	0	2	3	0	0	11	10	21	47.6%
Finance Assistants	1	0	0	1	1	0	1	0	0	1	0	0	3	2	5	40.0%
IEC Assistants	5	0	2	2	2	0	2	0	3	0	0	0	14	2	16	12.5%
Logistics Assistants	1	0	1	0	1	0	0	1	1	0	0	0	4	1	5	20.0%
Store Assistants	1	4	2	2	0	2	1	1	1	2	0	1	5	12	17	70.6%
Mobilizers	220	14	170	23	131	8	42	3	114	22	0	0	677	70	747	9.4%
Security officers	10	0	8	0	4	0	4	0	6	0	0	0	32	0	32	0.0%
Site Managers	5	0	4	0	2	0	2	0	3	0	0	0	16	0	16	0.0%
SOPs	71	30	69	56	51	19	27	8	76	34	0	0	294	147	441	33.3%
Supervisors	10	0	11	2	6	1	4	0	9	2	0	0	40	5	45	11.1%
Team Leaders	14	6	19	6	10	4	5	2	16	6	0	0	64	24	88	27.3%
Washers	0	12	0	12	0	4	1	3	1	9	0	0	2	40	42	95.2%
Water Fetchers	0	0	1	0	1	1	4	0	0	4	0	0	6	5	11	45.5%
M&E Assistants	1	0	1	0	0	1	1	0	1	0	0	0	4	1	5	20.0%
Total	340	69	293	104	209	44	97	18	233	83	0	1	1,172	319	1,491	21.4%

3. INFORMATION, EDUCATION AND COMMUNICATION ACTIVITIES

3.1 INTRODUCTION

The IEC campaign to support the 2016 IRS operations started in February 2016. The early rollout of the IEC activities was to give the project enough time to prepare the communities for IRS by sensitizing, educating, and resolving related issues that may exist in these communities. AIRS Ghana employed a variety of interpersonal and mass media IEC strategies to contribute to a successful spray operation. These strategies included the use of community meetings, stakeholder meetings, promoting IRS messages through the GHS community outreach programs, in-school programs, and house-to-house mobilization. The project also disseminated information through video shows on IRS and malaria; radio announcements, discussions with phone-in segments, and airing of jingles; and the use of pickup trucks fitted with public address systems and information vans from the district information services departments. Table 6 provides a timeline for the IEC activities implemented during this spray campaign.

TABLE 6. TIMELINE FOR 2016 IEC ACTIVITIES

Activities	March (Weeks)				April (Weeks)				May (Weeks)			
	1	2	3	4	1	2	3	4	1	2	3	4
Stakeholder meetings												
Pre-spray door to door mobilization												
During spray door to door mobilization												
Community Meetings												
Radio adverts/discussions												
Health facility events												
Churches and mosques												
Information van												
Video shows												

Unlike previous years, when communities in urban centers were sprayed towards the end of the spray campaign, in 2016, these communities, where acceptance often is low, were engaged early on. Depending on the size of the community, one or two spray teams were assigned to engage and spray the locations at the beginning of the spray campaign. This provided time to identify challenges and address them through dialogue with community leaders and intensive sensitization.

Due to its success in integrating community leaders' participation and support in the 2015 IRS campaign, AIRS Ghana continued the collaboration for the 2016 spray campaign. Community-level influencers (chiefs, queen mothers, imams, pastors, and other respected individuals from the community) served as advocates and worked alongside spray teams to increase acceptance of spray in their communities.

As in 2015, the project carried out community education aimed at resolving concerns, misconceptions, and the fatigue that goes with packing out belongings and re-packing after spraying. AIRS Ghana encouraged households to move heavy items to the middle of their rooms.

Strategies that were intensified in 2016 included the use of larger number of mobilizers to work alongside spray teams to mobilize and assist households with preparing their rooms for spraying. In addition, upon returning from the field, spray teams led by district AIRS staff carried out evening mobilization and prepared communities for spray the next day.

A few Peace Corps volunteers also joined the project in mobilizing their communities and sub-districts for spraying. Section 3.9 provides additional information on this.

3.2 PRE-SPRAY STAKEHOLDER MEETINGS

Pre-spray stakeholder meetings were held March 21-24, 2016, in each of the 16 sub-districts of the five targeted districts. Participants included community and religious leaders, district directors of health and their team from the GHS, and district chief executives and their teams from the district assemblies. Other participants were community leaders, mobilizers, heads of groups such as village savings and loans associations, farmers, traders, beauticians and hairdressers, youth, and Ataya (tea-drinking) groups as well as individual community members.

The purpose of these meetings was to get feedback to enhance IRS operations, review the sub-district's spray coverage from the previous years, set benchmarks and devise strategies for improving spray coverage during the 2016 spray campaign. The meetings also highlighted the role of district authorities and community leaders in the provision of infrastructure and office space for IRS activities and addressed misconceptions about the role of the AIRS Ghana Project with regards to the distribution of insecticide-treated bed nets, which was carried out a few weeks prior to the spray campaign by the GHS and NMCP. Some communities wrongly perceived that AIRS Ghana was responsible for the net distribution because the community volunteers that NMCP used for the net distribution were the same volunteers AIRS Ghana used for house-to-house mobilization. Some households, unhappy with the net distribution process, refused IRS to express their dissatisfaction.



Engaging stakeholders in IRS implementation at the sub-district level to ensure active community participation

3.3 2016 SPRAY CAMPAIGN LAUNCH

The 2016 spray campaign launch in West Mamprusi District on April 21, 2016, marked the beginning of the 30-day spray campaign. AIRS Ghana chose this low-coverage district, so the project could facilitate strong awareness creation among community members that the spray campaign had started. The launch also helped to solicit the contribution and support of community leadership in ensuring a successful campaign.



Spray Operators in a display of various spray techniques at the launch of the 2016 spray campaign

Guest of Honor Dr. Philip Ricks, Representative of the PMI and Centers for Disease Control and Prevention (CDC) in Ghana, pledged the U.S. Government's commitment to the fight against malaria and called for support from community leadership for the success of the program. Representative for the NMCP Program Manager, Mr. Samuel Oppong, also asked the global health community, donors, funding agencies, and the private sector to invest in malaria control to sustain gains already made as the country worked towards malaria elimination. A representative of the Northern Regional Director of Health, GHS, Dr. Abdulai pledged the support of the directorate to the campaign and called on health workers located in the operational areas of the project to support the campaign. A representative of the Overlord of the Mamprugu Traditional Area, who chaired the launch ceremony, responded to the call of support from community leaders by tasking all community leadership to ensure that their communities were sprayed.



PMI/CDC Ghana, Dr. Philip Ricks



Overlord of Mamprugu Spokesman, Mba Tarana

AIRS Ghana Chief of Party (COP) Dr. Yemane Yihdego urged communities to cooperate with the project by granting access to their houses. He also repeated the call for community leadership to contribute towards the total protection of their communities by ensuring that their communities were sprayed. AIRS Ghana Operations Manager Mr. Ernest Fletcher explained the 2016 timeline for the spray campaign and how communities had been scheduled to be sprayed in a systematic manner. He also briefly took the invited guests through the household preparations, and safety and compliance procedures.

The launch ceremony was followed by the symbolic spraying of the first room to signify the start of the spray campaign. All dignitaries went to a nearby house to observe this activity. A mobilizer took the household through the homeowner preparations, and the post-spray clean-up safety and compliance education. A female SOP educated guests on how the mixing of the insecticide is done. She then sprayed the room, and reinforced clean-up messages, which the mobilizer delivered earlier.

3.4 WORLD MALARIA DAY CELEBRATION

Ghana celebrated World Malaria Day, marked globally on April 25, 2016, nationally and at the regional level. The celebration for the Northern region was held in two districts: Saboba, a previous IRS district, on May 7, and in Kumbungu district, a current spray district, on May 5.

Ghana AIRS and USAID's Systems for Health project, as stakeholders in malaria control, provided financial and technical support for the preparation of the celebration in Kumbungu district. The district leadership of the Ghana Health Service spearheaded all planning and preparations of the festivities.

The District Chief Executive, representative of the Northern Regional Minister, and Northern Region Health Office Director pledged to support the ongoing malaria interventions in the region and thanked USAID and implementing partners for the zeal with which they collaborate with the GHS in the implementation of malaria interventions in the region. They called on members of the community to give access to their sleeping rooms for spraying so that the IRS intervention would be a success. The representative of the Kumbungu Paramount Chief, Vo Naa, tasked the other chiefs with ensuring their community members owned these interventions as they were for the good of their communities. PMI

CDC representative Dr. Philip Ricks pledged the U.S. Government’s support for investing in efforts to end the disease. The event, which took place while the spray campaign was going on, was additional input to the mobilization and sensitization campaign of the AIRS project.

As a part of the celebrations, a drama on the effects of malaria was staged to sensitize and educate community members about the dangers associated with malaria.

3.5 COMMUNITY MEETINGS

Community meetings started early in hard-to-reach and urban communities across all 16 sub-districts. The purpose of these meetings was to provide a platform for face-to-face interaction with community members. These meetings were aimed at identifying and addressing concerns; explaining the importance and the effectiveness of IRS as a malaria control strategy with evidence from the Anemia and Parasitemia (A&P) Study conducted in the Bunkpurugu-Yunyoo District that showed significant reduction in anemia and parasite rate after spray; and correcting misconceptions about the insecticide and the spray campaign in general, and the mandate of the project with regards to net distribution.

Community meetings started on February 1 and continued throughout the spray campaign. Table 7 shows the number of meetings held across all communities in the 16 sub-districts, especially in communities perceived to be relatively resistant to IRS based on information from the previous spray campaign. The target audiences for these meetings were traditional, religious, and opinion leaders, heads of village savings and loans associations, farmers, dressmakers, hairdressers, traders, youth, the physically challenged, and Ataya groups, and individual community members.

TABLE 7. NUMBER OF COMMUNITY MEETINGS HELD AND NUMBER OF ATTENDEES

District	No. of Meetings	Dates	Total No. of Attendees
Bunkpurugu-Yunyoo	86	February 1 – May 25	1,696
East Mamprusi	84	February 1 – May 25	1,801
Kumbungu	56	February 1 – May 25	662
Mamprugu Moaduri	4	February 1 – May 25	152
West Mamprusi	47	February 1 – May 25	1,008
TOTAL	277	February 1 – May 25	5,319

The meetings were an opportunity to highlight the project’s benefits to the community, and called attention to the spray target of at least 85 percent community spray coverage to ensure the total protection of the community. At these meetings, the project created awareness about the communal responsibility of all members in the community towards achieving the target. Community members and their leaders helped devise strategies to ensure that needed spray targets would be met.

Most community meetings were organized with help from the community leaders. The chief or queen mother⁷ owns the gong-gong, a special drum that is a traditional way of mobilizing communities or calling attention to important events or information dissemination about to happen in the community. As in 2015, beating the gong-gong was used to ensure that community members were well-informed about scheduled visits or revisits of spray teams to their communities in 2016. Announcements were made in the evenings prior to spraying and on the day of spray. A total of 650 gong-gong beating announcements were used to inform communities of impending spray visits.

⁷ Some communities in the Kumbungu District have a queen mother.



Gong-gong beater summoning community members to the chief's palace



Chief meeting community members to ask them to pack out for spray

3.6 COMMUNITY EDUCATION

IEC Assistants recruited for each of the 16 operational sites carried out community education events in communities of their designated operational sites (Table 8). Some of the events were carried out in collaboration with the District Information Services Departments. Also, the GHS allowed the project to educate the beneficiaries during its community outreach programs. AIRS Ghana used this opportunity to educate some mothers during educational outreaches at antenatal clinics and Community Health Planning and Service compounds. IEC Assistants carried out education in schools, churches, mosques, and other public places, and by going from door-to-door to talk with households. These outreach activities enabled communities to understand what IRS is, how it works as a preventive intervention, the malaria cycle, and how malaria affects susceptible groups.

TABLE 8. NUMBER OF COMMUNITY EDUCATION EVENTS

Activity	Bunkpurugu -Yunyoo	East Mamprusi	West Mamprusi	Kumbungu	Mamprugu Moaduri	Total
Door-to-door outreach	137	78	81	135	13	444
Information van (communities visited)	65	86	85	96	10	342
Educational outreach (primary, junior and senior high school, voc/ tech. schools visited)	74	30	26	15	5	150
Mosque and church outreach	81	93	89	81	7	351
Health outreach (antenatal clinics, Community Health Planning and Service compounds, etc. visited)	52	24	28	11	3	118

3.7 RADIO PROGRAMS AND VIDEO SHOWS

In 2016, AIRS Ghana repeated the successful 2015 multimedia approach, using radio and video. The project used three types of radio programming: spots/jingles, discussions with call-in segments, and announcements. There were two kinds of radio spots. One carried messages about the benefits of IRS, provided information on homeowner preparations and post-spray cleanup, and outlined health and safety messages in clear steps for households to follow. The other radio spot addressed concerns, misconceptions, and fatigue issues frequently raised by community members.

AIRS Ghana staff, district assembly representatives, DHMT representatives, pastors, imams, leaders of youth groups, and chiefs led the interactive radio discussions. The discussions alerted communities to the upcoming spray exercise, and addressed common community concerns and misconceptions. The speakers encouraged the households to leave heavy items in the middle of their rooms and not to pack out everything. Listeners were also educated about malaria, its effects, and how IRS is an effective malaria control intervention. They also discussed achieving the PMI spray coverage target of 85 percent and the NMCP/GHS target of 90 percent, and how each household was responsible for contributing to achieving these targets.

Radio announcements about communities scheduled to be sprayed were made in the evenings prior to spray and early in the morning of the spray day. This was done throughout the spray campaign period.

The project used the following radio stations: Eagle FM West and East Mamprusi districts), Simli Radio (Kumbungu and Mamprugu Moaduri districts), Tizaa Radio (the Nalerigu communities), and Scarp FM (Bunkpurugu-Yunyoo). The spots were aired three times a day from April 14 through May 25. As part of the AIRS Ghana collaboration with the GHS, the project took advantage of two radio discussion slots that were donated to GHS for World Malaria Day sensitization, to promote the importance of IRS. In WMD, radio stations provided extra airtime for AIRS Ghana as part of their social responsibility initiatives and the project ran more announcements and interactive shows to increase the coverage in the district. According to the 2015 Beneficiary Satisfaction Survey, about 50% of the population said they heard about IRS from radio, thus, radio-based messages are believed to have considerable impact on mobilization.

All radio initiatives were carried out in the local language to ensure full understanding and participation of community members. District AIRS teams successfully carried out monitoring of the radio initiatives in terms of timing and number of slots aired per day.

The project used video shows across the targeted districts as part of a larger community education strategy to explain the effects of malaria on children under five, the malaria cycle, and the effectiveness of IRS as a malaria control strategy in breaking this cycle. The project aired documentaries on severe malaria in children under five prepared by FHI360 under a USAID-funded malaria project. There were also videos on the malaria cycle and one on IRS produced by Hudson X-Pert sprayer. The use of video was to enable communities to see the effects of malaria. The videos were shown before and during the spray campaign, particularly in areas where Ghana AIRS usually encountered difficulties with acceptance. Videos were shown in the evenings at chiefs' palaces and community centers. Table 9 shows the number of radio programs, videos, and print materials distributed during the campaign.

TABLE 9. IRS RADIO PROGRAMS, VIDEO SHOWS, AND IEC MATERIALS DISTRIBUTED

Activity	Total Number
Radio spots; jingles (before, during, and after spray)	532
Radio programs (interactive shows)	16
Radio Announcements	278
Video shows	37
IRS materials distributed (to public places)*	7,000

* This is the number of IEC materials pasted in public places like schools and marketplaces. It does not include the IEC materials given to households during the house-to-house mobilization activity, which are itemized in Table 9.

3.8 HOUSE-TO-HOUSE MOBILIZATION

The project carried out house-to-house mobilization for the 2016 spray campaign over 12 days, March 2–13. To ensure effective supervision of household mobilization, each community was scheduled to begin and end its mobilization in no more than six days over the 12-day period.

AIRS Ghana trained and engaged 747 mobilizers from GHS to conduct the house-to-house mobilization. Most mobilizers resided in or near the communities they mobilized. The role of the mobilizers prior to spray is to enumerate households for spraying and deliver IRS messages. Also, through the face-to-face interaction, they were assigned to do the following: 1) ask if the household was tired of and inconvenienced by having to move their belongings for spraying as compare it to the benefits of good health, correct any misconceptions about IRS, and educate households on their roles and responsibilities before, during, and after their house was sprayed; 2) ask households if they would accept IRS; and 3) inform households that the mobilizers are the first point of contact for the project should they have any issues with the spraying of their rooms.

During house-to-house mobilization, mobilizers collected household data on the number of people reached with IRS messages, and how many households were willing to accept spraying. They also replaced IRS cards and stickers for those households that had lost their documents issued last year.

To draw the attention of the communities to the spray operations, mobilizers put up posters in public places such as around mosques, churches, markets, and health facilities. Table 10 shows results of house-to-house mobilization.

TABLE 10. HOUSE-TO-HOUSE MOBILIZATION RESULTS

District	No. Households Visited	No. Households Sensitized	No. Adults Reached with IRS Messages			No. IEC/BCC Materials Distributed to Households
			Males	Female	Total	
Bunkpurugu-Yunyoo	14,680	14,680	20,175	24,786	44,961	5,674
East Mamprusi	15,008	15,005	24,481	30,328	54,809	1,933
Kumbungu	7,867	7,865	17,312	20,413	37,725	11,311
Mamprugu Moaduri	3,992	3,989	6,735	8,055	14,790	1105
West Mamprusi	11,932	11,920	20,669	25,216	45,885	970
TOTAL	53,479	53,459*	89,372	108,798	198,170	20,993

* Number of households visited does not equal the number of the households sensitized because of a small number of cases where no adults could be found in the compound during the mobilization visit.

During the spray campaign, mobilizers ensured that residents were informed in advance about spray dates for their communities. On the day of spray, mobilizers helped to ensure that each household was ready for spraying; in some cases, they helped households pack out their belongings. Mobilization for the 2016 campaign also targeted the issue of not-sprayed structures.

In 2015, refusal of spray numbered 6,187 structures; 33.2 percent of unsprayed structures. In 2016, IEC Assistants with the help of mobilizers targeted and engaged households who refused IRS in 2015. Most households had refused IRS because of the odor of the insecticide. To counter this, the IEC Assistants encourage them to weigh the benefits of the program against the temporary discomfort caused by the odor and to contribute to the communal effort to achieve the spray coverage needed for the total protection of the community. As a result, the total number of refusal cases was reduced to 5,030 (30.3 percent) of total unsprayed structures in 2016.

Also in 2015, locked structures numbered 10,471; (56.2 percent) of unsprayed structures. Although the total percentage of not-sprayed structures fell by 1 percent in 2016 (from 8.3 percent in 2015 to 7.3 in 2016), this was not because the number of locked structures fell appreciably; in fact, while the number fell slightly, to 10,358, the percentage of not-sprayed structures represented by locked structures rose by 6 percent, to 62.5 percent. Locked structures are still a challenge as many of their owners have moved to distant areas, often to southern Ghana for work. AIRS Ghana will explore new strategies through further discussions with community and opinion leaders and all other stakeholders to find ways of accessing the locked structures.

3.9 COLLABORATION WITH PEACE CORPS VOLUNTEERS

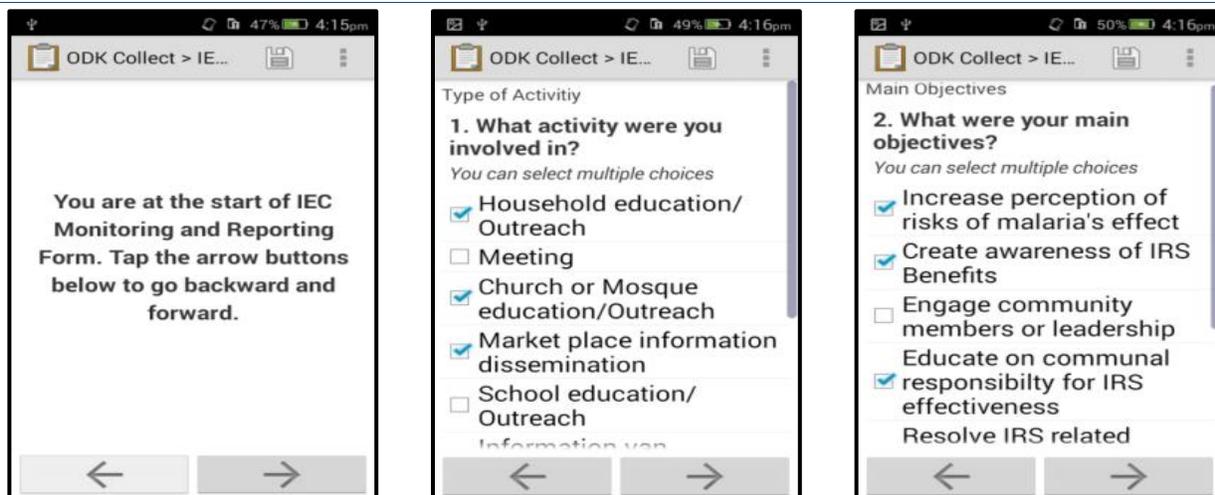
Eleven U.S. Peace Corps volunteers worked with AIRS Ghana in three districts: Kumbungu, and West and East Mamprusi, assisting with the mobilization of their host communities and when possible of nearby communities in their sub-districts. Equipped with IRS messages, they worked alongside spray teams to mobilize and encourage households to spray, correct misconceptions, and address concern. Based on availability, some also attended the pre- and post-IRS stakeholder meetings. The collaboration will be explored further in the future.

