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**GHANA**  
**END OF SPRAY REPORT**  
**2015**

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



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# ACRONYMS

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<b>AIRS</b>	Africa Indoor Residual Spraying
<b>BCC</b>	Behavior Change Communication
<b>BMP</b>	Best Management Practice
<b>b/p/n</b>	bites/person/night
<b>BSS</b>	Beneficiary Satisfaction Survey
<b>BYD</b>	Bunkpurugu-Yunyoo District
<b>CBS</b>	Community-based Surveillance
<b>COP</b>	Chief of Party
<b>DCV</b>	Data Collection Verification form
<b>DHMT</b>	District Health Management Team
<b>ECO</b>	Environmental Compliance Officer
<b>DOC</b>	District Operations Coordinator
<b>EE</b>	Error Eliminator form
<b>EMD</b>	East Mamprusi District
<b>EPA</b>	Environmental Protection Agency
<b>GEMS</b>	Global Environmental Management Support
<b>GHS</b>	Ghana Health Service
<b>HLC</b>	Human Landing Catch
<b>IEC</b>	Information, Education and Communication
<b>IRS</b>	Indoor Residual Spraying
<b>KD</b>	Kumbungu District
<b>M&amp;E</b>	Monitoring and Evaluation
<b>MaVCOC</b>	Malaria Vector Control Oversight Committee
<b>MBR</b>	Mean Biting Rate
<b>MMD</b>	Mamprugu Moaduri District
<b>NMCP</b>	National Malaria Control Program
<b>NMIMR</b>	Noguchi Memorial Institute for Medical Research
<b>PMI</b>	President's Malaria Initiative
<b>PMT</b>	Performance Monitoring Tool
<b>PPE</b>	Personal Protective Equipment

<b>PSC</b>	Pyrethrum Spray Catch
<b>PSECA</b>	Pre-Season Environmental Compliance Assessment
<b>SND</b>	Savelugu-Nanton District
<b>SOC</b>	Spray Operations Coordinator
<b>SOP</b>	Spray Operator
<b>TD</b>	Tolon District
<b>TKD</b>	Tolon-Kumbungu District
<b>TML</b>	Tamale Metropolis
<b>TOT</b>	Training of Trainers
<b>USAID</b>	United States Agency for International Development
<b>WHO</b>	World Health Organization
<b>WMD</b>	West Mamprusi District

# EXECUTIVE SUMMARY

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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. 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, necessitating the use of a significantly more expensive long-lasting organophosphate (Actellic 300 CS). Behavior change communication activities nevertheless 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 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 (or the project) to support the implementation of IRS in up to 20 African countries, including Ghana.

Implementation of Ghana's PMI IRS project has been built upon lessons learned in the country's eight years of spraying. In 2015, AIRS Ghana implemented IRS in five districts. The project continued spraying in two districts: East Mamprusi and Bunkpurugu-Yunyoo as in 2014. The Government of Ghana divided West Mamprusi into two districts in 2014: West Mamprusi and Mamprugu Moaduri. Due to low acceptance of IRS in Savelugu Nanton, that district was dropped as a target district after the 2014 spray campaign. Based on consultation with National Malaria Control Program, it was replaced by Kumbungu District. Kumbungu District was last sprayed in 2012, when it was part of Tolon Kumbungu District. (The Government of Ghana divided Tolon Kumbungu into two districts, Tolon and Kumbungu, in 2015). In summary, the five districts AIRS Ghana sprayed in 2015 were Bunkpurugu-Yunyoo, East Mamprusi, Kumbungu, Mamprugu Moaduri, and West Mamprusi. The 2015 IRS campaign lasted for 35 working days between April 14 and May 23.

The project recruited and trained temporary staff for the spray operations before the start of the campaign. Logistics and environmental compliance assessments were carried out to ensure that the standard operating procedures and Best Management Practices were followed. AIRS Ghana completed and received approval of a new Supplemental Environmental Assessment (2015-2020) before the start of the campaign because the 2010 assessment had expired. 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 found 224,592 structures. A total of 205,935 structures were sprayed, yielding a spray coverage of 91.7 percent. A total of 553,954 people were protected by IRS, including 11,676 pregnant women and 98,525 children under the age of five years.

For the first time, AIRS Ghana with assistance from a consultant under the Global Environmental Management Support contract and PMI piloted bio monitoring of exposure to the insecticide among temporary personnel involved in the spray campaign. Results show that, although some level of plasma cholinesterase depression was observed in some workers, there were no recorded cases of red blood cell cholinesterase depression and no clinical symptoms of overexposure were observed. AIRS Ghana will submit a separate report on the pilot, which was funded by core.

The challenges faced during the 2015 operations included malfunctioning Goizper pumps and attaining target coverage in some areas. The malfunctioning Goizper pumps were replaced with Hudson pumps. However, more efforts will be made to ensure all Goizper pumps are maintained and tested before they are given to SOPs. AIRS Ghana worked 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.

**TABLE ES-1. AIRS GHANA AT A GLANCE**

Number of districts covered by PMI-supported IRS in 2015	5 districts: Bunkpurugu Yunyoo, East Mamprusi, Kumbungu, Mamprugu Moaduri, West Mamprusi
Insecticide	Organophosphate (Actellic 300 CS)
Number of structures covered by PMI-supported IRS in 2015	205,935
Number of structures found by spray operators during 2015 PMI-supported IRS spray season	224, 592
2015 spray coverage	91.7%
Population protected by PMI-supported IRS in 2015	553,954 (including 11,676 pregnant women and 98,525 children under 5 years old)
Dates of PMI-supported IRS campaign	April 14 to May 23, 2015
Length of campaign	35 days
Number of people trained with U.S. Government funds to deliver IRS <sup>1</sup>	698

<sup>1</sup> 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.