3.10 MONITORING OF IEC/BCC ACTIVITIES USING MOBILE PHONE BASED CHECKLIST

AIRS Ghana introduced two mobile phone-based supervisory tools for monitoring IEC/ BCC activities of the 2016 spray campaign: the Monitoring and Reporting Form, and the Mobilization Supervision Form. Both worked on Android-based smart phones using Open Data Kit (ODK). The purpose of using mobile tools was to quickly get reports from the field and, when needed, to immediately feedback corrective actions. For this purpose, the project purchased 16 new mobile phones, one for each IEC assistant.

3.10.1 MONITORING AND REPORTING FORMS

IEC Assistants used the Monitoring and Reporting Form to report on IEC activities they carried out from the 16 operational sites. As expected for IEC, most activities took place in the pre-spray period. IEC Assistants had to fill the form after every activity and take the GPS coordinates at the locations where they conducted the activity. This enabled the project to know what activities were being conducted at any point in time, and where those activities were conducted. It also enabled the IEC Coordinator to monitor the activities and provide immediate feedback on challenges reported.



Screen shot from the IEC/ BCC activity Monitoring and Reporting mobile data collection form

A total of 155 activities were reported. Table 11 shows the pre-spray activities reported with the objectives they intended to meet. The project team will work on expanding the form to track and report activities conducted during the spray campaign.

TABLE 11. OBJECTIVES TARGETED AND ACTIVITIES* REPORTED

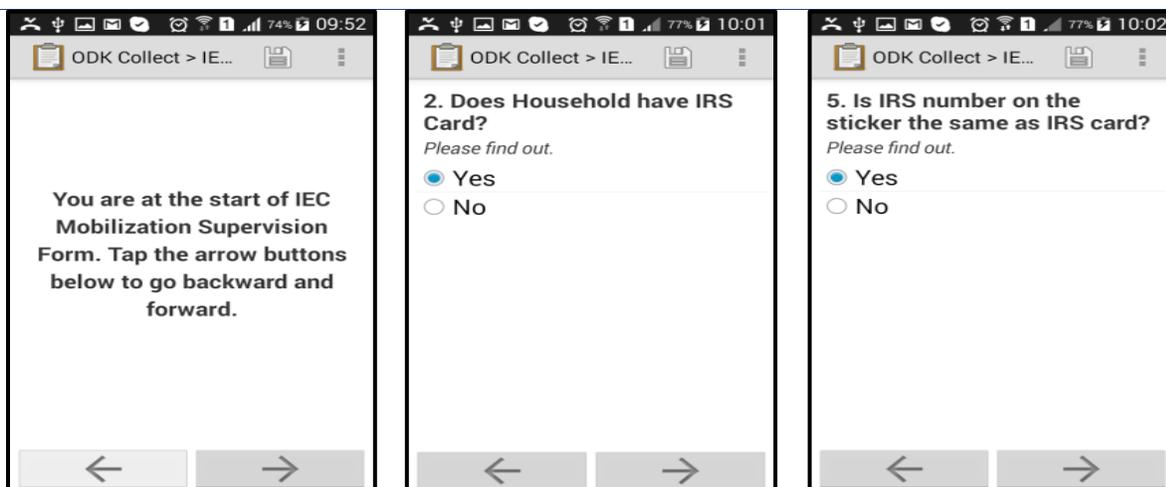
Objective	Number of Activities Reported Targeting the Objective
Increase perception of risk of malaria	104
Create awareness of benefits of IRS	122
Engage community leadership	84
Educate on communal responsibility for IRS effectiveness	89
Resolve IRS-related issues	90
Homeowner preparations, health, safety and compliance	67

*Total of 155 activities where one activity can have multiple objectives and one activity is repeated in different places and at different times. Activities include but are not limited to educational meetings at schools, churches, mosques, health centers, and communities.

Generally, the use of smart phones for monitoring the implementation of IEC strategies made it easy to know which strategies and messages were being used more often than others and to address any issues that arose.

3.10.2 MOBILIZATION SUPERVISION FORM

IEC assistants used the Mobilization Supervision ODK Form to supervise mobilizers during the house-to-house mobilization. Its purpose was to ensure that mobilizers were sensitizing households accordingly and collecting accurate data.



Screen shot from the Mobilization Supervision mobile data collection form

The form was created from a paper form that AIRS Ghana had used in previous years. The mobile version had an embedded option to report corrective actions immediately. In the two-week period of the supervision of the house-to-house mobilization, IEC assistants inspected 1,880 compounds. Table 12 presents breakdown of mobilization supervisory reports by district.

TABLE 12. NUMBER OF MOBILIZATION SUPERVISION VISITS CONDUCTED

District	No. of Communities Visited	No. of Supervisions
Bunkpurugu-Yunyoo	93	458
East Mamprusi	111	620
Kumbungu	117	240
Mamprugu-Moaduri	25	211
West Mamprusi	66	351
Total	412	1880

Table 13 summarizes the data AIRS Ghana collected through the mobilization supervision using smart phones. The data show that each compound visited by supervisors had been visited by a mobilizer. Also, 99.7 percent of the households visited confirmed that they have their IRS cards and essentially the same number (99.6 percent) confirmed that they had their IRS sticker. In 99.8 percent of compounds, the IRS card and the sticker had the same number. Where the numbers were different, both IRS card and sticker were replaced with matching ones. In addition, the data show that 99.5 percent of households knew how to prepare their home for spraying and what to do after spraying was done in their homes. Also, over 80 percent of households understood that the mobilizer was the first point of contact for the household with the project team. Households were well aware of other key IRS messages of IRS.

TABLE 13. MOBILIZATION RESULTS: HOUSEHOLD AWARENESS OF 2016 IRS CAMPAIGN

Supervisory question	Yes		No		Total
	#	%	#	%	
Has a mobilizer visited this household?	1880	100.0%		0.0%	1880
Does household have IRS card?	1875	99.7%	5	0.3%	1880
IRS sticker ID present?	1872	99.6%	8	0.4%	1880
Is IRS number on the sticker the same as IRS card?	1865	99.8%	3	0.2%	1868
Has the household been sensitized?	1847	98.6%	26	1.4%	1873
Does household know the benefits of IRS?	1836	99.4%	11	0.6%	1847
Does household know how to prepare their homes for spray?	1864	99.5%	9	0.5%	1873
Does household know what to do after the house has been sprayed?	1863	99.5%	10	0.5%	1873
Does household know whom to consult when there's an issue about IRS that needs to be resolved after the spray?	1611	86.0%	262	14.0%	1873
Does household know USAID/the American people are providing IRS to the community?	1444	77.1%	429	22.9%	1873

The project used these findings to reinforce relevant messages in the media, information van education, community meetings, and community outreach programs.

District officials and community leaders participated with the project staff in monitoring mobilization during the spray campaign. Disease Control Officers, from the district health office, who supervised the mobilization efforts, ensured the communities had been informed about household preparations, and safety and compliance activities to be performed before, during, and after spray. The project staff and District Environmental Health Officers (DEHOs), from the district coordinating office, also supervised the adherence of households to safety information they had received on what to do before, during, and after the spray exercise. During spray operations, IEC Assistants, Team Leaders, and Field Supervisors used an attendance sheet to monitor the mobilization activities of community-based Mobilizers. Community members also served as backup checks to verify that Mobilizers had sensitized and mobilized their communities.

4. IMPLEMENTATION OF IRS ACTIVITIES

4.1 SPRAY CAMPAIGN

AIRS Ghana implemented the 2016 IRS in five targeted districts in the Northern Region. Following the IRS launch in West Mamprusi District, spray operations began on April 22 simultaneously in all 16 operational sites across the five districts and concluded on May 26 (30 operational days).

By the end of the campaign, SOPs had found 227,857⁸ structures and sprayed 211,283 of them with an overall spray coverage of 92.7 percent. Table 14 shows the targets for each district, structures found and sprayed, and coverage. It also shows the number of spray days for each district.

Ethnic conflicts meant that local police refused the project a security clearance to spray two communities in Bunkpurugu-Yunyoo district: Sanbiruk had an estimated 149 structures, Sayeegu an estimated 339. Apart from this, there were no major challenges to the smooth implementation of the 2016 spray campaign.

TABLE 14. 2016 STRUCTURES SPRAYED IN FIVE DISTRICTS

District	Targeted No. of Structures*	Structures Found by SOPs	Structures Sprayed	Spray Coverage	Targeted Population*	Pop. Protected	No. of Spray Days
Bunkpurugu-Yunyoo	52,844	53,156	50,742	95.5%	128,855	125,903	30
East Mamprusi	66,098	67,479	63,057	93.4%	176,774	173,736	30
Kumbungu	33,546	34,006	31,932	93.9%	86,289	86,578	30
Mamprugu Moaduri	20,366	20,290	18,767	92.5%	53,589	51,534	30
West Mamprusi	51,737	52,926	46,785	88.4%	140,191	133,120	30
Total	224,592	227,857	211,283	92.7%	585,698	570,871	30

* Based on structures found by SOPs in 2015.

4.2 SUPERVISION OF IRS

IRS is a highly technical process that demands thorough supervision and monitoring in order to achieve the intended impact. The AIRS Ghana team ensured that there was adequate monitoring and supervision at all levels throughout the spray campaign. The COP, Operations Manager, M&E Manager, Database Manager, IEC Coordinator and the Environmental Compliance Officer (ECO) formed one supervision team guiding districts/sites on all technical aspects of IRS. The district-level supervision teams comprised the DOC, the District M&E Assistant, and the District Logistics Assistant. At the operational site level, the supervisory team comprised the Site Manager, Field Supervisors, and Team Leaders.

⁸ This figure includes estimates for the number of structures found/not-sprayed in compounds not accessed. Every compound in a community that is not accessed is assigned a number of structures equivalent to the average number of structures per compound in that community based on the 2014 (and 2012 for Kumbungu district) spray data.

All supervisors used standard AIRS supervision and monitoring tools to assess the spray quality, environmental compliance activities, and spray data collection. The tools are described in Table 15.

TABLE 15. SPRAY CAMPAIGN SUPERVISORY TOOLS

Supervisory Tool	Purpose and Person Responsible
Spray Operator Morning Mobilization and Vehicles Inspections	<p><i>Purpose:</i> To ensure spray teams leave for the day with the correctly accounted for personal protective equipment (PPE), equipment, insecticide, and supplies, and are safely transported to the spray site.</p> <p><i>Person responsible for completing this checklist:</i> Site Manager, Field Supervisor, ECO, Spray Operations Coordinator (SOC)</p>
End-of-Day Cleanup	<p><i>Purpose:</i> To ensure spray teams correctly follow environmental compliance procedures for cleaning equipment, account for insecticide stocks, and store equipment for the next day.</p> <p><i>Person responsible for completing this checklist:</i> Site Manager, ECO, visiting HQ staff, and SOCs (when visiting an operational site)</p>
Home Owner Preparations and Spray Operator Performance	<p><i>Purpose:</i> To ensure that SOPs spray houses (structures) that have been correctly prepared for spraying (inside and out) and use correct spray and insecticide handling techniques.</p> <p><i>Person responsible for completing this checklist:</i> Spray Field Supervisors, IEC/Coordinator, ECO, Operations Manager, and SOCs (when visiting the field for supervision)</p>
Storekeeper Performance	<p><i>Purpose:</i> To ensure that Site Storekeepers are following best warehousing practices and accounting for stocks and equipment.</p> <p><i>Person responsible for completing this checklist:</i> Site Manager, District SOC, District Logistics Assistant, Logistics Coordinator, Operations Manager, COP, visiting HQ staff</p>
Directly Observed Spraying	<p><i>Purpose:</i> To ensure proper application of insecticides by correctly applying the spray techniques.</p> <p><i>Person responsible for completing this checklist:</i> Team Leaders</p>

A monitoring and supervision schedule was developed and used during the 2016 spray campaign. The schedule showed the role of specific individuals involved, the type of supervisory tools to be used, and the frequency of the usage of each supervisory tool. The schedule captured the COP, Operations Manager, M&E Manager, Database Manager, IEC Coordinator, and all DOCs, Site Managers, Field Supervisors, and Team Leaders.

4.2.1 DIRECTLY OBSERVED SPRAYING



Team Leader is conducting directly observed spray (DOS) supervision

Due to growing concerns of spray quality, house preparation before spray, and the level of supervision by Team Leaders observed in some AIRS counties, the PMI AIRS Project introduced the Directly Observed Spraying (DOS) supervision tool to ensure technical aspects of the campaign met standards.

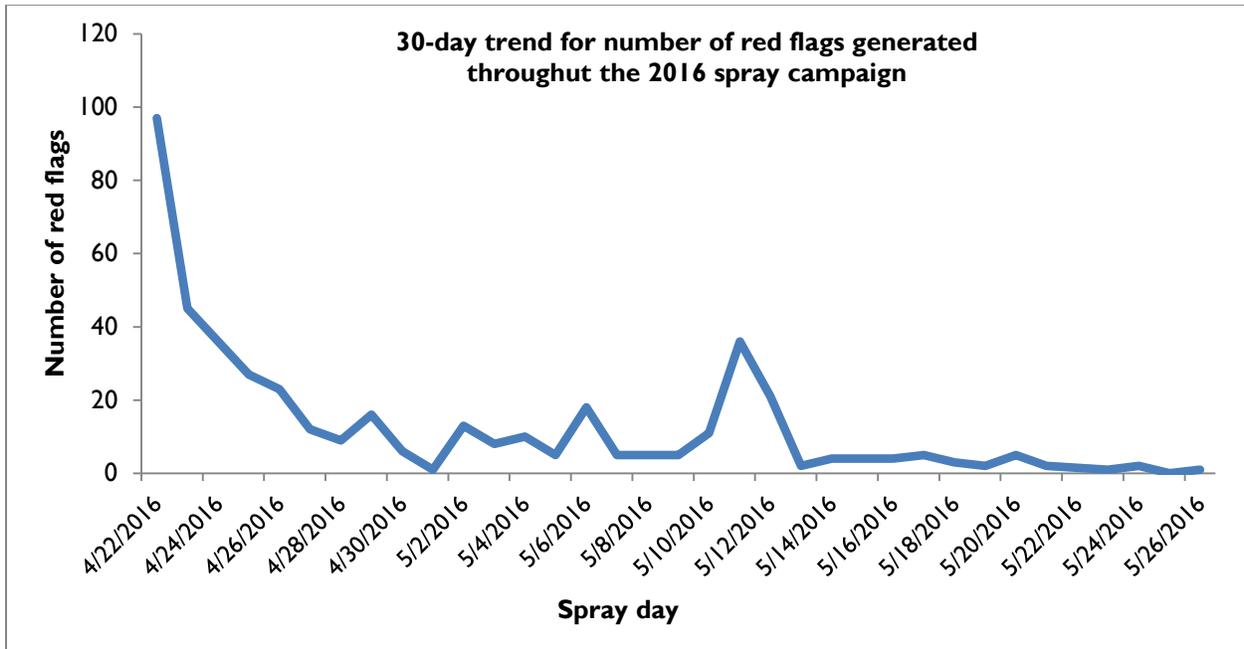
One of the most important technical requirements of IRS is depositing the right amount of insecticide on the wall or sprayable surface. This depends on the training of SOPs, but also how they operate in the field. Supervisors observe the SOP preparations and spraying techniques such as keeping the nozzle tip at the right distance from the wall, maintaining their speed, and applying corrective measures on the spot, when required. The PMI AIRS team designed a DOS form with 10 questions to help supervisors to directly observe and monitor the quality of the activities carried out by SOPs, from the correct use of PPEs to making sure equipment is functioning and structures are prepared for spraying, to correct mixing and applying of insecticides with special emphasis on spray quality.

In Ghana, Team Leaders were primary users of the DOS form because other levels of supervisors had a supervisory checklist that served the same purpose. AIRS Ghana set a target of five forms for each Team Leader per day (at least once for each of the five SOPs under a Team Leader's supervision). All Team Leaders received training on how to use the DOS form during the Team Leaders and Spray Operators training. Team Leaders were also trained to provide instant feedback and on-the-spot corrective measures if any red flags issues were observed.

To monitor the use of the DOS form and the level of errors being observed and corrected, AIRS Ghana designed a database to capture data collected through the DOS form. The project procured five new laptops, one per district, and recruited five Data Entry Assistants for this purpose.

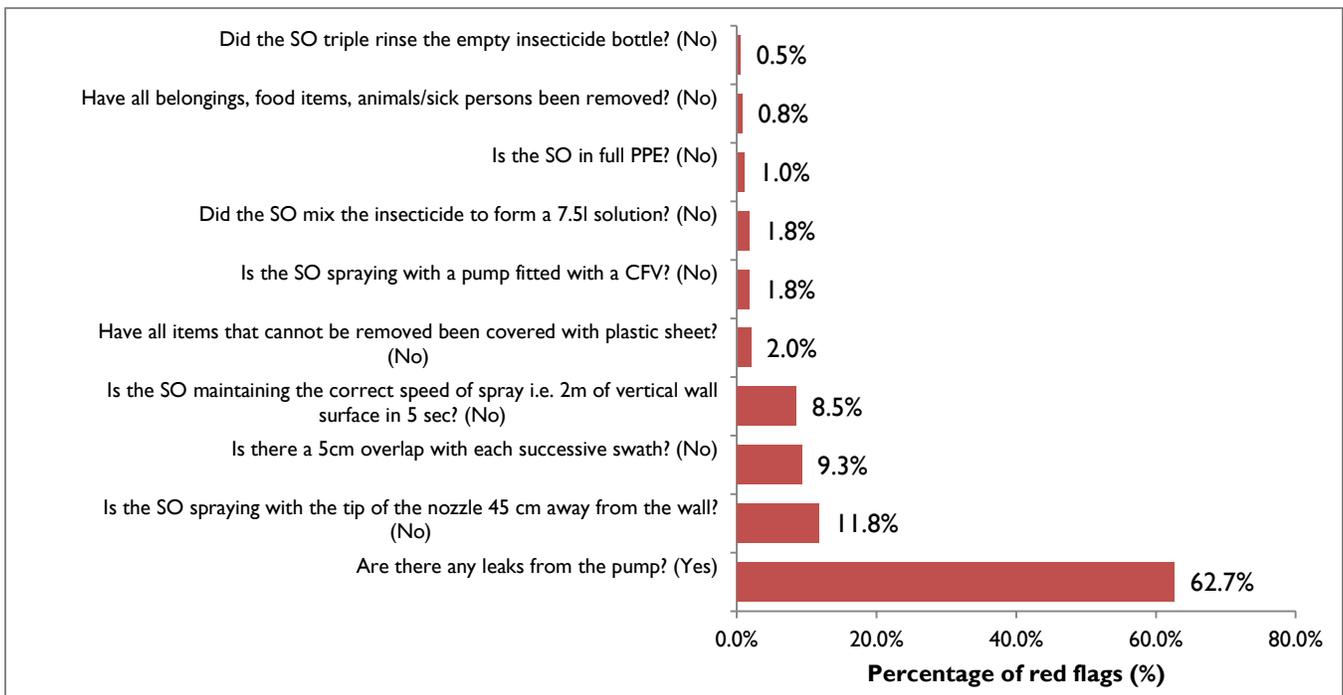
In total, Team Leaders completed 12,504 DOS inspections over the 30-day spray campaign period. Of these, 12,187 (97.5 percent) inspections did not raise any "red flags." The remaining 317 (2.5 percent) inspections raised the 399 red flags described below. Team Leaders addressed them on the spot. Just over a third of the red flags (142, or 35.6 percent) were observed in the first two days of spray operations. The remaining 64.4 percent were spread over 28 days, as illustrated in Figure 1.

FIGURE 1. NUMBER OF RED FLAGS OBSERVED EACH SPRAY DAY



Further analysis showed that about 63 percent of all the 399 red flags were due to some form of leakages from the spray pump. The leakages were not the type that lead to spillage of insecticides but rather were leakages of air through some part of the spray pumps, especially from around where the nose connector is attached to the spray pump. The air leak only meant the pumps lost pressure faster than usual and SOPs had to pressurize them frequently. Nevertheless, the pumps were repaired or replaced as soon as the problem was brought to the attention of the Site Managers. Figure 2 shows the distribution of red flags about other issues.

FIGURE 2. DISTRIBUTION OF RED FLAGS BY QUESTIONS ASKED



4.3 DATA REPORTING

SOPs collected data using the daily SOP data collection form. Team Leaders checked and verified the data cards. Further checks were completed by the Field Supervisors, District M&E Assistants, and Data Entry Assistants before the data were entered daily into the database. AIRS Ghana shared weekly IRS progress reports with the project home office and PMI, and also with the GHS (regional and district officials), District Assembly, and NMCP.

4.4 LOGISTICS AND STOCK MANAGEMENT

In line with operational standards, AIRS Ghana trained and hired five District Logistics Assistants and 17 Site Store Assistants to manage central, district, and site warehouses. They maintained and updated records including stock cards and ledger book for each item with details of transactions, quantities involved, dates, and destination. Supervisors (COP, Operations Manager, Logistics Coordinator, ECO, DOCs, and Site Managers) regularly conducted physical stock counts to ensure that the actual stock corresponded with records on stock cards and ledger book.

District Logistics Assistants completed weekly inventories for each operational site in their districts, and reconciled the operational site inventory balance with the inventories at each district warehouse. The project used it as a basis to approve requests for IRS materials and to reconcile central warehouse stock in Tamale with district stocks. To ensure that goods were tracked, signed copies of requests and delivery notes accompanied each logistical transaction.

Operational site Store Assistants used insecticide tracking sheets to record the quantities of Actellic 300CS bottles each Team Leader received each day. At the close of each spray day, the Store Assistants recorded the number of full and empty bottles returned on the same tracking sheet, and transferred the data onto the stock cards for reconciliation. The Logistics unit worked closely with the M&E team to ensure that quantities of used insecticides on stock cards corresponded to what was reported in the database.

4.5 MOBILE DATA COLLECTION, MESSAGING AND REPORTING

The use of mobile phones for data collection and reporting has become an integral part of many current projects. In 2016, AIRS Ghana used mobile phone data collection, messaging and reporting applications based on CommCare and ODK platforms.

4.5.1 MHEALTH

The mHealth tools the AIRS Ghana used in 2016 were:

- Job aid messaging including gender awareness messages
- The daily performance monitoring tool (PMT), for real-time spray data reporting via SMS

These two tools were all built on the TextIt messaging platform.

SMS based job aid messaging: The project introduced SMS-based job aid and gender awareness SMS messaging in 2015. These are primarily used to remind spray teams and supervisors of standard operating protocols and key environmental compliance issues as well as to reinforce the need to create a work environment that is void of discrimination against individuals based on their gender, religion, or ethnicity. Through the SMS job aid system, AIRS Ghana leadership sent out notices and information to all categories of spray team members at least three times a week throughout the spray campaign. Spray

team members were categorized into SOPs, males, females, and supervisors. Table 16 provides examples of the job aid and gender awareness messages that were sent out between May 10 and 14, 2016. Spray team members received the messages on their personal phones. During the campaign, AIRS Ghana leadership modified the messages based on the issues reported through the digitized supervisory forms.

TABLE 16. SAMPLE OF 2016 SPRAY CAMPAIGN JOB AID MESSAGES

Message	Group Sent To	Time Sent
<i>Good morning! Please remember that your target is to spray 18 or more structures per day. Thanks for the good job.</i>	SOPs	before 7 a.m.
<i>Please remember to use your FULL PPE when mixing insecticide, during spraying and during end of day clean up.</i>	SOPs, Team Leaders	before 7 a.m.
<i>Please remember to perform the DOS for spray operator in your team today. Use BLUE pen to indicate positive answers and use RED pen to indicate negative answers.</i>	Team Leaders	before 7:30 a.m.
<i>Please remember that your target is to perform the home owner preparation and spray operator performance inspection in 5 compounds anytime you have the smart phone with you.</i>	Field supervisors	before 7 a.m.
<i>Sexual harassment creates a workplace environment that is hostile. We must all help to ensure it does not occur on the project.</i>	SOPs, Team Leaders, Supervisors	
NO one should be harassed for their ethnic or tribal status, religion, age, national origin, disability, race, sex, marital status, sexual or gender orientation.	SOPs, Team Leaders, Supervisors	before 7 a.m.

Receipts of job aid messages were monitored by supervisors through interactions with spray team members during field supervision. In 2015, the major challenge was delayed arrival of some messages due to slow network connectivity around some operational sites. As a result, in 2016, the project scheduled SMS message delivery well ahead of their desired time of arrival. On average, out of the 1,068 daily messages scheduled, about 980 (91.7 percent) arrived at the expected time. The remaining 88 were either delivered later or not at all, again because of slow network connectivity around some operational sites.

As in 2015, AIRS Ghana also used the *WhatsApp* application to communicate with DOCs and Site Managers, especially when immediate action was required.

Daily spray performance reporting: As introduced in 2015, daily spray performance reporting through SMS-based daily PMT reporting of spray data was used in addition to the paper-based performance tracking sheet at each operational site. At the end of each day, Site Managers copied data from the Team Leader summary forms into the paper-based performance tracking sheet and then sent the same data as an SMS to a data aggregation center in Tamale. The four key indicators reported through the SMS system were: number of structures found, number of structures sprayed, number of insecticide bottles used, and number of SOPs who worked that day. The purpose of the PMT SMS was to provide senior management team with real-time information on daily performance to enable quick corrective decisions to improve ongoing spray operations. Data reported through the PMT SMS reporting were shared daily with the COP, Operations Manager, and certain home office staff including the Director of Operations. Once a week, the NCMP and regional and district health management teams received summary email updates as well. To aid this reporting process, each Site Manager was equipped with a simple java-enabled phone.

At the same time, Data Entry Assistants were entering daily data and sending it to the cloud-based platform so the data were available to the AIRS Ghana M&E team and the home office by the next day. This enabled the M&E team to produce summary tables on spray performance indicators and share them with management almost at the same time as PMT SMS. As the campaign progressed and revisits took place, data from the database reflected the spray progress more accurately than the daily SMS, which double counted the structures found during revisits. Therefore, leaving out data entry by totals and the daily SMS data tracking in the next campaign could be discussed.

4.5.2 Field Supervision Reporting Using Phone-based Supervisory

In 2015, AIRS Ghana converted all paper-based supervisory tools into a mobile data collection using the ODK platform. In 2016, the same supervisory tools were used but on two different platforms. To improve functionality, the project used the ODK platform to maintain the environmental compliance supervisory tools (Pre-season Storeroom and Soak pit Assessment tool, Pre-contract Transport Inspection tool, and the Post-IRS Environmental Compliance Inspection tool, used mainly by the AIRS Ghana ECO). Other supervisory tools (Morning Mobilizations and Vehicle Inspection tool, Homeowner Preparation and Spray Operator Performance tool, Store Keeper Performance tool and End of Day Clean up tool) were migrated from ODK to Dimagi's CommCare application system. In addition, the project converted one M&E tool (data collection verification form) for the first time from paper-based to mobile data collection form using the CommCare platform.

The purpose of these conversions was to get quick feedback on compliance reports coming from the field and enable immediate corrective actions when needed. All supervisory tools were programmed on Android-based smart phones and used before, during, and after the spray campaign. Field Supervisors used them to conduct SOP performance and homeowner preparation checks. Site Managers used them to supervise daily morning mobilization, storekeepers' performance, and end-of-day cleanup inspection. The ECO used the system for the pre-season environmental compliance assessment (PSECA), vehicle inspection, and post-spray site inspection and certification. The AIRS technical team used the CommCare-based system to supervise all aspects of the spray operation. As soon as data were submitted to a cloud server, an email was generated and sent to a set of recipients, including the COP, Operations Manager, ECO, and home office team. Immediate follow-up was done on any issues that were reported through the emails.

All categories of staff that used the mobile supervision and reporting systems received adequate full-day training before the start of the spray campaign. IT and M&E teams quickly resolved issues identified during the spray campaign. The Dimagi representative responsible to the AIRS Ghana team also followed up with the team frequently throughout the period of the campaign. A common complaint was the conflict of user passwords due to sharing of phones among some field supervisors; the issue was resolved expeditiously.

4.6 NOZZLE TIP TEST

To ensure quality of spray, proper functioning of spray equipment and all of its parts is very important. During the 2016 spray campaign, AIRS Ghana employed a pump mechanic to fix any malfunction that arose during spray campaign. This move was helpful and issues with spray pumps did not stall spray operations as happened in 2015. This also reduced the occurrence of SOPs attempting to fix nozzles in the field with insecticide in the pump.

In ensuring that all spray pumps were discharging at the right rate, the project decided to perform regular nozzle tip test once a week. Site Manager and Supervisors conducted the tests. The tests consisted of discharging the content (water) of a spray pump into a measuring cylinder for one minute. The normal discharge range with control flow valve (CFV) was considered as 580ml +/- 10%. If the total volume after one minute was less than approximately 522ml, the nozzle tip was cleaned and retested. If the discharge was still below 522ml after cleaning, the nozzle tip was considered blocked and was replaced. Also, if the discharge was more than approximately 638ml, the nozzle tip was replaced.

On average, 92.4 percent of nozzle tips functioned normally while the remaining nozzles were either under discharging (3.7 percent) or over discharging (3.9 percent). All nozzle tips that did not meet the normal performance range were replaced. The project will maintain these tests in the future to ensure high quality in the application of insecticides.

5. POST-SPRAY ACTIVITIES

5.1 POST-SPRAY STAKEHOLDER MEETINGS

AIRS Ghana held the post-spray stakeholders meetings after the end of the spray campaign from June 6 to 11, 2016, in all five target districts. The purpose of these meetings was to discuss spray coverage for the sub-district for the year, examine the trend of coverage over the years, review decisions and strategies decided on during the pre-spray meetings to improve spray coverage, and then to find out what worked and what did not. The participants also discussed challenges encountered during the spray campaign, lessons learned, and best practices to adopt in preparation for the next spray campaign. It was also an opportunity for the project to show appreciation to all stakeholders for their support and single out exemplary communities for other communities to emulate. In all of these meetings, it was very clear that stakeholders appreciated PMI's assistance for the various malaria control interventions and for a continuous implementation of the project.

A major concern of stakeholders in communities in all target districts that caused some households to refuse spraying was the odor of the insecticide. Some participants at the stakeholder meetings urged the project to improve the smell of the insecticide to increase the spray coverage.

The project will hold a national post-spray evaluation meeting in Tamale in August 2016. Participants will include the NMCP, the Overlord of the Mamprugu Traditional Area, the Paramount Chief of the Kumbungu Traditional Area, AngloGold Ashanti, regional health directorate, district health directorates and district assemblies in target districts, and the EPA. The objectives of this meeting will be to:

- Present the performance of 2016 spray operations to stakeholders
- Share best practices and challenges from the 2016 IRS campaign
- Secure the commitment of community leaders for the next round of spray in 2017

5.2 DEMOBILIZATION

After the 2016 spray campaign, AIRS Ghana moved all logistical items from the various operational sites to either the district stores or the central warehouse in Tamale within two weeks of the end of operations.

The team cleaned all rinsing barrels at all operational sites. The project organized transportation of all waste items (used nose masks, hand gloves, and empty Actellic 300 CS bottles) to the main district stores to await proper and final waste disposal. Of the 49,915 bottles of Actellic 300 CS available for the 2016 spray campaign, 49,596 bottles were distributed to the districts and 47,133 bottles were used. The project transported leftover stock of full Actellic 300 CS bottles (2,463 bottles) from the district warehouses to the central warehouse in Tamale. The final inventory that included the 319 bottles that stayed at the central warehouse showed that 2,782 bottles of Actellic were left over at the end of the 2016 campaign.

Other post-spray activities are captured in chapters 6, Entomology, and 7, Environmental Compliance.

6. ENTOMOLOGY

This chapter summarizes activities conducted between March and May 2016. The AIRS entomology team worked closely with the district staff of the GHS and district assemblies to implement all planned field activities. AIRS Ghana also partnered with the NMIMR to support advanced molecular evaluations.

6.1 SENTINEL SITES

Five districts are being used as entomological monitoring districts in 2016. The 14 communities selected in 2015 continued to be sentinel sites. These communities include IRS sprayed communities, communities from which IRS has been withdrawn as well as communities that have never been sprayed. Table 17 presents the districts and their corresponding communities selected for the entomological surveillance.

TABLE 17. ENTOMOLOGICAL MONITORING SITES

Districts	Communities/ Sentinel Sites	Insecticide spray history					
		2008-2010	2011	2012	2013	2014	2015
BYD	Bunbuna, Yunyoo, Nasuan, and Sanbiruk*	NSp	ACy	ACy	PM	PM	PM
KD	Gbullung and Gupanerigu	DM	ACy	ACy	NSp	NSp	PM
SND	Diare, Nanton, and Tarikpaa (IRS was withdrawn in 2015)	DM	ACy	PM	PM	PM	NSp
TD	Dimabi and Woribugu (IRS was withdrawn in 2013)	DM	ACy	ACy	NSp	NSp	NSp
Tamale Metropolis (TML)	Kulaa, Tugu, and Yong (comparison communities with no history of IRS)	Control	Control	Control	Control	Control	Control

*As a result of inter-community conflict, Sanbiruk was replaced by Kpemale.

As noted above, entomological monitoring activities for 2016 were conducted from March through May. They included:

- Vector susceptibility to insecticides
- Cone bioassay tests for quality assurance of the IRS program and residual efficacy of the sprayed Actellic 300 CS formulation of pirimiphos methyl (an organophosphate)
- Mosquito collections to identify species of malaria vectors in targeted districts and assess the impact of the IRS on feeding and resting behavior as well as longevity of local vector species

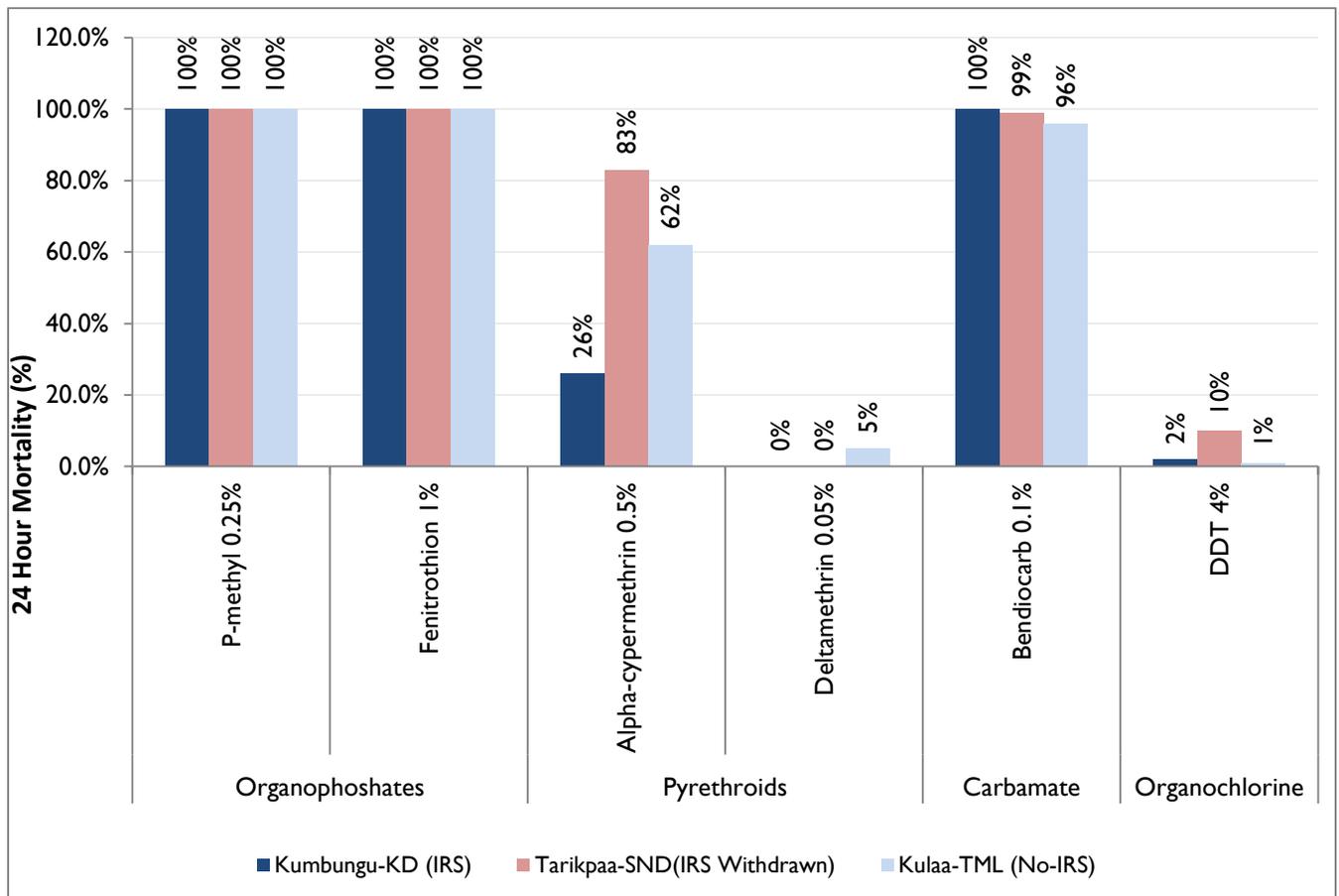
6.2 PRE-SPRAY INSECTICIDE SUSCEPTIBILITY TESTS

Prior to the IRS operations, in March-April, 2016, the susceptibility of local wild *An. gambiae* s.l. species to selected World Health Organization (WHO)-recommended insecticides for IRS was assessed using the WHO tube assay method.

The insecticides tested were pirimiphos methyl 0.25 percent, fenitrothion 1 percent, alpha-cypermethrin 0.5 percent, deltamethrin 0.05 percent, bendiocarb 0.1 percent, and DDT 4 percent. *An. gambiae* s.l. species collected were exposed to these insecticides for 60 minutes, after which the mosquitoes were held for 24 hours to record the 24-hour mortality.

The results of the insecticide susceptibility tests conducted in March-April, 2016 are presented in Figure 3. They show that the local vector species (*An. gambiae* s.l.) from the IRS communities is susceptible to the organophosphates (pirimiphos methyl and fenitrothion) and the carbamate (bendiocarb) tested except at Kula where possible resistance was indicated for bendiocarb. *An. gambiae* s.l. is resistant (0%–83% mortality) to the pyrethroids (alpha-cypermethrin and deltamethrin) and DDT at all sentinel sites (1%–10%).

FIGURE 3. INSECTICIDE SUSCEPTIBILITY RESULTS ON AN. GAMBIAE s.l. MOSQUITOES AT THREE SITES



6.3 QUALITY ASSURANCE TESTS OF IRS AND RESIDUAL EFFICACY OF THE SPRAYED INSECTICIDE

As part of the AIRS Ghana's quality check, standard WHO cone bioassays were used to test the quality of work by the different spray teams and to evaluate the residual life of the sprayed insecticide (Actellic 300 CS). The team conducted tests on three main types of sprayed surfaces: mud from traditional houses, cement from modern houses, and wood from the doors and windows.

6.3.1 QUALITY ASSURANCE OF THE IRS PROGRAM

Spray quality assessments were conducted in 10 communities within two weeks of the start of the IRS campaign to provide real-time feedback on spray quality to the spray teams. The communities were:

- Cheyohi-I, Gbullung, and Yuni in Kumbungu
- Bunbuna, Kpemale, Kualik, Tuna-2, and Tusugu in Bunkpurugu-Yunyoo
- Langbinsi in East Mamprusi
- Kata-Banawa in West Mamprusi

Additional tests were carried out in three entomological sentinel sites to assess the quality of spraying. These communities were sprayed in May, by which time the spray quality tests were reported. But because these are entomological sentinel sites, the team went ahead to test for the quality of spray. These communities were:

- Gupanerigu in Kumbungu
- Yunyoo and Kpemale-I in Bunkpurugu-Yunyoo

The project chose the houses sprayed by different SOPs in different spray teams for the test. In each community, four houses (two with cement wall surfaces and two with mud wall surfaces) were selected for the assessment of the quality of spray on the predominant surface types (cement and mud). Cone bioassay was conducted on the wooden doors or windows of each room selected for the cone bioassay, to assess the performance of sprayed insecticide on wood surface. However in Langbinsi (EMD) and Kata-Banawa (WMD) the bioassays were conducted in two houses each, since there weren't enough mosquitoes for four houses.

In Cheyohi-I, Gbullung, Kpemale, Kualik, and Gupanerigu, wall bioassays were conducted using both a laboratory-raised Kisumu strain of the *An. gambiae* s.s. and wild female adults of *An. gambiae* s.l. reared from larvae collected in project districts. However in Bunbuna, Tuna-2, Tusugu, Yuni, Langbinsi, Kata-Banawa, Yunyoo, and Kpemale-I, wall bioassays were conducted using the Kisumu strain only, since scarcity of breeding sites made it difficult to collect enough wild mosquito larvae from these areas and raise them for the wall bioassays. All mosquitoes used for the tests were 2–5 days old. To assess the spray quality on the different wall surfaces in each room, three walls of the room were tested, with cones fixed at about 1.5m high on each wall. Three cone bioassays were carried out on the walls in any one house together with one assay on the wooden door or window using 10 adult female mosquitoes per cone.

One control cone assay was done for every four bio-assay tests, by fastening cardboard on unsprayed surfaces and exposing the control mosquitoes to the cardboard but also to conditions similar to exposed mosquitoes. To avoid the possibility of the control mortality increasing due to the airborne effect of the Actellic 300CS formulations, the control tests were set up in not-unsprayed structures with fairly similar conditions (relative humidity and temperature) as the rooms being tested.

The cone exposure chamber was fastened with tape to the selected spot on the surface to be tested. Ten mosquitoes were introduced into the chamber and left exposed on the surface for 30 minutes. At the end of the exposure period, the mosquitoes were collected and transferred to paper cups. The number of mosquitoes that were knocked down at the end of the exposure period (30 minutes) and at 60 minutes was recorded. A third set-up was mounted in the sprayed rooms for 30 minutes to assess the airborne effect of the sprayed insecticides at the time of the assays on mosquito species (Kisumu and wild *An. gambiae* s.l.). The number of mosquitoes that were knocked down after a 30-minute exposure and at 60 minutes were recorded as was done for the tests.

All the mosquitoes were brought to the AIRS entomology laboratory where the temperature and relative humidity were maintained at 25°C–29°C and 75–85 percent, respectively. The mosquitoes were given a 10 percent sugar solution on cotton pads during the 24-hour holding period. The dead and live mosquitoes were counted after 24 hours and the mortalities calculated. Mortalities were corrected using Abbot's formula if the control mortalities were between 5 percent and 20 percent, but tests were discarded and repeated if control mortalities exceeded 20 percent.

6.3.2 RESIDUAL EFFICACY OF ACTELIC 300 CS

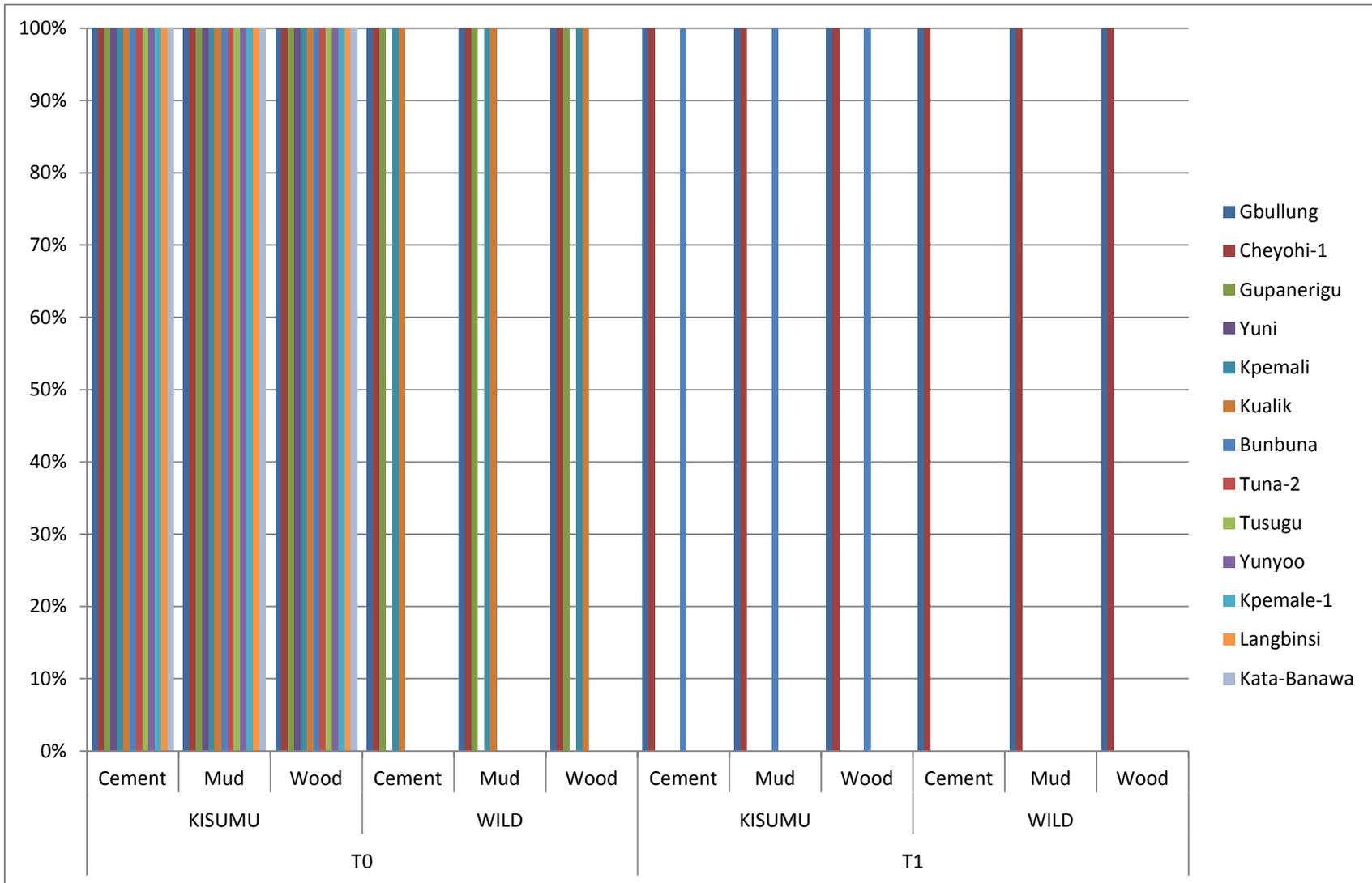
One month post-IRS follow-up bioassays (T_1) were conducted in May 2016 in Cheyohi-I, Gbullung, and Bunbuna, to assess the residual efficacy of pirimiphos methyl sprayed using susceptible Kisumu colonies from the AIRS insectary as well as wild *An. gambiae* collected from the IRS district of Kumbungu. The post-IRS wall bioassays will be conducted for the other sentinel sites monthly.

6.3.3 RESULTS

The results for the spray quality tests (T_0) and one-month post-IRS residual efficacy tests (T_1) are presented in Figure 4. The 24-hour mortalities for all the tests conducted on all surfaces were 100 percent in all the communities evaluated. Control mortalities ranged between 0 percent and 20 percent; since test mortalities were all 100 percent, no correction was calculated for the mortalities recorded.

The results from the airborne effect tests also confirm that pirimiphos methyl has an airborne effect on mosquito mortality at T_0 but follow-up bioassays showed no significant airborne effect after one month (Figure 5), while mortality of mosquitoes exposed to the sprayed walls was still 100.

FIGURE 4. MORTALITY RATE OF *AN. GAMBIAE* S.L./S.S., EXPOSED TO SPRAYED SURFACES DURING SPRAY QUALITY CHECK (T0) AND ONE MONTH AFTER SPRAY (T1), 2016

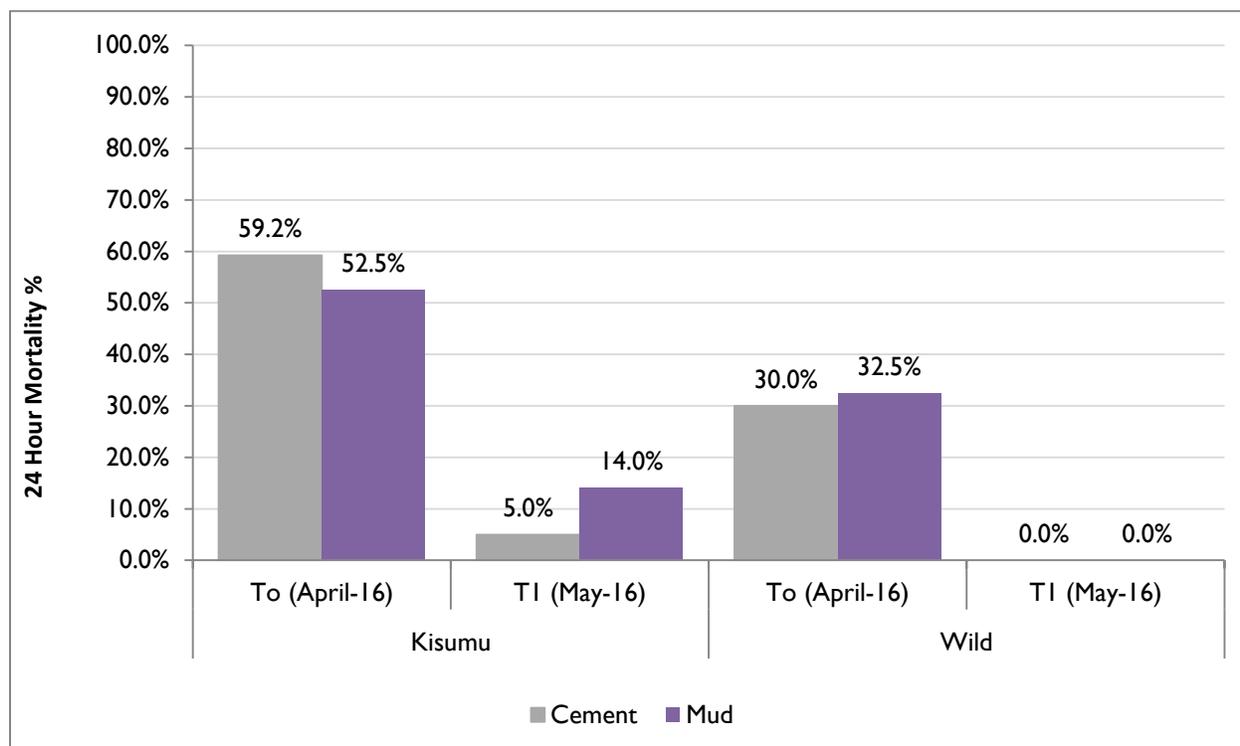


Gbullung: sprayed on 04/25- 04/26/16 and tested on 04/29/16 and 05/3/16;
Yuni: sprayed on 04/23/16 and tested on 04/28/16;
Kualik: sprayed on 04/23/16 and tested on 04/25/16 and 4/29/16;
Tuna-2: sprayed on 04/23/16 and tested on 04/26/16;
Yunyoo: sprayed on 05/18/16 and tested on 05/24/16;
Langbinsi: sprayed on 05/02/16 and tested on 05/03/16;
Cheyohi- I: sprayed on 04/22/16 and tested on 04/23/16.and 04/25/16;

Note:

Gupanerigu: sprayed on 05/02/2016 and tested on 05/11/2016;
Kpemali: sprayed on 04/26/16 and tested on 04/27/16 and 04/30/16;
Bunbuna: sprayed on 04/28/16 and tested on 05/2/16;
Tusugu: sprayed on 04/27/16 and tested on 04/28/16;
Kpemale- I: sprayed on 05/17/16 and tested on 05/18/16;
Kata-Banawa: sprayed on 05/04/16 and tested on 05/05/16

FIGURE 5. AIRBORNE EFFECT (% MORTALITY OF WILD *AN. GAMBIAE* s.l. AND KISUMU STRAIN *AN. GAMBIAE* s.s.) OF ACTELIC 300CS, CEMENT AND MUD PLASTERED ROOMS, 1 MONTH AFTER SPRAY, MAY 2016



6.4 INDOOR RESTING DENSITY, BITING RATE, AND PARITY

6.4.1 MONITORING DENSITY AND BEHAVIOR OF THE VECTOR

Mosquito collections were performed in the five sentinel districts to assess and understand the effect of IRS on species composition, density, and biting behavior of the local vectors in sprayed communities, and to compare with other unsprayed communities. Pre- and post-spray mosquito collections using the Human Landing Catch (HLC) and Pyrethrum Spray Collection (PSC) methods were performed in the sentinel sites. Collections were done monthly, from March to May 2016.

HLCs were conducted using eight trained mosquito collectors in each community. The collectors worked in two teams of four, in two houses each night. In each house, two collectors worked indoors while the other two worked outdoors, taking a total of four nights to evaluate eight compounds in the community per month.

The PSCs were done the next morning (6:00–7:00 a.m.) after the HLCs. Thus, a total of eight rooms were surveyed for each community every month.

6.4.2 RESULTS

6.4.2.1 VECTOR SPECIES COMPOSITION

The *Anopheles* species collected between March and May using HLC and PSC methods included *An. gambiae* s.l., *An. funestus* group, *An. pharoensis*, and *An. nili*. *An. gambiae* s.l. formed about 97 percent

(n=1,265) of the total number collected (n=1,302), *An. funestus* formed 1.4 percent (n=18), *An. pharoensis* about 0.2 percent (n=16), and *An. nili* 1.2 percent (n=3).

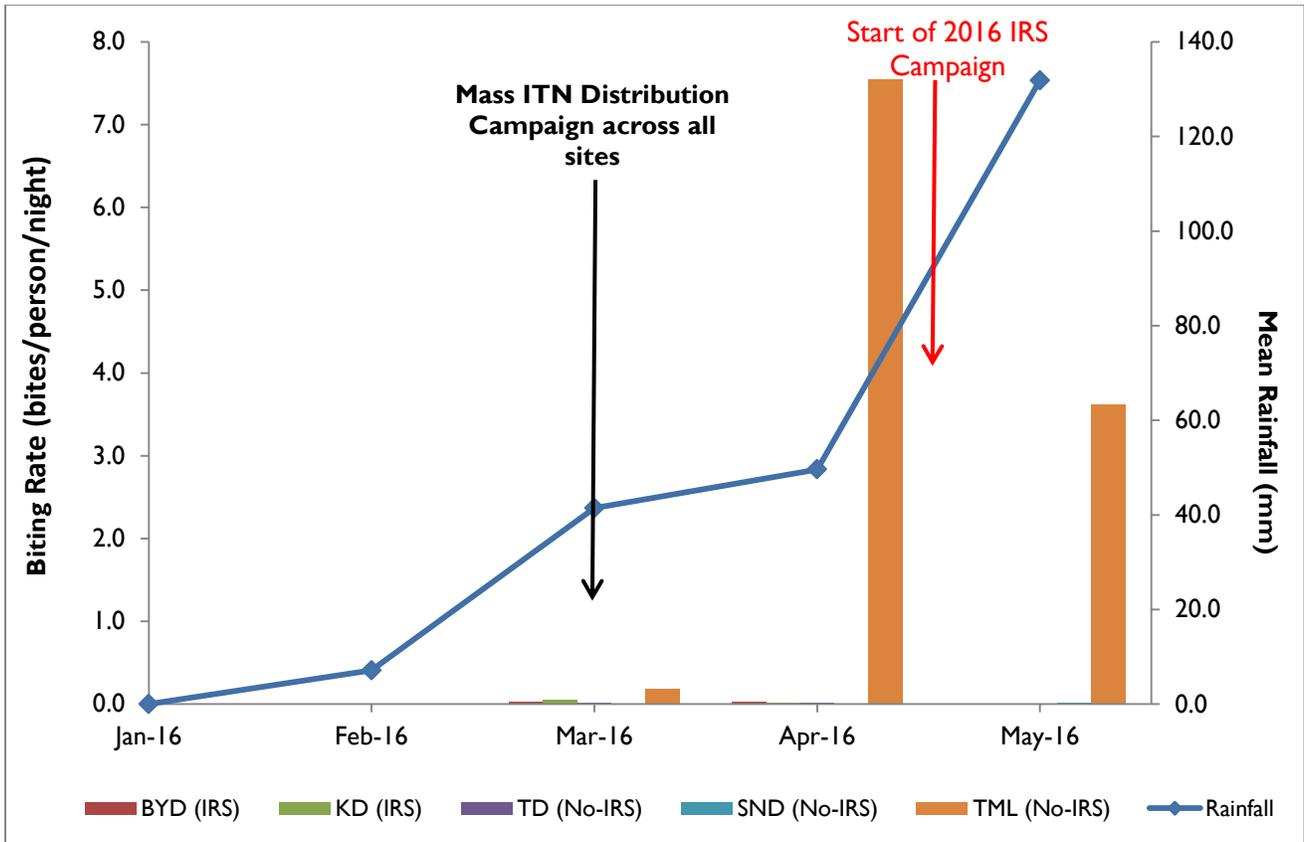
6.4.2.2 BITING RATES

The results of the mean biting rates (MBR) of *An. gambiae* s.l. (the predominant vector species), presented in Table 18 and Figure 6, show that MBR of *An. gambiae* s.l. decreased in the sprayed districts from 0.02 b/p/n (pre spray) to 0 (post spray) in Bunkpurugu-Yunyoo and from 0.03 b/p/n pre-spray to 0.0 b/p/n post spray in Kumbungu. Similarly the biting rates in Tolon and Tamale decreased from 0.02 b/p/n (pre spray) to 0 (post spray) and 3.86b/p/n to 3.61b/p/n respectively. In SND, however, there was a slight increase in biting rates in May from 0.01 to 0.02b/p/n. However, April-May is a low mosquito season and as a result, the number of mosquitoes collected during the two months was too low to make any meaningful comparisons.

TABLE 18. PRE- AND POST-IRS BITING RATES OF AN. GAMBIAE S.L., HLC METHOD

Sentinel Site	Total <i>An. gambiae</i> s.l.		Biting Rates (b/p/n)		
	Pre-IRS	Post-IRS	Pre-IRS MBR	Post-IRS MBR	MBR
IRS					
BYD	6	0	0.02	0.00	0.02
KD	4	0	0.03	0.00	0.02
Non-IRS					
SND	1	2	0.01	0.02	0.01
TD	2	0	0.02	0.00	0.01
TML	742	347	3.86	3.61	3.78

FIGURE 6. BITING RATE OF FEMALE AN. GAMBIAE MOSQUITOES, MARCH-MAY 2016



Note: No mosquito collections done in January and February.

6.4.2.3 HOST-SEEKING BEHAVIOR

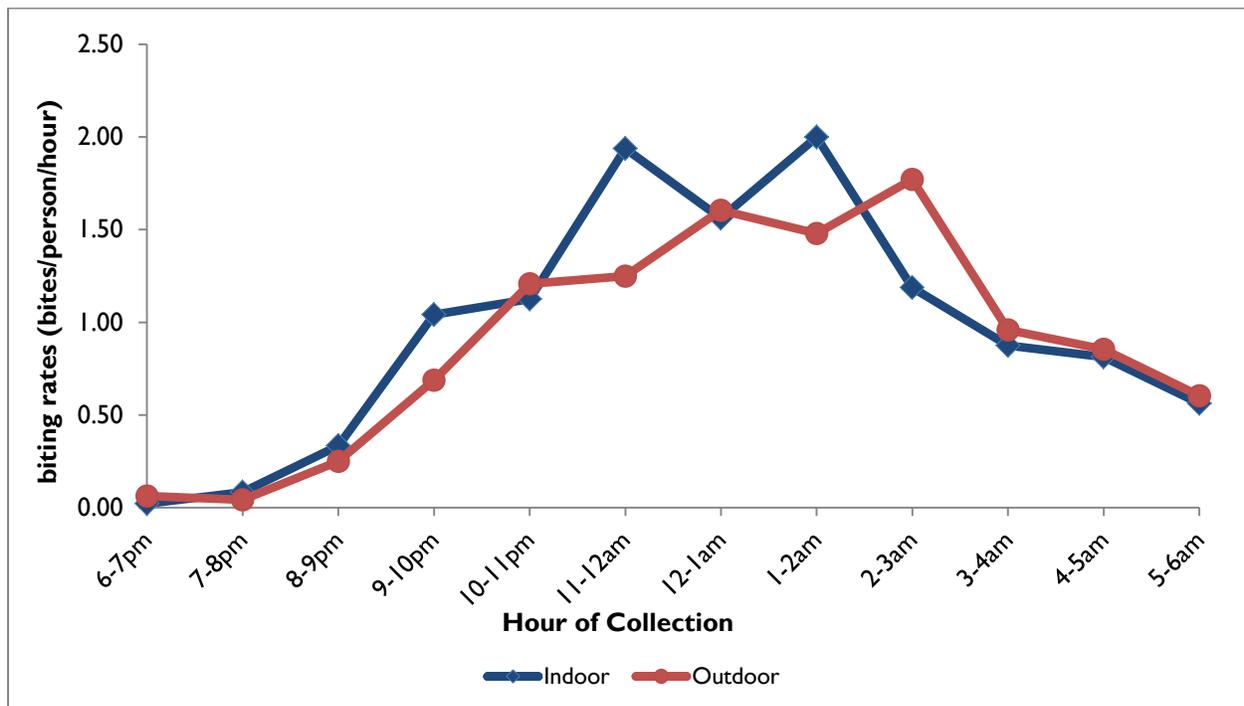
The project conducted HLC in unsprayed houses in Tamale, Savelugu Nanton, and Tolon districts and sprayed houses in Kumbungu and Bunkpurugu-Yunyoo districts. April and May are in the dry season, when mosquito density is very low. As a result, the project collected low numbers of mosquitoes, which made it difficult to make inferences from the variations observed between the indoor and outdoor biting densities of *An. gambiae* s.l. from Bunkpurugu-Yunyoo, Kumbungu, Savelugu-Nanton, and Tolon. *An. gambiae* from Tamale, however, showed high exophagy during March–April (pre-IRS) collections but this shifted to endophagy during the May (post-IRS) collections. The indoor biting rates for *An. gambiae* s.l. recorded in Tamale in May 2016 were significantly higher than outdoor biting rates recorded during the same period ($p=0.03$) (Table 19). Figure 7 shows the biting cycle of *An. gambiae* s.l. (the predominant vector species) collected from Tamale (the not-sprayed district) between March and May 2016. The team observed that both indoor and outdoor biting activity started from 6:00 p.m. and gradually rose from 8:00 p.m. The majority of bites occurred between 11:00 p.m. and 5:00 a.m.

TABLE 19. TOTAL INDOOR/OUTDOOR BITING/LANDING COLLECTIONS OF AN. GAMBIAE s.l., PRE- AND POST-IRS

Sentinel Site	# of Mosquitoes Indoors	# of Mosquitoes Outdoors	Endophagic Index	Exophagic Index	Chi-square Statistic	P-value
Pre-IRS						
BYD (IRS)	3	3	0.50	0.50	0.00	1.00
KD (IRS)	3	1	0.75	0.25	1.00	0.32
SND (IRS withdrawn)	1	0	1.00	0.00	1.00	0.32
TD (IRS withdrawn)	0	0	0.00	0.00	1.000	0.32
Tamale (Non-IRS)	367	375	0.49	0.51	0.09	0.77
Post-IRS						
BYD (IRS)	0	0	-	-	-	-
KD (IRS)	0	0	-	-	-	-
SND (IRS withdrawn)	2	0	0.00	1.00	2.00	0.16
TD (IRS withdrawn)	0	2	1.00	0.00	2.00	0.16
Tamale (Non-IRS)	194	153	0.56	0.44	4.84	0.03*

Note:* p-value significant at 0.05

FIGURE 7. HOST-SEEKING BEHAVIOR OF AN. GAMBIAE S.L. COLLECTED INSIDE AND OUTSIDE UNSPRAYED HOUSES IN TAMALE, MARCH-MAY 2016



6.4.2.4 PARITY RATES OF VECTOR SPECIES

Due to the low number of mosquitoes collected from the HLCs in Bunkpurugu-Yunyoo, Kumbungu, Savelugu-Nanton, and Tolon, no dissections were done for these sites; dissections of *An. gambiae* s.l. were done for Tamale only. The results revealed a higher proportion of older *Anopheles* populations in the not-sprayed communities (Table 20). There was a slight reduction in the parity rates in May 2016, but it was not significant.

TABLE 20. PRE- AND POST-IRS DISSECTIONS FOR AN. GAMBIAE S.L., TAMALE

Period	Dissected	# Parous	Parity (%)
March-April 2016	316	251	79.4%
May 2016	155	127	81.9%

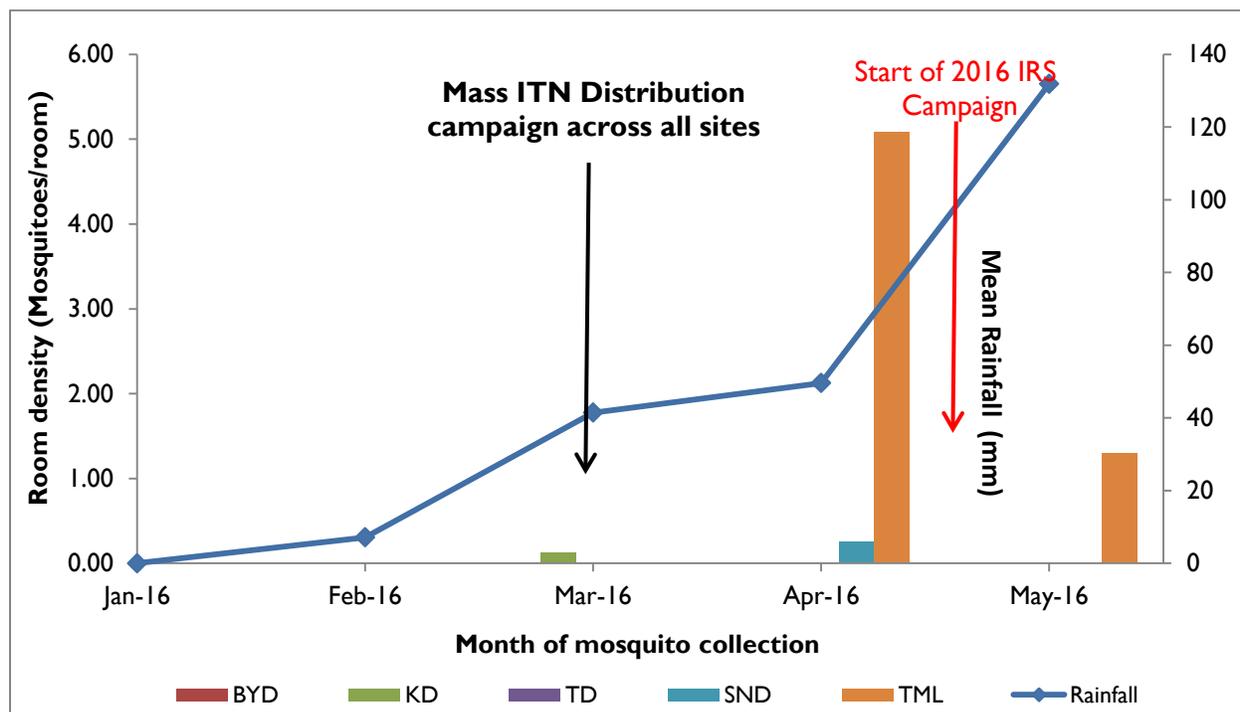
6.4.2.5 VECTOR DENSITIES

The project conducted PSCs in sprayed rooms in Kumbungu and Bunkpurugu-Yunyoo and not-sprayed rooms in Tamale, Savelugu-Nanton, and Tolon. The results (in Table 21 and Figure 8) show that Tamale recorded the highest indoor resting densities of 2.13 mosquitoes /room, whereas Kumbungu and Savelugu-Nanton recorded 0.04 and 0.08 mosquitoes /room, respectively. No mosquitoes were collected from the PSC in Tolon and Bunkpurugu-Yunyoo. The low densities of mosquitoes recorded could be because the period of collection coincided with the late dry season. Table 17 shows that the room density of *An. gambiae* s.l. in Kumbungu, Savelugu-Nanton, and Tamale decreased in May 2016 (post IRS).

TABLE 21. PRE AND POST IRS INDOOR RESTING DENSITIES OF AN. GAMBIAE S.L., PSC METHOD

Sentinel Site	Pre-IRS	Post-IRS	Mean IRD
IRS			
BYD	0.00	0.00	0.00
KD	0.06	0.00	0.04
Non -IRS			
SND	0.13	0.00	0.08
TD	0.00	0.00	0.00
TML	2.54	1.29	2.13

FIGURE 8. INDOOR RESTING DENSITIES OF AN. GAMBIAE S.L. COLLECTED FROM SPRAYED ROOMS AND NOT-SPRAYED ROOMS, PSC METHOD, MARCH-MAY 2016



Note: No mosquito collections done for January and February.

6.4.2.6 NATIONAL INSECTICIDE MONITORING PARTNERSHIP

As part of the national strategy to manage resistance in Ghana, the government instituted the National Insecticide Monitoring Partnership (NIRMOP) under the leadership of the NMCP to bring together researchers and partners working on vector control within Ghana. Objective of NIRMOP is to routinely generate and monitor insecticide resistance data in the country. PMI supports 10 sentinel sites under the NIRMOP areas where NMIMR collects insecticide resistance data once every year. Global Fund supports data collection in 10 other sentinel sites.

6.5 DISCUSSION AND CONCLUSIONS

The high 24-hour mortalities recorded from the T_0 and T_1 (one month post spray) wall bioassays showed 100 percent mortality and could indicate a good spray quality. However, the residual efficacy of the sprayed insecticides will be monitored till the percentage mortalities fall below the 80 percent threshold for two consecutive months. The susceptibility test results confirm that the local vector species in the IRS area are still highly susceptible (100 percent) to pirimiphos methyl used for the 2016 IRS operations.

The low numbers of mosquitoes collected during the period (March–May 2016) could be because this period coincides with the end of the dry season, when most breeding sites have dried up. The reductions in indoor resting densities across all the sites could in part be attributed to the effect of IRS and insecticide-treated net distribution campaign. Considering the low mosquito numbers collected

during the period however, it is difficult to assess the effect of IRS on indoor resting densities and longevity of local vector species. The transmission indices across all sites will be monitored through the transmission season (July–December) to measure the impact of IRS on all entomological indices of malaria transmission.

7. ENVIRONMENTAL COMPLIANCE

7.1 PRE-SEASON ASSESSMENT

The 2016 IRS campaign was carried out under the Supplemental Environmental Assessment (SEA) (2015–2020) that was approved by PMI for Ghana in 2015. As a result, only a letter report was required prior to the start of the 2016 spray campaign. The following activities were conducted as part of preparations to make the 2016 IRS campaign fully compliant with standard environmental compliance protocols and procedures.

7.1.1 LETTER REPORT AND PRE-SEASON ENVIRONMENTAL COMPLIANCE ASSESSMENT

To inform the 2016 letter report, AIRS Ghana carried out a PSECA, conducted in two phases using smart phones. The Ghana AIRS ECO with support from Ghana's EPA representative and all DEHOs from the IRS districts made preliminary visits to all 16 operational sites in the five districts. The visits took place on January 11–16 to assess the existing stores and soak pits, identify where maintenance was required, and generate work lists for rehabilitation and refurbishment of the sites. All sites were found to need some minor renovations to bring them up to PMI's Best Management Practices Manual (BMP) standards. These included repair of cracks in the floor of wash areas, de-silting and re-filling of some soak pits, repair of locks for insecticide storage rooms, reconstruction/ renovation of toilet and bath facilities, and some painting.

In all, eight soak pits were de-silted and re-filled; five were in Bunkpurugu-Yunyoo District and three in East Mamprusi District. The Kpasinkpe wash area and soak pit were relocated closer to the stores to enhance proper vigilances and supervision. Feedback from the initial visits to the sites gave the team inputs into the preparation of the Letter Report for 2016.

A letter report was written and submitted to PMI that summarized key environmental compliance indicators. The letter report was submitted for informational purposes prior to the start of the 2016 campaign.

7.1.2 FINAL PRE-SEASON ENVIRONMENTAL COMPLIANCE ASSESSMENT

The re-inspection and certification of the storage facilities and soak pits was carried out from April 11–16 by a team that comprised the AIRS Ghana COP and ECO, EPA officials, and DEHOs. The team confirmed that all repairs recommended in the initial PSECA had been made and that each operational site was ready for 2016 spray operations; on these grounds, a green light was given to start the 2016 IRS campaign.

7.1.3 USE OF MOBILE SOAK PITS

Based on improved functioning of mobile soak pits (MSPs) and factors in Ghana that made use of MSPs advantageous – spray sites located where spray teams camping nearby would save travel time, challenges with temporary soak pits – it was recommended for Ghana to introduce MSPs in the 2016 spray campaign in four of the five IRS districts. Bunkpurugu-Yunyoo, the only district where MSPs were not used, did not have locations that needed MSPs to expedite spray activities. The MSP will be considered for future operations in Bunkpurugu-Yunyoo.

All sites considered for MSP installation were inspected prior to the spray campaign to ensure that they met the BMP standard for a regular soak pit. Because this was the first use of MSPs in Ghana, MSPs were first piloted at the Singa site (Kumbungu district) to learn for better application in other locations. Initial installation was led by

the AIRS Ghana ECO and witnessed by the COP and the Operations Manager, Site Managers, Field Supervisors, and Team Leaders in the district. The pilot installation and use encountered no problems, and so with the ECO's assistance, MSPs were installed in the other three districts. In all, 11 MSPs were built and used.

During the campaign, more potential locations were identified as suitable for siting MSPs in future.

After operations ceased, all MSPs were successfully uninstalled and put in the stores for future use. However, used granulated activated charcoal in the MSPs will be disposed of appropriately alongside other solid waste.



One of the MSPs installed at Singa in Kumbungu District



Decommissioning of MSPs in West Mamprusi District

7.2 MID-SEASON ENVIRONMENTAL COMPLIANCE ASSESSMENTS

The AIRS Ghana ECO together with other supervisors including the COP and Operations Manager visited all 16 operational sites to assist and support the district teams to ensure full environmental compliance during the spray campaign. The team used the visit to conduct mid-season environmental compliance assessments for all the sites using the appropriate supervisory checklists: Spray Operator Morning Mobilization and Vehicles Inspections, Home Owner Preparations and Spray Operator Performance, End of Day Cleanup, and Store Keeper Performance. Emphasis was on the safety of the IRS workers and community members, proper storage of insecticides, stock control and inventory management procedures, effluent waste disposal, proper spill response procedures, and pump maintenance. The team paid special attention to the use of PPE, handling of insecticide, and mixing procedures including the triple-rinse process for empty Actellic 300 CS bottles. During the assessments, the team observed that all the sites met the standards for IRS operations. Nevertheless, instant corrective measures were provided where necessary.

Reminders were sent out during morning assemblies at the various sites throughout the spray campaigns to ensure that environmental compliance requirements were adhered to at all times.

To further strengthen security and safety measures at the workplace and in the field, Elizabeth Haverty, a Security Analysis from the AIRS home office at Abt Associates visited the AIRS Ghana office in Tamale on April 27–29, 2016. She inspected the office premises and shared with the Ghana team a Security Management Plan.

In addition, as part of USAID's independent assessment of AIRS Ghana environmental compliance standards, USAID Regional Environmental Compliance Advisor Henry Nii Arday Aryeetey visited Ghana May 9–12, 2016 to conduct an environmental assessment of the program. He was accompanied by to the field by the AIRS Ghana ECO. He visited six operational sites (Kumbungu, Dalun, Walewale, Kpasinkpe, Langbensi, and Gambaga) in three of the five IRS districts. There he met and interviewed SOPs, supervisors, Site Managers, Store Assistants, and home owners as well as drivers and security guards, and carried out inspections using the four Mid-Spray checklists listed above.

During his final debriefing meeting with the AIRS Ghana team in Tamale, he commended the program for maintaining very high standards in environmental compliance and recommended some improvements, which were noted by the AIRS Ghana team.

A representative from the Ghana EPA also took part in the Mid- Spray inspections. His monitoring and supervision took him to Kumbungu, West Mamprusi, and Mamprugu Moaduri districts on May 24–26. In his report, he also commended the project and applauded the environmental compliance of its IRS operations.

7.3 DAILY SOP HEALTH CHECKS

As part of ensuring worker safety and compliance, the PMI AIRS project introduced a daily health check for SOPs, and the AIRS Ghana team was one of the first countries to roll out this requirement. The main purpose of the health check is to document that all SOPs are fit and in good health prior to going to the field, and are not reporting any symptoms of overexposure to insecticide. Team Leaders performed the health checks every morning throughout the spray campaign using the Daily Health Team Leader Checklist. The checklist has five questions that include inquiries on whether an SOP had taken breakfast, has symptoms of fatigue or other health complaints, has a low performance the previous day due to health related issues. The data analysis and reporting was part the routine daily activity. The team is supposed to report any red flags to his supervisors or site manager each morning after the check up and the supervisors and site managers to report it to the operation manager and take action the same day. However, none of the SOPs reported symptoms preventing him/her from going to the field. All completed checklists are currently kept at the district level for future reference.

7.4 INCIDENTS

The 2016 spray campaigns witnessed no motor accidents involving SOPs, in contrast to a few car and motor bike incidents reported in 2015. There was an incident in Kumbungu district when a spray pump malfunctioned, resulting in spillage on an SOP and on the floor of the structure being sprayed. All spill response procedures were appropriately followed and the SOP received immediate medical attention. He returned to work the following day and worked throughout the campaign. The project will continue to stress the need for an accident-free campaign.

7.5 POST-SEASON ENVIRONMENTAL COMPLIANCE ASSESSMENT

All storage facilities and soak pits at the 16 operational sites have been cleaned and all solid waste transported to the district main stores waiting for final transportation to the regional stores. The post-spray environmental compliance inspections took place June 21–30. All sites have been well cleaned and temporarily closed according to BMP standards. All storage facilities will remain locked and guarded by security guards until the next spray campaign. The DOCs will visit all storage facilities and soak pits with fences that are locked and bio-beds covered with black plastic sheets every two months to ensure that the facilities are still guarded, clear of vegetation, and generally in good shape.

7.6 WASTE DISPOSAL

The main forms of solid waste generated during the 2016 IRS campaigns are the following:

- Empty triple-rinsed bottles of Actellic CS
- Used nose masks, torn hand gloves, and damaged rubber boots
- Excavated charcoal and sawdust from repaired soak pits
- Used granulated activated charcoal from MSPs
- Damaged cover sheets

All solid waste materials must be disposed of in accordance with the PMI/IRS BMP. To this end, much of the solid waste (used nose masks, excavated charcoal and saw dust as well as the used GAC) have been packaged into bags and are waiting to be incineration at Zoil Service Limited in Takoradi in July and August 2016.

The well-washed used coveralls and damaged rubber boots will be given to deserving SOPs.

A total of 47,135⁹ triple-rinsed Actellic 300 CS empty bottles generated from the 2016 spray campaign will be sent in July and August to Cyclus Elmina Plastic Recycling Limited or Zoil Services Limited for recycling. The recycling will be witnessed by the Ghana AIRS ECO and a representative from the Ghana EPA, and a certificate of destruction and production will be issued.

AIRS Ghana has not been able to identify a company to recycle the torn hand gloves and but it continues to look for alternative waste management companies that can do this. The AIRS team is working with the EPA on how best to dispose of these items. In the interim, the torn gloves will be chopped into pieces and disposed of in a licensed landfill in Takoradi, according to the BMP recommendations.

The detailed environmental monitoring and mitigation report is attached as Annex B.

⁹ This includes 47,133 bottles used directly for the 2016 spray campaign and two bottles used in October 2015 to test the CFV for Hudson pumps.

8. MONITORING AND EVALUATION

8.1 KEY OBJECTIVES AND APPROACH

The AIRS Ghana M&E systems drew strength from previous years' experiences, lessons learned, and best practices that were shared across AIRS countries.

As outlined in the 2016 work plan, the M&E approach was to use lessons learned to:

- Emphasize accuracy of both the data collection and the data entry process through comprehensive training and supervision at all levels;
- Streamline and standardize data and information flow to minimize errors and facilitate timely reporting;
- Ensure IRS data security and storage for future reference through establishment and enforcement of proper protocols; and
- Communicate IRS data and information to stakeholders in a timely and clear manner.

8.2 DATA COLLECTION AND DATA MANAGEMENT

Data were collected using standardized data collection forms designed to capture all core PMI indicators. All data collection was preceded by training data collectors (mobilizers, SOPs, District M&E Coordinators, etc.) on data capture. Mobilization data were collected by mobilizers (IEC implementers and CBS volunteers) during house-to-house mobilization. During spray operations, all spray data were collected by SOPs and verified through data quality assessment processes. To ensure data integrity, AIRS Ghana also used a number of quality assurance and control tools. Table 22 describes all of the 2016 data collection and quality assurance tools, their purposes, and intended users. An expanded list of quality assurance methods and tools that AIRS Ghana used across all components of IRS operations is provided in Annex C.

TABLE 22. GHANA IRS 2016 DATA COLLECTION AND QUALITY ASSURANCE TOOLS

Data Collection Tool	Used by Whom and When
Training Participants Registration Form	Used by lead trainer at training workshop to capture category and number of people trained; disaggregated by gender.
BCC/IEC Mobilization Form	Used by IEC (CBS) mobilizers during pre-spray house-to-house mobilization/sensitization activities to collect data on number of households and people reached with IRS messages and the number of IEC/BCC materials distributed directly to households.
Daily SOP Form	Used by SOPs during spray operations to capture structures found, structures sprayed and not sprayed, population protected and unprotected, and information surrounding mosquito net availability.
Error Eliminator (EE) form	<p>Purpose:</p> <ul style="list-style-type: none"> • To check the completeness and correctness of data collected in the field by SOPs. • To highlight common data collection errors so they can be quickly identified with corrections being made and on-the-spot re-training provided. <p>Used by:</p> <ul style="list-style-type: none"> • Team Leaders, on daily basis, to check completeness and accuracy of the forms filled by the SOPs under their supervision. <p>Supervisors, District SOC, District M&E Coordinators, Operations Manager, Database Manager, and M&E Manager also used the EE when visiting the field.</p>
Data Collection Verification form (DCV; Mobile data collection application form)	<p>Purpose:</p> <ul style="list-style-type: none"> • Used during randomized household visits to check the accuracy of data collected in the field by SOPs, i.e., to ensure that the data written on the Daily SOP Forms matches the information reported by households and/or the data recorded on the IRS Cards disseminated to households. <p>Used by:</p> <ul style="list-style-type: none"> • District M&E Coordinators, predominantly. <p>Database Manager and the M&E Manager.</p>

In 2013, the AIRS project introduced standardized data quality assurance tools, the Error Eliminator (EE) and Data Collection Verification form (DCV), to improve both supervision and, ultimately, the quality of data collection and data entry. These tools were effectively used during the 2016 spray campaign. The DCV was, however, converted from a paper form into a mobile data collection application form. Tables 23 and 24 show the numbers of households interviewed using the DCV form and issues observed and resolved, respectively.

TABLE 23. NUMBER OF HOUSEHOLDS/COMPOUNDS VISITED USING THE DCV FORM

District	No. of Households/Compounds Visited
Bunkpurugu-Yunyoo	100
East Mamprusi	56
Kumbungu	124
Mamprugu Moaduri	115
West Mamprusi	112
Total households visited	507

**TABLE 24. USE OF DCV FORM:
COMMON ISSUES FOUND AND CORRECTIVE ACTIONS TAKEN**

Errors/Issues Observed	Corrective Actions Taken
<i>Understatement of total number of eligible structures found by SOPs.</i> It was observed that some SOPs did not count locked eligible structures in compounds as part of the total number of structures found.	The M&E team provided correction regarding this error to SOPs, Team Leaders, and Field Supervisors. It was emphasized that all eligible structures were to be counted, whether locked or open. Spray teams were to probe further concerning the eligibility of structures, when the structure was locked, and when the occupant would be returning.
<i>Overstatement of total number of eligible structures found.</i> In some compounds, some new SOPs considered eligible rooms as structures and counted them as though they were structures. Some SOPs also overcounted the total number of eligible structures by counting food stores and traditional shrines (especially when these structures were locked at the time of visit). In a few instances, some SOPs were convinced by households to count structures under construction as eligible with the hope that they would be occupied in few days time. Many of these structures were not completed at the time of the verification.	The M&E team addressed SOPs, Team Leaders, and Field Supervisors, asking them to take note of these common errors. They were advised to be careful in determining the eligibility of structures before recording them. Spray teams were reminded of the eligible structure definition and of how to identify an eligible structure. It was also reiterated that the eligibility of a structure is based on evidence at the time of the visit, not on its expected future eligibility.
<i>Overstatement of total number of eligible structures sprayed.</i> This was mainly due to structures with more than one room counted as sprayed when not all the rooms were sprayed. Rooms sprayed were also counted as structures sprayed by some new SOPs.	Before IRS operations started, the SOPs were cautioned about this error. Team Leaders and Field Supervisors intensified field spot checks to avoid the error. All affected compound data were corrected.
<i>Undercounting of number of structures sprayed.</i> It was observed in some compounds that the number of sprayed structures were undercounted. This was specific to very large compounds where SOPs had to make their way through different courtyards in the same compounds in order to access all structures.	The M&E team asked SOPs, Team Leaders, and Field Supervisors to note this error and to be careful in counting both eligible and sprayed structures especially in large compounds with different courtyards. They also were advised to make use of chalk in counting of structures sprayed and not sprayed in such compounds.

8.3 DATA ENTRY

AIRS Ghana employed a total of 21 Data Entry Assistants (four in Bunkpurugu-Yunyoo, five in East Mamprusi, four in Kumbungu, three in Mamprugu Moaduri, and five in West Mamprusi) to enter all mobilization, spray and DOS data generated from the five districts. Project laptops were used for the 2016 spray round data entry. The database setup entailed using a server and workstations in each data entry center. The project team installed the 2016 AIRS Ghana database on 16 computers and the DOS database on the additional five laptops that were procured for this purpose. Data were entered simultaneously in each of the five districts. Data entry was carried out at two levels, first by “Totals” (i.e., data entry by the total lines of each spray operator form) for quick reporting and feedback, then by “Details” (i.e., data entry by detailed data collected for each compound) for more accurate data entry and verification.

8.4 DATA CLEANING

Data cleaning was done by Data Entry Assistants at the district level and involved the following:

- Ensuring that all data cards were entered correctly by the double entry method described above;
- Comparing the Totals and Details data and ensuring that all necessary corrections were made so that the Totals and Details data are the same;
- Checking and removing duplicate records; and
- Identifying and entering missing records.

Data cleaning was done using a Microsoft Access-based IRS Cleaning/Reporting tool. The Data Entry Assistants cleaned both mobilization and spray data daily throughout the spray campaign with final data cleaning completed within eight days of the end of the spray campaign.

8.5 RESULTS

A list of all program indicators for the 2016 spray campaign is presented in the M&E Plan matrix in Annex D. The following sections summarize the results for the core PMI indicators and other spray indicators.

8.5.1 NUMBER OF STRUCTURES FOUND, SPRAYED, AND SPRAY COVERAGE

A total of 227,857 structures were found by SOPs during the 2016 spray campaign. Across the five districts, 211,283 structures were sprayed by SOPs, for total spray coverage of 92.7 percent. Spray coverage increased from 91.7 percent in 2015 to 92.7 percent in 2016. Details of the number of structures found, sprayed, and district spray coverage are presented in Table 25.

8.5.2 POPULATION PROTECTED

There were 599,482 people counted as living in the structures found by SOPs. Of this number, 95.2 percent (570,871 people) were protected through IRS. The total number of people protected included 10,881 pregnant women and 96,150 children under the age of five years.

TABLE 25. SUMMARY OF 2016 SPRAY RESULTS

District	Structures			Population			Pregnant Women		Children Under 5 Years	
	Found by SOPs	Sprayed	% Sprayed	Protected	Not Protected	% Protected	#	% protected	#	% protected
Bunkpurugu-Yunyoo	53,156	50,742	95.5%	125,903	4,157	96.8%	2,090	1.7%	18,570	14.7%
East Mamprusi	67,479	63,057	93.4%	173,736	7,426	95.9%	3,448	2.0%	29,631	17.1%
Kumbungu	34,006	31,932	93.9%	86,578	3,750	95.8%	1,675	1.9%	15,242	17.6%
Mamprugu Moaduri	20,290	18,767	92.5%	51,534	2,921	94.6%	1,153	2.2%	9,196	17.8%
West Mamprusi	52,926	46,785	88.4%	133,120	10,357	92.8%	2,515	1.9%	23,511	17.7%
Total	227,857	211,283	92.7%	570,871	28,611	95.2%	10,881	1.9%	96,150	16.8%

8.5.3 REASONS FOR UNSPRAYED STRUCTURES

A total of 16,574 structures were not sprayed during the campaign. The two main reasons why these structures were not sprayed were: 1) SOPs found structures locked (10,358, or 62.5 percent) and 2) the household refused spraying (5,030, or 30.3 percent). A common reason for locked structures was that their owners were away (for short or protracted periods, in some cases over a year), and a common reason for refusal was that some household members did not like the smell of the insecticide. The issue of some locked structures was handled through revisits; SOPs sprayed the structures when the owners returned. Nevertheless, some structures remained locked through the end of the spray campaign and could not be sprayed. Overall, locked structures accounted for 4.6 percent of total structures found by SOPs during the 2016 campaign.

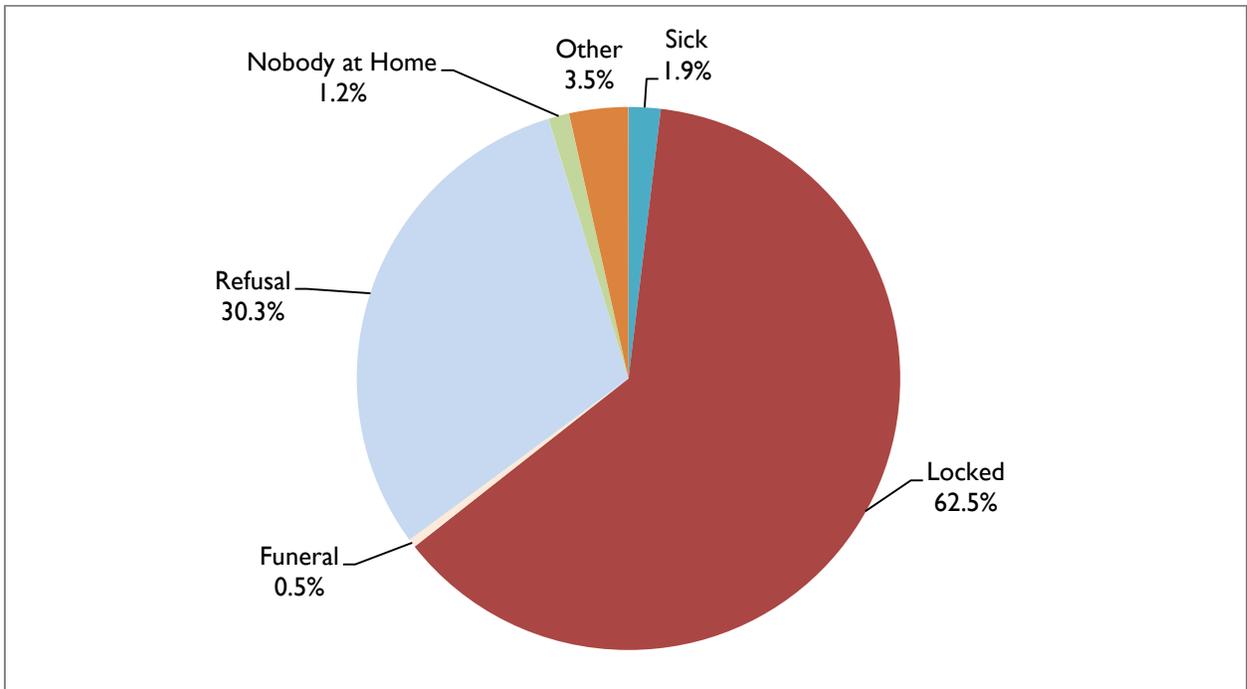
Some structures (314; 1.9 percent) were not sprayed because they had sick people in them. Additionally, 204 structures (1.2 percent) were not sprayed because there was “nobody at home” at the time of the SOP visit, while 85 structures (less than 1 percent) were not sprayed because the household was holding a funeral in the home at the time of the SOP visit. Details on the reasons why structures were not sprayed are summarized in Table 26 and illustrated in Figure 9.

TABLE 26. REASONS FOR NOT SPRAYING STRUCTURES, BY DISTRICT

District	Sick		Locked		Funeral		Refusal		Nobody Home		Other		Total Not-sprayed Structures
	#	%	#	%	#	%	#	%	#	%	#	%	
Bunkpurugu-Yunyoo	92	3.8%	1,297	53.7%	20	0.8%	817	33.8%	8	0.3%	180	7.5%	2,414
East Mamprusi	93	2.1%	2,639	59.7%	20	0.5%	1,562	35.3%	24	0.5%	84	1.9%	4,422
Kumbungu	39	1.9%	1,221	58.9%	13	0.6%	742	35.8%	14	0.7%	45	2.2%	2,074
West Mamprusi	63	1.0%	4,107	66.9%	21	0.3%	1,591	25.9%	147	2.4%	212	3.5%	6,141
Mamprugu Moaduri	27	1.8%	1,094	71.8%	11	0.7%	318	20.9%	11	0.7%	62	4.1%	1,523
Total	314	1.9%	10,358	62.5%	85	0.5%	5,030	30.3%	204	1.2%	583	3.5%	16,574

*11 non-sprayed structures were not assigned a reason.

FIGURE 9. REASONS FOR NOT SPRAYING STRUCTURES



8.5.4 AVAILABILITY AND USE OF MOSQUITO NETS

Across the five districts, a total of 268,492 mosquito nets were available at the time of the SOP visits; 9,884 pregnant women and 88,730 children under five years of age slept under a mosquito net the night before the SOP visit. Table 27 presents mosquito net indicators, by district. Percentages are calculated using the total population of pregnant women and children under five reported in both sprayed and non-sprayed structures.

TABLE 27. NUMBER AND USAGE OF MOSQUITO NETS

District	Total Mosquito Nets Found	Preg. Women Sleeping under Mosquito Nets the Previous Night		Children Under 5 Sleeping under Mosquito Net Previous Night	
		#	%	#	%
Bunkpurugu-Yunyoo	62,132	2,005	95.9%	17,942	96.6%
East Mamprusi	78,000	3,150	91.4%	27,302	92.1%
Kumbungu	41,847	1,540	91.9%	14,261	93.6%
Mamprugu Moaduri	23,556	1,062	92.1%	8,646	94.0%
West Mamprusi	62,957	2,127	84.6%	20,579	87.5%
Total	268,492	9,884	90.8%	88,730	92.3%

8.5.5 OTHER SPRAY INDICATORS

The five districts received 49,596 bottles of Actellic 300 CS for the 2016 spray operations from the regional stores. A total of 47,133 bottles were used to spray the 211,283 structures. No insecticide was reported missing or damaged, and 2,463 bottles were returned to the regional stores by the districts. Each bottle of Actellic 300 CS sprayed an average of 4.5 structures. On average, 421 SOPs (out of 441 hired) worked each day across the five districts. Each SOP sprayed an average of 16.7 structures a day with an average of 3.7 bottles of Actellic 300 CS used per day as presented in Table 28. The leftover insecticide will be used during the 2017 spray campaign.

TABLE 28. INSECTICIDE TRACKING AND SOP PERFORMANCE

Indicator	District					
	Bunkpurugu-Yunyoo	East Mamprusi	Kumbungu	Mamprugu Moaduri	West Mamprusi	Overall
Total bottles received from regional stores	11,700	15,336	7,320	4,092	11,148	49,596
Total bottles used	11,409	14,055	7,027	3,899	10,743	47,133
Total bottles damaged or lost	0	0	0	0	0	0
Total bottles left over (Returned to regional office)	291	1,281	293	193	405	2,463
Average number structures sprayed per bottle	4.4	4.5	4.5	4.8	4.4	4.5
Average number of bottles per SOP per day	4.2	3.9	3.4	3.7	3.4	3.7
Average number of SOP working per day	91	121	68	35	106	421
Average number of structures sprayed by SOP per day	18.6	17.4	15.7	17.9	14.7	16.7

9. CAPACITY BUILDING OF THE MINISTRY OF HEALTH

Capacity building is an ongoing process through which individuals, groups, and organizations enhance their ability to identify and meet development challenges. AIRS Ghana's role is to build the knowledge and skills of the Ministry of Health in the implementation of IRS.

AIRS Ghana's guiding partnership principles emphasize the importance of building relationships with local partners and strengthening their skills in areas such as strategic planning, leadership, operating systems, advocacy, organizational management, and program development and management.

Based on the agreement between the PMI Ghana team, the NMCP, and AIRS Ghana, Disease Control Officers and DEHOs in the targeted districts were assigned to the 2016 spray campaign for 20 days. Disease Control Officers worked closely with the AIRS DOCs in the planning and supervision of spray operations at the district level. DEHOs also worked closely with the AIRS DOCs and the AIRS ECO to ensure environmental compliance during the 2016 spray campaign.

Both Disease Control Officers and DEHOs were also helpful in community sensitization and mobilization especially in relatively resistant communities.

In addition to embedding the district staff to the spray teams during the spray campaign, the following NMCP and EPA staff attended regional trainings on entomology and environmental compliance.

- A representative of the regional EPA attended environmental compliance training held in Dakar, Senegal
- The NMCP entomologist participated in a regional entomology training held in Harare in late June 2016

In future campaigns such mentorship opportunities will continue to ensure that practical skills in the planning, implementation, and supervision of IRS are properly transferred to NMCP and GHS staff.

Also, PMI, through AIRS Ghana, has been supporting the National Insecticide Resistance Monitoring Partnership (NIRMOP), which brings together researchers and vector control implementers within Ghana to generate and monitor insecticide resistance data in the country. One of the key areas of the partnership has been to provide the framework for sharing data on insecticide resistance in a collaborative way so as to support disease control strategies, especially those that require the use of insecticides. The partnership is constituted from members of the NMCP's MaVCOC and has a secretariat with a coordinator situated at the NMIMR.

10. CHALLENGES AND RECOMMENDATIONS

The following challenges, lessons learned, and recommendations were identified during the 2016 spray campaign.

10.1 CHALLENGES

1. A conflict started between two communities in some parts of Bunkpurugu-Yunyoo. As a result, the project was not allowed to enter and thus did not spray the two communities during the 2016 spray campaign.
2. The pace of spraying slowed in two districts, Kumbungu and West Mamprusi, towards the end of the campaign. The spray team worked hard to ensure that coverage improved in affected sub-districts. As in 2015, the project generated detailed data reports from communities and compounds with low coverage, either due to refusal, locked structures or other reasons, to better address issues that affect coverage. An intensive mobilization and sensitization campaign was conducted in identified communities. Some adjustment such as Sunday spraying, evening mobilization by SOPs and use of MSPs were introduced to address bottlenecks, which resulted in increased coverage.
3. Locked structures were still a challenge. Many residents of compounds with locked structures continued to report that the owners of the structures have migrated to other areas, especially southern Ghana, to work and took their keys with them. This is despite efforts to minimize the number of locked structures through targeted IEC messages.
4. There was some resentment towards the AIRS Ghana spray campaign, due to confusion with the recent NMCP campaign of insecticide-treated net distribution. The NMCP held a mass distribution of insecticide-treated nets a few weeks prior to the IRS campaign and some households that were felt left out cited this as a reason for refusing IRS. They were simply asking AIRS Ghana to give them nets in return for permission to spray their houses. AIRS Ghana used as mobilizers NMCP volunteers who worked for the net distribution, which added to the confusion, despite messaging that AIRS played no role in net distribution.
5. Repeated cracking in soak pits requires rehabilitation every other year. Also, some soak pits, especially in Gambaga, have become too small for the number of spray teams that use them. During this spray campaign, there were times it took longer than expected for the effluent waste to drain completely, especially when it rained.
6. New structures being built very close to the existing government-assisted stores might mean that some AIRS operations sites no longer meet the BMP standards. The project may not get other government-assisted facilities due to lack of infrastructure at the sub-district level.

10.2 LESSONS LEARNED AND RECOMMENDATIONS

1. The project will closely monitor the situation in communities with internal conflict prior to the next year spray. Provided the conflict is resolved and there is no risk to spray teams, AIRS Ghana will plan operations in those locations.
2. The project will start early on to use data on low-coverage communities and compounds to carry out more targeted mobilization and spraying in those locations. The data will help spray teams and community leaders to resolve issues and concentrate their efforts on mobilizing specific households to accept spraying. The

project will continue applying strategies it used in 2016 campaign, such as:

- Arranging for the media campaign to consistently run in the communities resistant to spraying.
 - Mobilizing spray teams from sites that completed their work ahead of schedule to help with mop-up campaigns, as was done in Walewale, West Mamprusi district.
 - Letting SOPs stay overnight in their communities to sensitize and mobilize households during evening and early morning hours. Doing this helped the SOPs find more compounds to spray, work with communities to address spray-related issues, confirm willingness to spray, and mark the households for revisits. In addition, SOPs were able to identify their compounds for spraying the evening before the spray day. As a result, next morning the households were made ready before the supervisors arrived to the community with insecticides and other items. This approach helped reduce the time spent looking for a compound to be sprayed and household preparation.
 - Installing MSPs for end-of-day cleanup in some big communities, which gives SOPs more time to engage in evening mobilization and will be expanded to more communities.
3. AIRS Ghana will conduct an analysis of the locked structures and compare the results with a similar report produced in 2015 to identify trends and correlations. This will help PMI and NMCP partners to agree on a way forward with the locked structures as part of the annual IRS target.
 4. The NMCP might not be planning another mass distribution campaign next year. However, the project will be on alert for such a campaign and work with the district health office and community leaders to ensure that messages clearly distinguish the IRS campaign from the net distribution.
 5. The project will consider using thick tarpaulins to cover the ground of the soak pits as is done in other countries, to reduce the repair cost of constantly reappearing cracks. These thick tarpaulins will work better at ensuring that all effluent wastes from washing are directed into the bio-beds. Also, it is recommended that some soak pits, especially in Gambaga, should be desilted and expanded to handle the number of spray teams operating from that site. The USAID Mission Environmental Officer and AIRS Technical Program Manager also recommended expanding the existing soak pits or adding one soak pit at the Gambaga and Wungu sites to accommodate the need for the high number of spray teams. All new soak pits will be constructed with plastic sheeting on the vertical walls to prevent migration of contaminated water prior to contact with the carbon bed. It is also recommended that the project continue supplementing regular soak pits with MSPs.
 6. It is important for the project to start scouting out other structures that can be used to relocate operational sites that do not meet BMP standards in the coming year.
 7. The project is considering locally recruiting SOPs in some operational sites for the 2017 campaign. IRS is done in many large communities where SOPs can be recruited and stay throughout the spray campaign, without daily travel to the main district operations site. MSPs can be used for cleaning and waste disposal instead of permanent soak pits. Such an arrangement will allow SOPs more time for mobilization and interaction with communities. The project tested this approach in Jadema Community (Mamprugu Moaduri district) and Nalerigu Township (EMD) in 2016. It has identified communities to which this approach can be expanded in 2017, and it will explore the use of MSPs there.
 8. Assigning NMCP/GHS staff for supervision and other various tasks should continue in future spray campaigns to help building practical experience on IRS implementation. Disease Control Officers carried out some supervision and the DEHOs observed end-of-day cleanup and general environmental compliance. However, their focus in 2016 was on community mobilization. This was good, but in the future they should be involved earlier in the process to gain practical experience and understanding in IRS planning and implementation. This will require the NMCP/GHS to provide their embedded staff for a greater length of time.

9. In 2016, SOP training lasted five days. This enabled trainers to cover different aspects of training and place more emphasis on gaining practical experience than in past years. The same number of days is recommended for future SOP training.
10. The use of DOS should also be intensified in the coming year to ensure good spray quality. The implications of the SOPs knowing they will be supervised directly and the Team Leaders having the responsibility of daily checking and ensuring spray quality are believed to have a positive impact on spray quality. However, involving higher-level supervisors to some extent could also make DOS even more effective.
11. AIRS Ghana tested the new generation of Goizper pumps during the 2016 spray campaign. The team confirmed that most of the problems with the plunger and leakage were corrected and the performance of the new pumps was impressive. Most of the pumps used in 2016 were old Hudson pumps repaired with parts from unused pumps and spare kits. Given that Hudson pumps and spare kits are expensive, the team recommends having more of the new Goizper pumps for the 2107 spray campaign.

ANNEX A. FULL INVENTORY OF STOCK AND QUANTITIES POST-SPRAY

TABLE A-I. IRS 2016 INTERNATIONAL PROCUREMENT ITEMS

Item Description	UOM	Bal B/f	# Procured	Total	# Used	# Damaged/ Bad	# After Campaign	Remark
INSECTICIDE								
ACTELLIC 300 CS	Bottle	11349	38568	49917	47135	0	2782	2 bottles were used for CFV test
PPE								
Boot	Pair	723	0	723	35		688	
Coverall	Pcs	956	364	1320	210		1110	
Face Shield	Pcs	238	1030	1268	602		666	
Hand Gloves	Pair	1796	204	2000	1567		433	
Hard Hat	Pcs	550	64	614	56		558	
Head Gear	Pcs	721	0	721	-53		774	
Heavy Duty Gloves	Pair	87	0	87	51		36	
Nose Mask	Pcs	3598	24000	24000	18214		5786	Bal B/F were not used due to expiration
HUDSON PUMP & ACCESSORIES								
Hudson (8 Ltrs)	Pcs	434	0	434	0		434	
Hudson (10 Ltrs)	Pcs	192	0	192	0		192	
Hudson (12 Ltrs)	Pcs	40	0	40	0		40	
CFV	Pcs	300	190	490	457		33	All 33 are without washers
Lance Tube	Pcs	55	0	55	48		7	
Nozzle Body	Pcs	146	0	146	46		100	
Nozzle Cap	Pcs	146	0	146	46		100	

Item Description	UOM	Bal B/f	# Procured	Total	# Used	# Damaged/ Bad	# After Campaign	Remark
Nozzle Tip 8002E	Pcs	784	200	984	622		362	117 are ceramic, 139 are metallic
Pressure Gauge	Pcs	27	0	27	27	0	0	
Repair Kit	Set	105	10	115	53	0	62	
Shutoff Valve Body Cap	Pcs	296	0	296	96		200	
Strainer	Pcs	150	0	150	150		0	
Valve Cap	Pcs	25	0	25	0		25	
GOIZPER PUMP & ACCESSORIES								
Goizper (8 Ltrs)	Pcs	89	0	89	0		89	
Goizper IK Super (10 Ltrs)	Pcs	0	10	10	6		10	
1066 LDE Fan Yell (Nozzle tip)	Pcs	202	0	202	0		202	
Handle (Trigger)	Pcs	188	2	190	8		182	
Holes	Pcs	302	2	304	14		290	
IK-12 VC Service Kit	Set	15	0	15	0		15	
Lance Tube	Pcs	0	2	2	2		0	
Metallic Adopter	Pcs	17	0	17	0		17	
Plunger	Pcs	0	50	50	50	0	0	
Pressure Regulator (CFV)	Pcs	97	2	99	14		85	
Tube with Nuts 0.6M (Strainer)	Pcs	54	0	54	20		34	
IRS REUSABLE								
Thermometer	Pcs	26	0	26	20	20	6	
MOBILE SOAK PIT ITEMS								
Activated Carbon (Charcoal 10 Kg)	Bag	0	18	18	11		7	
BIO-MONITORING TEST KIT								
Test Mate Analyser	Pcs	15	0	15	0		15	

TABLE A-2. IRS 2016 LOCAL PROCUREMENT ITEMS

Item Description	UOM	Bal B/f	Quantity Procured	Total	Quantity Used	Quantity Damaged /Bad	Quantity After Campaign	Remark
PPE's								
Apron	Pcs	5	75	80	56	4	76	
Cotton socks	Pair	2	1202	1204	1092	0	112	
Neck cover	Pcs	1150	0	1150	1165	182	968	
IRS Reusable								
Bathing bucket	Pcs	44	30	74	26	55	48	
Calibrated cup	Pcs	0	16	16	16	0	16	
Danger sign	Pcs	73	9	82	82	0	82	
Fire extinguisher	Pcs	34	0	34	32	2	32	
Flash light	Pcs	43	445	488	480	104	384	
Hand wash bowl	Pcs	35	1	36	32	0	36	
Heavy duty brush	Pcs	29	11	40	39	11	29	
Jerry can	Pcs	84	25	109	103	49	61	
Mobilizers vest	Pcs	0	715	715	715	492	223	
Pliers	Pcs	8	16	24	16	7	17	
Rain coat	Pcs	3	0	3	3	1	2	
Rinsing barrels	Pcs	138	0	138	134	0	142	4 retrieved from old stock
Rope (drying line)	Pcs	18	2	20	20	1	19	
Sand bucket	Pcs	16	4	20	20	0	20	
Screw driver	Pcs	22	18	40	16	21	19	
Shifting spanner	Pcs	15	13	28	16	11	17	
Shovel	Pcs	20	4	24	21	0	24	
Spray bag	Pcs	745	0	745	584	7	738	
Spread sheet	Pcs	491	698	1189	619	619	570	
Wash basin	Pcs	60	18	78	61		87	
Water cup	Pcs	195	301	496	417	201	295	
Water filter	Pcs	223	239	462	390	78	384	
Water jug	Pcs	19	65	84	55	22	62	

Item Description	UOM	Bal B/f	Quantity Procured	Total	Quantity Used	Quantity Damaged /Bad	Quantity After Campaign	Remark
Whistle	Pcs	2	81	83	54	54	29	
IRS Consumables								
Antiseptic (Carmel 250ml)	Bottle	0	725	725	710	0	15	
Atropine inj. (1 amp)	Pcs	180	220	400	350	0	50	
Bar soap (key soap)	Pcs	41	505	546	506	0	40	
Bathing soap (geisha)	Pcs	2212	0	2212	1629	76	486	76 expired
Batteries (dry cell)	Pair	225	1672	1897	847	0	1050	
Chalk	Pck	7110	0	7110	2100	0	5010	
Empty sack	Pcs	66	104	170	126	0	44	
First aid kit	Set	16	68	84	74	0	10	
Liquid soap	Pcs	54	31	85	44	0	41	
Nozzle brush	Pcs	0	462	462	458	0	4	
Powdered soap	Sachet	125	518	643	614	0	29	
Rubber band	Pck	0	18	18	17	0	1	
Sanitary pad	Set	0	320	320	216	0	104	
Towel	Pcs	0	601	601	597	0	4	
Vitamin E cream	Pcs	34	521	555	530	0	25	
Print Materials								
Daily spray operator card	Pcs	1441	18000	19441	17906	1441	1535	All bal B/f were scrapped off due to modification in 2016
Daily team I summary form	Pcs	0	4000	4000	3500	0	500	
Data collection verification form	Pcs	120	500	620	320	0	300	
Delivery book	Booklet	3	40	43	19	0	24	
Error elimination/ team lead form	Pcs	2030	9000	11030	7303	0	3727	All bal B/f were scrapped off due to modification in 2016
Goods receipt note	Booklet	16	0	16	1	0	15	
IEC IRS steps poster	Pcs	0	7000	7000	3500	0	3500	
IEC malaria free poster	Pcs	0	7000	7000	3500	0	3500	
IRS card and stickers	Pair	0	49286	49286	49286	0	0	

Item Description	UOM	Bal B/f	Quantity Procured	Total	Quantity Used	Quantity Damaged /Bad	Quantity After Campaign	Remark
Ledger book	Pcs	4	24	28	25	0	3	
MoI card	Pcs	2500	3000	5500	4000	0	1500	
MSDS	Set	11	32	43	43	0	0	
Performance tracker	Pcs	0	16	16	16	0	0	
PMI/AIRS anti-sexual harassment	Pcs	12	4	16	16	2	14	
Request book	Booklet	0	30	30	21	0	9	
Spray operator's guide	Booklet	117	0	117	76	0	41	
Store keeper's guide	Booklet	29	0	29	5	0	24	
Spill response procedure	Set	7	32	39	36	3	36	
Stock card	Pcs	770	2500	3270	2634	0	636	
Team leader guide	Booklet	20	0	20	17	0	3	
USAID/ PMI sticker	Pcs	376	1000	1376	1076	0	300	
Mobile soak pit items								
Heavy duty brush	Pcs	0	11	11	11	0	11	
Hoe	Pcs	0	11	11	11	0	11	
Napkin	Pcs	0	43	43	43	43	0	
Mobile soak pit bucket	Pcs	0	11	11	11	0	11	
Shovel	Pcs	0	11	11	11	0	11	
Tarpaulin (9mx5m)	Pcs	0	6	6	6	0	6	
Wash basin	Pcs	0	11	11	11	0	11	
Water jug	Pcs	0	11	11	11	0	11	
Mobile phone for IRS field reporting								
Samsung	Pcs	18	0	18	0	4	14	
Samsung galaxy pocket	Pcs	31	0	31	31	0	31	
Huawei	Pcs	0	31	31	0	0	31	

ANNEX B. GHANA IRS ENVIRONMENTAL MITIGATION AND MONITORING REPORT

Mitigation Measure	Status of Mitigation Measures	Outstanding Issues Relating to Required Conditions	Remarks
I a. Pre-contract inspection and certification of vehicles used for pesticide or spray team transport.	Pre-contract inspection and certification of vehicles for 2016 operations was conducted on April 20, 2016. All vehicles that were contracted had to meet all criteria. 41 vehicles with the driver's documents were inspected; 37 met all requirements and were certified.	No outstanding issues	During inspection, 4 vehicles that did not meet the criteria were disqualified. All other vehicles (12 pickup trucks for supervision and 25 Benz buses for transporting SOPs) passed inspection and were certified for the 2016 IRS campaign.
I b. Driver training.	AIRS Ghana trained 41 drivers of rented vehicles in Tamale on April 20, 2016. Topics included safety measures for transporting insecticides and safe driving techniques.	No outstanding issues	AIRS Ghana initially trained 37 drivers for the 37 vehicles contracted. However, 4 drivers decided not to work and the rental companies replaced them. Thus, the total number of drivers trained was 41.
I c. Cell phone, PPE, and spill kits on board during pesticide transportation.	All drivers had cell phones as a pre-requisite to rental of their vehicles. The drivers were given a set of PPE to use when transporting insecticide and/ or spray team members. Each vehicle used for pesticide transport was equipped with a spill response kit. 372 morning mobilization and vehicle inspections were conducted during the 2016 spray campaign. In only 42 instances did a vehicle not have all required PPE and a spill kit. Site managers took corrective actions before the vehicles left for the field.	No outstanding issues	Spill kits were provided after certification and training. When some items were missing, the project arranged for their quick replacement.

Mitigation Measure	Status of Mitigation Measures	Outstanding Issues Relating to Required Conditions	Remarks
I d. Initial and 30-day pregnancy testing for female candidates for jobs with potential pesticide contact.	On April 13-14, prior to recruiting SOPs, the project conducted initial pregnancy tests with 252 female candidates for the positions of SOP, Washer, Team Leader, and Store Assistant. The project conducted the second test on May 18-19 for 223 females who were hired.	No outstanding issues	Females found to be pregnant during the second test were re-assigned to duties unrelated to pesticide use. For example, Store Assistants (mostly females) who tested pregnant were limited to managing the non-pesticides store. Therefore, Store Managers (mostly males) were put in charge of the pesticides store. All test records are available on file.
I e. Health fitness testing for all operators.	Passing a pre-spray general physical/ medical examination is required for spray personnel. All spray personnel candidates had such an exam, on April 18-19. All 640 applicants who were examined were declared medically fit for training as spray team members.	No outstanding issue	The medical exam was conducted by trained Medical Assistants from government health facilities. The exam included checking blood pressure, respiratory system, pulse, vision, ear nose and throat, chest condition, and Locometer system. Of the 640 candidates, 9 did not pass the exam and were not hired. All physical exam records are available on file.
I f. Procurement of, distribution to, and training on the use of PPE for all workers with potential pesticide contact.	Both international and local procurements for PPE were done on time. The PPE were received and distributed on April 11-16 to all operational sites, prior to the spray start. Also, all candidates with potential pesticides contact were completely trained on correct use of PPE.	No outstanding issues	The project trained 17 store keepers, 5 Logistics Assistants, and 41 contract drivers on the use of PPE in handling pesticide.
I g. Training on mixing pesticides and the proper use and maintenance of spray pumps.	At the TOT and SOP trainings, the instructors demonstrated the proper mixing of pesticides including triple rinse of the Actellic 300 CS bottles. The trainings also demonstrated the proper use and maintenance of spray pumps. All Supervisors, Site Managers, Team Leaders, SOPs, DOCs, and government officials (Disease Control Officers and DEHOs in the targeted districts) were trained in 2016 to implement IRS.	No outstanding issue	AIRS Ghana trained 79 people (DOCs, DEHOs, Site Managers and Supervisors, and Disease Control Officers) at the TOT, and 582 at SOP training on how to mix pesticides and maintain pumps.
I h. Provision of adequate facilities and supplies for end-of-day cleanup.	Each operational site had an adequate storage facility that was either provided by government or rented from an individual. 301 end-of-day inspections were conducted. No issues were observed regarding provision of adequate facilities and supplies.	No outstanding issue	

Mitigation Measure	Status of Mitigation Measures	Outstanding Issues Relating to Required Conditions	Remarks
1i. Enforce clean-up procedures.	All supervisors inspected clean-up procedures as scheduled. Site Managers and supervisors supervised pump clean-up procedures throughout the spray campaign. Site supervisors and Team Leaders observed washing and bathing at each site. The COP, Operations Manager, ECO, and DOCs also supervised clean-up procedures once in the field. Of 301 end-of-day inspections, there was only one instance of clean-up procedures not being enforced (a Team Leader did not supervise washing of pumps). This was corrected by informing the Team Leader to attend to his supervisory duty.	No outstanding issues	
2a. IEC campaigns to inform homeowners of responsibilities and precautions.	Homeowners were fully informed about their roles, responsibilities, and precautions mainly through house-to-house mobilization. The SOPs were also trained to inform the households about what they should do before, during, and after the spraying. In addition, community meetings, radio jingles, and discussions highlighted roles, responsibilities, and precautions for homeowners before, during, and after their homes were sprayed.	No outstanding issues	2,008 homeowner preparation and SOP performance checks were carried out. In 3 instances, mobilizers did not inform homeowners about their responsibilities and precautions during the IEC campaign. Few households did not know some of the post-spray requirements. The project reps corrected those gaps on the spot.
2b. Prohibition of spraying of houses those are not properly prepared.	Great emphasis was placed on adequately preparing structures before spraying was done. This was mainly achieved through trainings and physical spot checks by all categories of supervisors including Team Leaders and Field Supervisors. With the introduction of DOS, Team Leaders greatly increased inspections of structures before spraying and corrective measures were taken where needed.	No outstanding issues	Of 2,008 inspections of homeowner preparation and SOP performance, inspectors observed only 10 instances of improper preparation of structures before spraying. Some food items were not removed or were not covered. These were corrected before spraying was done.
2c. Two-hour exclusion from house after spraying.	SOPs reminded households to wait two hours after spraying before opening the rooms, and to after that allow circulation of air for at least 30 minute before cleaning. Households were advised to mop their rooms, bury dead insects, and wash their hands with soap and water after cleaning.	No outstanding issues	This message was repeatedly stressed in the radio discussions and the jingles played through out the 2016 campaign.

Mitigation Measure	Status of Mitigation Measures	Outstanding Issues Relating to Required Conditions	Remarks
2d. Instruct homeowners to wash itchy skin and go to health clinic if symptoms do not subside.	All homeowners were instructed to wash with plenty of water and soap if any household member experienced itching skin, and report to the nearest clinic if itching persisted.	No outstanding issues	32 Medical Assistants and one EPA staff member were trained on insecticide poison management on March 3, 2016. Nearby health facilities were also stocked with antidote in the unlikely event of insecticide poisoning.
3a. Indoor spraying only.	SOPs sprayed only the interior of sleeping rooms, including behind the doors, inner walls, ceiling, and eaves of all sleeping rooms.	No outstanding issues	Spraying glass or metal surfaces or the floor is prohibited.
3b. Training on proper spray technique	During TOT and SOP trainings, the project emphasized the standards of spray techniques such as keep one meter distance between SOP and the “sprayable” surface; keep the nozzle tip 45cm from the “sprayable” surface; and spray at the correct speed. There was constant supervision in the field to ensure quality spray through the homeowner preparation and SOP performance checklist and the DOS.	No outstanding issues	AIRS Ghana improved TOT and SOP trainings by introducing a white cloth as an unmarked background wall for practical spray exercises. The purpose was to ensure that SOPs can keep correct distance and speed on a wall without any marking (like a wall in a typical structure). Each SOP had to pass this test before he/ she was recruited.
3c. Maintenance of pumps.	SOPs, Supervisors, and Team Leaders were trained in pump maintenance. Pumps were checked daily before use. Parts of pumps that were found to be faulty were replaced.	No outstanding issues	Site managers and supervisors serviced and calibrated pumps on weekends. Also, a pump mechanic was hired to service pumps that were beyond the repair knowledge of SOPs, site managers, and supervisors.
4a. Choose sites for disposal of liquid wastes according to PMI BMPs.	Site selection was done jointly with EPA representatives. All operational sites were inspected to ensure that they meet BMP standards before they were certified for use. AIRS Ghana ECO inspected all 11 MSPs sites prior to installation.	No outstanding issues	ECO, EPA representatives, and DEHOs participated in the certification of all sites including sites where MSPs were installed.
4b. Construct soak pits with charcoal to adsorb pesticide from rinse water.	All soak pits were constructed with five layers of sawdust, charcoal, bigger stones, smaller stones, and gravel as the top layer with the appropriate dimension of 2 × 1 × 1 meters. They were sloped towards the bio bed. Construction was supervised by Ghana AIRS ECO and EPA. Also, all MSPs that were built had activated carbon charcoal to adsorb pesticide from rinse water. All MSPs were properly uninstalled at the end of operations.	No outstanding issues	

Mitigation Measure	Status of Mitigation Measures	Outstanding Issues Relating to Required Conditions	Remarks
4c. Maintain soak pits as necessary during season.	Most soak pits were fairly newly refurbished to the best standards. There was no need to do any renovation during the spray campaign. All soak pits lasted through the spray campaign.	Gambaga and Wungu soak pits need to be expanded because of the large number of spray teams that operate from those sites. This will reduce pressure on the current soak pits and cut waiting time during end-of-day cleanup, when spray teams members are exhausted.	Puddling around Gambaga soak pit was reported. The large number of spray teams/SOPs using it resulted in it taking longer than expected for full absorption of liquid to take place.
4d. Inspection and certification of solid waste disposal sites before spray campaign.	The project will arrange recycling and incineration of all solid waste generated in 2016 at EPA-certified waste management companies: Cyclus Elmina Plastic Recycling Limited and Zoil Services Limited. COP, Operations Manager, ECO, and Finance and Administrative Manager completed site inspections of these companies in early January 2015. The home office also visited the sites during the SEA preparation. All facilities had required registrations and equipment that meet BMP standards. They will be visited again before waste materials are sent for final disposal and recycling.	No outstanding issues	AIRS Ghana will ensure that these facilities are still licensed to operate.
4e. Monitoring waste storage and management during campaign.	The project stored and managed all wastes during the spray campaign according to BMP standards. Store assistants clearly and regularly labeled sacks/boxes for keeping used nose masks, hand gloves, and all other waste. The boxes were allocated in separate parts of the storerooms.	All solid waste including triple-rinsed empty Actellic 300 CS bottles are currently stored in district warehouses waiting for transport to the central warehouse in Tamale. In July-August 2016, the project will move the waste to Cyclus Elmina Plastic Recycling Limited and/or Zoil Services Limited for disposal.	
4f. Monitoring disposal procedures post-campaign.	Waste disposal will be done at Cyclus and/or Zoil Services Limited. The ECO and EPA representative will monitor the post-spray campaign solid waste procedure.	This is expected to be done in July-August 2016.	

Mitigation Measure	Status of Mitigation Measures	Outstanding Issues Relating to Required Conditions	Remarks
5a. Maintain records of all pesticide receipts, issuance, and return of empty sachets/bottles.	Store assistants and managers kept records of all insecticide receipts, issuance, and returned empties on stock cards with a backup in a ledger books at the regional, district, and operational site level.	No outstanding issues	
5b. Reconciliation of number of houses sprayed vs. number of sachets/bottles used.	Pesticide usage has been consistent in Ghana. The average number of structures sprayed per bottle is 4.5. This was calculated every day throughout the spray campaign to ensure that insecticide usage is consistent with number of structures sprayed. No abnormalities were detected.	No outstanding issues	
5c. Visual examination of houses sprayed to confirm pesticide application.	Team Leaders, Field Supervisors, Senior Supervisor, and the M&E team performed regular spot checks in sprayed houses to verify and confirm insecticides application. This was mainly done through visual examination of sprayed walls, eaves, and ceilings.	No outstanding issues	All regional and the district supervisors were key in checking the quality of spray.
5d. Perform physical inventory counts during the spray season.	On a regular basis, ECO, Logistics and Procurement Coordinator, District Logistics Assistants, DOCs, Operation Manager, and COP conducted physical counts of randomly selected inventory items. Site Managers, ECO, and other supervisors used the storekeeper performance checklist to verify the stocks. A total of 227 of store inspections were carried out throughout the campaign. No issues were found with inventory numbers.	No outstanding issues	All stored items had inventory stock cards. ECO and Logistics and Procurement Coordinators checked, audited, and verified the stock cards and used their data for final inventory reconciliation.

ANNEX C. DATA QUALITY ASSURANCE AND CONTROL METHODS

Issue	Method/Tools for Quality Assurance
Mobilization data integrity	<ul style="list-style-type: none"> • Use of standardized data collection forms. • Comprehensive training for mobilization data capture. • Multiple levels of supervision • Household visits for spot checks. • Database designed with locks and validation checks. • Use of EE to ensure complete and accurate data collection.
Spray data integrity	<ul style="list-style-type: none"> • Use of standardized data collection forms. • Comprehensive training for spray data capture. • Multiple levels of supervision. • SOPs supervised directly by their Team Leaders. • Supervisors monitored the Team Leaders and verified SOP forms. • M&E Manager, Database Manager, and District M&E Coordinators monitor and verified data captured by SOPs, Team Leaders, and Supervisors. • Structure spot checks to cross-check daily spray data captured by SOPs. • Database designed with locks and validation checks. • Use of EE and DCV forms to ensure complete and accurate data collection. • Compared number of compounds sprayed with number of compounds mobilized, to address any issues with missed compounds.
Spray data entry and management	<ul style="list-style-type: none"> • Data entry training for all Data Entry Assistants. • Prompt (daily) field data entry and transfer. • Data entry via double-data-entry method <ul style="list-style-type: none"> ▪ Initial data entry of totals per data collection form within 12 hours after spray ▪ Follow-up entry of details data, i.e., data per individual household/compound, within 24 hours after spray • Data scan for irregularities by Database Manager and IRS supervisory staff. • Use of Microsoft Access-based IRS Cleaning/Reporting tool to clean data daily.
Data security	<ul style="list-style-type: none"> • Data collection forms printed on durable sheets. • Paper data collection forms filed systematically in arc files. • Database designed with passwords to restrict unauthorized entry. • Databases backed up daily on the server laptop, Dropbox, and external drives.

ANNEX D. GHANA MONITORING AND EVALUATION PLAN INDICATOR MATRIX

UPDATED: June 04, 2016

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
Component I: Establish cost-effective supply chain mechanisms and execute logistical plans								
I.1 Procurement								
I.1.1 Number and percentage of insecticide procurements that had a pre-shipment QA/QC test at least 60 days prior to spray campaign	<ul style="list-style-type: none"> Data source: Project records – insecticide procurements Reporting frequency: Each spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	I; 100%	I;100%	I;100%	I;100%	TBD; 100%	
I.1.2 Number and percentage of international insecticide procurements delivered in country, at port of entry, at least 30 days prior to the start of spray operations	<ul style="list-style-type: none"> Data source: Project records – international procurements Reporting frequency: Each spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	I; 100%	I;100%	I; 100%	I;100%	TBD; 100%	

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
I.1.3 Number and percentage of international equipment procurements, including PPE, delivered in country, at port of entry, at least 30 days prior to start of spray operations	<ul style="list-style-type: none"> Data source: Project records Reporting frequency: Each spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	1; 100%	0;0%	2 ¹⁰ ; 100%	1 ¹¹ ;50%	TBD; 100%	
I.1.4 Number and percentage of local procurements for PPE delivered 14 days before the start of spray operations	<ul style="list-style-type: none"> Data source: Project records Reporting frequency: Each spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	1; 100%	1;100%	2 ¹² ; 100%	2; 100%	TBD; 100%	
I.1.5 Successfully completed spray operations without an insecticide stock-out	<ul style="list-style-type: none"> Data source: Project records Reporting frequency: Each spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	Completed	Completed	Completed	Completed	Completed	
I.2 In-Country Exemption and Custom Clearance Process								
I.2.1 Complete exemption and clearance process within the minimum 2 weeks	<ul style="list-style-type: none"> Data source: Project records Reporting frequency: Each spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	Completed	Completed	Completed	Completed	Completed	
I.3 In-Country Logistics, Warehousing, and Training								
I.3.1 Number and percentage of logistics and warehouse managers trained in IRS supply chain management	<ul style="list-style-type: none"> Data source: Training records Reporting frequency: Each spray campaign 	<ul style="list-style-type: none"> By Spray Campaign By Gender 	21; 100%	22;100% (7 males, 15 Females)	22; 100%	22; 100% (9 Males, 13 Females)	TBD; 100%	

¹⁰ One for Goizper pump parts and one for Hudson pump parts and other PPEs

¹¹ Hudson repair kit and other PPEs did not arrive 30 days before start of spray campaign, but they arrived in time for distribution before the start of the spray campaign.

¹² One for cotton sacks and one for coveralls

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
1.3.2 Number and percentage of base stores where physical inventories are verified by up-to-date stock records	<ul style="list-style-type: none"> Data source: Project records Reporting frequency: Each spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	16; 100%	16; 100%	16; 100%	16; 100%	TBD; 100%	
1.3.3 Submit up-to-date inventory records 30 days after the end of each spray campaign	<ul style="list-style-type: none"> Data source: Project records Reporting frequency: Each spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	Completed	Completed	Completed	Ongoing	TBD; 100%	
Component 2: Implement safe and high-quality IRS programs and provide operational management support								
2.1 Planning and Design of IRS Programs								
2.1.1 Annual PMI AIRS country work plan developed and submitted on time	<ul style="list-style-type: none"> Data source: Project records Reporting frequency: Annually 	<ul style="list-style-type: none"> By Spray Campaign 	Completed	Completed	Completed	Completed	Completed	
2.1.2 Percentage reduction in project operational expenses per structure from the previous year, excluding insecticide costs	<ul style="list-style-type: none"> Data source: Project financial records Reporting frequency: Annually 	<ul style="list-style-type: none"> By Spray Campaign 	5%	31% ¹³	5%	21% ¹⁴	5%	

¹³ Cost comparison 2014 vs. 2015: the project-wide approach to calculating this indicator is comparing the ratio between Oracle charges for Operations code in two years and the number of structures sprayed in two years. In case of Ghana, the total of the two ratios is considered as a percent saved because the country charged less but sprayed more structures in 2015 as compared to 2014. Insecticide and capital costs are excluded.

¹⁴ As above applied for 2015 vs. 2016 calculations. Increase in structures sprayed between 2016 and 2015 is 5,348

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
2.2 Support of Safety and Health Best Practices and Compliance with USAID and Host Country Environmental Regulations								
2.2.1 SEA/letter reports submitted on time based on schedule agreed upon with the-PMI COR team	<ul style="list-style-type: none"> Data source: Project records – submitted SEAs/ letter reports Reporting frequency: Each spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	Completed	Completed	Completed	Completed	Completed	
2.2.2 Number of spray personnel trained in environmental compliance and personal safety standards in IRS implementation	<ul style="list-style-type: none"> Data source: Project records – Training reports Reporting frequency: Each spray season 	<ul style="list-style-type: none"> By Spray Campaign By Gender 	648	651 (459 male, 192 female, 29.5% female)	664	662 ¹⁵ (455 Male and Female 207)	TBD	
2.2.3 Number of health workers receiving insecticide poisoning case management training	<ul style="list-style-type: none"> Data source: Project records – Training reports Reporting frequency: Each spray season 	<ul style="list-style-type: none"> By Spray Campaign By Gender 	44	31 (29 male, 2 female) 6.5%	37	33 (30 Male, 3 Female)	TBD	
2.2.4 Number of adverse reactions to pesticide exposure documented	<ul style="list-style-type: none"> Data source: Incident report forms Reporting frequency: Each spray campaign 	<ul style="list-style-type: none"> By Spray Campaign By Residential/ occupational exposure 	0	0	0	0	0	

¹⁵ This includes Site Manager (16), Field Supervisors (48), Team Leaders (92), Spray Operators (490), Government officials (11), and DOC (5) for Year 2.

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
2.2.5 Number and percentage of soak pits and storehouses inspected and approved prior to spraying	<ul style="list-style-type: none"> Data source: Project records – Reports submitted by district environmental officers Reporting frequency: Each spray season 	<ul style="list-style-type: none"> By Spray Campaign By Soak Pit By Storehouse 	16; 100%	16; 100%	16; 100% (Soak pits)	16 ¹⁶ ; 100%	TBD; 100%	
2.3 Conduct Communications Activities and Community Mobilization								
2.3.1 Number of radio spots and talk shows aired	<ul style="list-style-type: none"> Data source: Project records Reporting frequency: Per spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	472 jingles 28 talk shows	513 jingles 11 talk shows 298 radio announcements	392 ¹⁷ jingles 12 talk shows	826 (532 radio spots and jingles, 16 radio programs: interactive shows, 278 radio announcements)	TBD	
2.3.2 Number of IRS print materials disseminated	<ul style="list-style-type: none"> Data source: Project records Reporting frequency: Semi-annually 	<ul style="list-style-type: none"> By Spray Campaign By Type of printed material and message(s) 	26,333	26,333 (22,433 posters and 3,900 brochures)	27,993 ¹⁸ posters	27,993 ¹⁹ posters	TBD	

¹⁶ 16 soak pits were inspected and approved prior to spray operation. Also 11 mobile soak pits (MSP) were used on rotational basis among four districts (KD, MMD, WMD, and EMD). The proposed sites for the installation of MSPs were inspected and approved before installation was done.

¹⁷ This includes: Jingles=35 days * 3 times a day * 2 radio stations and announcements =35 days* 2 times a day * 2 radio stations during spray campaign. Pre-spray jingles = 7 days * 3 times * 2 radio stations.

¹⁸ There were no printing and distribution of brochures in 2016; we only printed and distributed posters.

¹⁹ 20,993 distributed by mobilizers and 7,000 distributed through other means.

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
2.3.3. Number of people reached with IRS messages via door-to-door mobilization	<ul style="list-style-type: none"> Data source: Mobilization Data Collection Forms Reporting frequency: Daily per mobilization conducted 	<ul style="list-style-type: none"> By Spray Campaign By Gender 	289,353 ²⁰	214,864 (100,020 Male, 114,844 Female)	292,849 ²¹	198,170 (89,372 Male, 108,798 Female)	TBD	
2.4 Spray Targeted Structures According to Technical Specifications								
2.4.1 Number of structures targeted for spraying	<ul style="list-style-type: none"> Data source: Previous spray campaign data, enumeration data (targets); Daily Spray Operator Forms (results) Reporting frequency: Daily per spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	231,345	224,592	224,592	227,857	TBD	
2.4.2 Number of structures sprayed with IRS	<ul style="list-style-type: none"> Data source: Daily Spray Operator Forms Reporting frequency: Daily per spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	196,643 ²²	205,935	190,903	211,283	TBD	
2.4.3 Percentage of total structures targeted for spraying that were sprayed with a residual insecticide (Spray Coverage)	<ul style="list-style-type: none"> Data source: Daily Spray Operator Forms Reporting frequency: Daily per spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	85%	91.7%	85%	92.7%	85%	

²⁰ 50% of targeted population for 2015 campaign, 596,706

²¹ 50% of targeted population for 2016 campaign, 585,698

²² 85% of number of structures targeted for spraying

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
2.4.4 Number of people residing in structures sprayed (Number of people protected by IRS)	<ul style="list-style-type: none"> Data source: Daily Spray Operator Forms Reporting frequency: Daily per spray campaign 	<ul style="list-style-type: none"> By Spray Campaign By Gender By pregnant women By children <5 years old 	596,706	553,954 (11,676 pregnant women, 98,525 children under 5 years old)	585,698	570,871 (10,881 pregnant women, 96,150 children under 5 years old)	TBD	TBD
Component 3: Ongoing Monitoring and Evaluation and Quality Control Measures								
3.1 Submit AIRS Ghana M&E Plan to PMI for approval	<ul style="list-style-type: none"> Data source: Project records Reporting frequency: Semi-annual 	<ul style="list-style-type: none"> By Spray Campaign 	Completed	Completed	Completed	Completed	Completed	
3.2 Conduct a post-spray data quality audit within 60 days of completion of spray operations	<ul style="list-style-type: none"> Data source: Spray operations reports Reporting frequency: Per spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	N.A.	N.A.	N.A.	N.A.	Completed or N.A.	
Component 4: Contribute to Global and Country-Level IRS Policy Setting and Develop and Disseminate Experiences and Best Practices								
4.1 Number of guidelines/checklists/tools related to IRS operations developed or refined with project support	<ul style="list-style-type: none"> Data source: Project records – Activity reports Reporting frequency: Semi-annually 	<ul style="list-style-type: none"> By Spray Campaign By guideline/checklist /tool 	TBD	N.A.	2	9	TBD	
4.2 Number of articles/best practices documents published	<ul style="list-style-type: none"> Data source: Project records – Activity reports Reporting frequency: Semi-annually 	<ul style="list-style-type: none"> By Spray Campaign By IRS Technical Area 	N/A	N/A	2	0	TBD	

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
4.3 Number of best practice presentations given at national/ regional/international workshops and conferences	<ul style="list-style-type: none"> Data source: Project records – Activity reports Reporting frequency: Semi-annually 	<ul style="list-style-type: none"> By Spray Campaign By IRS Technical Area 	TBD	1 ²³	1	2 ²⁴	TBD	
4.4 Number of enterprises engaged through public-private partnerships	<ul style="list-style-type: none"> Data source: Project records – Activity reports Reporting frequency: Semi-annually 	<ul style="list-style-type: none"> By Spray Campaign 	TBD	N.A.	N.A.	N.A.	TBD	

Component 5: Contribute to the collection and analysis of routine entomological and epidemiological data

5.1 Support entomological monitoring activities and insecticide resistance strategies

5.1.1 Number of entomological sentinel sites supported by the PMI AIRS Project established to monitor vector bionomics and behavior (vector species, distribution, seasonality, feeding time, and location)	<ul style="list-style-type: none"> Data source: Entomological reports Reporting frequency: Annually 	<ul style="list-style-type: none"> By Spray Campaign 	14	14	14	14	TBD	
5.1.2 Number and percentage of entomological monitoring sentinel sites measuring all the five primary PMI entomological monitoring indicators	<ul style="list-style-type: none"> Data source: Entomological reports Reporting frequency: Annually 	<ul style="list-style-type: none"> By Spray Campaign 	14, 100%	14,100%	14, 100%	14;100%	TBD	

²³ The Second Pan African Mosquito Control Association Annual Control Conference, October 6-8, 2015. Tanzania

²⁴ Recycling of Actellic bottles and bio-monitoring during the PMI AIRS project regional meeting in Cape Town

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
5.1.3 Number and percentage of entomological monitoring sites measuring at least one secondary PMI indicator	<ul style="list-style-type: none"> Data source: Entomological reports Reporting frequency: Annually 	<ul style="list-style-type: none"> By Spray Campaign 	14, 100%	14, 100%	14, 100%	14; 100%	TBD	
5.1.4 Number and percentage of insecticide resistance testing sites that tested at least one insecticide from each of the four classes of insecticides recommended for malaria vector control	<ul style="list-style-type: none"> Data source: Entomological reports Reporting frequency: Annually 	<ul style="list-style-type: none"> By Spray Campaign By Insecticide class 	10, 100%	8, 80%	10, 100%	2; 20% (Ongoing; as of June 2, 2016)	TBD	
5.1.5 Number of wall bioassays conducted within 2 weeks of spraying to evaluate the quality of IRS	<ul style="list-style-type: none"> Data source: Entomological reports Reporting frequency: Per spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	24	44,	40 ²⁵	52 ²⁶	TBD	
5.1.6 Number of wall bioassays conducted after the completion of spraying at monthly intervals to evaluate insecticide decay	<ul style="list-style-type: none"> Data source: Entomological reports Reporting frequency: Per spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	128, 100%	396 Completed	128	36 (Ongoing; as of June 2, 2016)	TBD	
5.1.7 Number of vector susceptibility tests for different insecticides conducted in selected sentinel sites	<ul style="list-style-type: none"> Data source: Entomological reports Reporting frequency: Per spray campaign 	<ul style="list-style-type: none"> By Spray Campaign 	40, 100%	39 ²⁷ Completed	40	17 (Ongoing; as of June 2, 2016)	TBD	

²⁵ Target: 10 communities, 4 tests per community, 40 tests in total

²⁶ Actual: 13 communities, 4 tests per community, 52 tests in total. The 52 tests are made up of 16 tests for wild mosquitoes and 36 tests for Kisumu mosquitoes.

²⁷ Pirimiphos methyl 0.25% (11); fenitrothion 1% (1); alpha-cypermethrin 0.05% (8); deltamethrin 0.05% (5); propoxur 0.1% (2); bendiocarb 0.1% (7); DDT 4% (5)

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
5.2 Support Epidemiological Malaria Data Collection and Analysis								
5.2.1 Collect routine epidemiological data	<ul style="list-style-type: none"> Data source: Project Reports Reporting Frequency: Annually 	<ul style="list-style-type: none"> By Spray Campaign 	N/A	N/A	N/A	N/A	TBD	
5.2.2 Number of targeted health facilities with routine epidemiological malaria data collection supported by the PMI AIRS Project	<ul style="list-style-type: none"> Data source: Epidemiological reports Reporting frequency: Annually 	<ul style="list-style-type: none"> By Spray Campaign 	N/A	N/A	N/A	N/A	TBD	
Component 6 (Cross-cutting): Capacity Building, Knowledge Transfer, Gender Inclusion								
6.1 Increasing the Role of Women and Addressing Gender Barriers								
6.1.1 Number of people trained to deliver IRS in target districts	<ul style="list-style-type: none"> Data source: Project records – Training reports Reporting frequency: Semi-annually 	<ul style="list-style-type: none"> By Spray Campaign By Spray Campaign By Gender Percentage of Women Trained 	707	698 (504 males, 194 females; 27.8% females)	708	694 (484 Male, 210 Female; 30.3% females)	TBD	
6.1.2 Total number of people trained to support IRS in target districts	<ul style="list-style-type: none"> Data source: Project records – Training reports Reporting frequency: Semi-annually 	<ul style="list-style-type: none"> By Spray Campaign By Spray Campaign By Gender Percentage of women trained 	1,629	1,544 (1,252 males, 292 females; 18.9% females)	1,664	1,667 (1,359 Male, 308 Female; 18.5% females)	TBD	

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
6.1.3 Number and percentage of women recruited (i.e. number/percentage of women on the selection list) for IRS employment	<ul style="list-style-type: none"> Data source: Project records – Recruitment reports Reporting frequency: Semi-annually 	<ul style="list-style-type: none"> By Country 	258 ²⁸	306 (20.8%)	573 ²⁹	319 (21.4%)	TBD	
6.1.4 Number of people trained as IRS Training of Trainers	<ul style="list-style-type: none"> Data source: Project records – Training reports Reporting frequency: Semi-annually 	<ul style="list-style-type: none"> By Spray Campaign By Gender Percentage of women trained 	82	78 (74 males, 4 females; 5.1% females)	83	79 (74 Male, 5 Female; 6.3% females)	TBD	
6.1.5 Total number of people hired to support IRS in target districts	<ul style="list-style-type: none"> Data source: Project records – Contracts signed Reporting frequency: Semi-annually 	<ul style="list-style-type: none"> By Spray Campaign By Gender Percentage of women hired 	678	1,471 (1,165 males, 306; 20.8% females)	1,465	1,491 (1,172 Male, 319 Female; 21.4% Female)	TBD	

²⁸ Based on 40% female target for all positions. Total number of people to be recruited is approximately 646 (excluding 32 security personnel). 40% gives 258.

²⁹ Based on 40% female target for all positions. The total number of people expected to be recruited for all temporal positions in 2016 (excluding 32 security personnel) is approximately 1,433.

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
6.1.6 Number of women hired in supervisory roles in target districts (this number includes site supervisors, team leaders, M&E assistants and others who supervise seasonal staff) ³⁰	<ul style="list-style-type: none"> Data source: Project records – Contracts signed Reporting frequency: Semi-annually 	<ul style="list-style-type: none"> By Spray Campaign Percentage of women hired By role 	17 ³¹	27 ³²	35 ³³	33 ³⁴	TBD	
6.1.7 Number of staff (permanent and seasonal) who have completed gender awareness training	<ul style="list-style-type: none"> Data source: Project records – Training reports Reporting frequency: Semi-annually 	<ul style="list-style-type: none"> By Spray Campaign By Gender Percentage of women 	22 ³⁵	20 ³⁶ 17 males, 3 females	64 ³⁷	64 (59 Male, 5 Female; 7.8% female)	TBD	
6.2 Capacity Building								
6.2.1 Number of government officials trained in IRS oversight	<ul style="list-style-type: none"> Data source: Project records – Training reports Reporting frequency: Semi-annually 	<ul style="list-style-type: none"> By Spray Campaign By Gender Percentage of Women 	10	11 (11 males, 0 female)	11	10 (10 males, 0 female; 0% female)	TBD	

³⁰ People counted includes: Site Managers, Field Supervisors, IEC Assistants, M&E Assistants, Logistics Assistants, and Team Leaders.

³¹ Approximately 174 people will fill these supervisory positions [Site Managers (16), Field Supervisors (44), IEC Assistants (16), M&E Assistants (5), Logistics Assistants (5), and Team Leaders (88)] for year 1; we are targeting 10% of them to be female.

³² Site Managers (0), Field Supervisors (3), IEC Assistants (2), M&E Assistants (1), Logistics Assistants (1), and Team Leaders (20)

³³ Approximately 20% of the total number of people expected to fill this position. (174 people will fill these supervisory positions [Site Managers (16), Field Supervisors (44), IEC Assistants (16), M&E Assistants (5), Logistics Assistants (5), and Team Leaders (88)].)

³⁴ This includes M&E Assistant (1), Field Supervisors (5), Team Leaders (24), IEC Assistants (2) and Logistics Assistant (1), and Site Managers (0).

³⁵ 22 permanent staff will be trained in Year 1.

³⁶ The permanent staff are 22; two entomology staff missed it because they were in the field. There are plans for them to take the training soon.

³⁷ The number includes only TOT participants for Year 2 who did not take part in the training in Year 1. Even though government officials will be at the TOT, they will not be counted because they are neither permanent nor seasonal staff on the project.

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
6.2.2 Implement all activities outlined in their yearly Capacity Building Action Plan	<ul style="list-style-type: none"> Data source: Project records – Capacity assessment reports Reporting frequency: Semi-annually 	<ul style="list-style-type: none"> By Spray Campaign 	Completed	Incomplete ³⁸ (2 out of 3 activities completed) one to be done soon	Completed	Completed	Completed	
6.2.3 Ghana government implements at least one aspect of the IRS program independently.	<ul style="list-style-type: none"> Data source: Project records – MOUs Reporting frequency: Semi-annually 	<ul style="list-style-type: none"> By Spray Campaign 	N/A	N/A	N/A	N/A	TBD	

³⁸ The 2 completed activities involved the successful attachment of Ghana Service and District Assembly staff on IRS project activities. NMCP staff were not attached.