# I. INTRODUCTION

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Indoor residual spraying (IRS) is a major component of Ghana's current National Malaria Control Strategy. Ghana's new 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 since 2008. In 2015, the 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) in the Northern Region. A total of 231,345 structures were targeted for spraying, which began on April 14 and ended on May 23 in all five districts.

By the end of the 2015 campaign, 224,592 structures had been found and 205,935 structures sprayed, for a spray coverage of 91.7 percent. A total of 553,954 people were protected, including 11,676 pregnant women and 98,525 children under the age of five years. Table I lists the number of districts sprayed and population protected each year for the past eight years.

**TABLE I. NUMBER OF DISTRICTS AND POPULATION PROTECTED 2008-15**

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

The project achieved the following results during 2015 IRS operations:

- All districts achieved the 85 percent PMI spray coverage target. Four of the five districts achieved the 90 percent NMCP spray coverage target.
- PMI AIRS Ghana through Noguchi Memorial Institute for Medical Research (NMIMR) is providing financial support to the NMCP for entomological monitoring activities with focus on insecticide resistance mapping and monitoring. NMIMR is also providing technical backup to the AIRS monthly entomological evaluations conducted by trained field technicians under the direct supervision of the AIRS Entomologist. The Noguchi team also provides technical support to insecticide monitoring tests, conducts quarterly technical supervision and performs advanced molecular evaluations of the samples collected by the AIRS project entomology team. The entomological monitoring activities generate critical data on vector behavior relevant to IRS, effectiveness of the spray program and potency of the insecticide used for vector control.

- AIRS Ghana provided the National Malaria Vector Control Oversight Committee (MaVCOC) technical support on IRS and entomology issues and 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

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### 2.1 INSECTICIDE SELECTION

As in 2013 and 2014, in 2015 the AIRS Ghana team and the NMIMR, PMI, GHS, NMCP, and MaVCOC analyzed all entomological data and, based on findings regarding susceptibility of the local vectors and residual efficacy, decided that the long-lasting organophosphate, Actellic 300 CS is still effective and would be most appropriate for the 2015 IRS spray campaign. (See Section 6.2 for susceptibility results.)

### 2.2 MICRO-PLANNING

To effectively plan for a successful IRS campaign and as part of strengthening local ownership, the AIRS Ghana team conducted micro-planning meetings with the government stakeholders just before the start of the spray season. A regional meeting was held with the Ghana Health Directorate, Environmental Protection Agency (EPA), and regional NMCP. The purpose of the meeting was to review the operational plan and target for the 2015 operations and also renew stakeholder roles and commitments. Planning meetings were also held with stakeholders at the district and community levels particularly with District Health Directorates and District Assemblies. 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 2015 IRS operations
- Recruitment of spray operators (SOPs)
- Official launch of the 2015 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 of office and storage facilities for AIRS district team (especially in Kumbungu District)

### 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 2015. 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 in operational sites in Kumbungu District and at the Bunkpurugu Binde site, district assemblies or DHMTs provided space and facilities for the remaining operational sites. The District Health Directorate also provided space for the data center in Kumbungu all free of charge.
- Quantification of IRS commodities. This was based on the number of structures targeted for spraying, number of days of spray operations, number of SOPs to be hired, 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

Procurement of commodities was separated into international and local procurements to ensure cost effectiveness and timely delivery of commodities. The AIRS Ghana team procured local supplies including operator's bags, neck covers, detergents, and production of IEC/ BCC materials (posters and brochures).

A major and an important component of international procurement was the purchase of Actellic 300 CS. A total of 3,747 bottles of Actellic 300 CS were left over from the 2014 IRS campaign. After taking 12 bottles for entomological tests, 3,735 bottles remained for the 2015 IRS campaign. Using 231,345 structures as the 2015 spray target, AIRS Ghana calculated that a total of 56,656 bottles of Actellic 300 CS (including a 20 percent cushion) would be required. With 3,735 bottles available from 2014, the project needed to procure 52,921 bottles. Because of product packaging of 12 bottles per box, the project procured 4,411 boxes (52,932 bottles).

Other international consignments included repair kits and parts for both Hudson and Goizper pumps, nose masks, hard hats, coveralls, boots, and hand gloves. Both local and international procurement items were received and distributed to various operational sites before the start of the 2015 spray operations. Annex A lists all materials procured and post-spray stock quantities remaining.

## 2.5 HUMAN RESOURCE REQUIREMENTS

The district human resource requirements consisted of two groups: 1) district AIRS full-time staff (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 Officers. In addition, some GHS officers, community-based volunteers, and individuals who could read and write were engaged by AIRS Ghana to carry out house-to-house mobilization activities. The project engaged additional human resources to carry out entomological activities. These included Mosquito Collectors and Supervisors.

## 2.6 GENDER INTEGRATION

To contribute to the PMI AIRS objective of integrating women into a variety of IRS implementation activities, AIRS Ghana used the following strategies to increase women's participation:

- I. The AIRS Ghana gender representative attended a project-wide training on gender and brought

back to the country program various strategies that were used to improve female participation.

2. As part of preparation for the 2015 spray campaign, the project held separate meetings with various stakeholders, particularly women’s groups and heads of households, to discuss the various roles on IRS and to urge them to encourage their daughters, wives, and sisters to take up a role of interest to them.
3. AIRS Ghana made a commitment to have at least one female SOP on every spray team.

In 2015, the project trained 194 females to deliver IRS, 27.8 percent of the total number of people trained (698). In both absolute and percentage terms, the females trained were comparable to 2014, when 207 (27.6 percent of a total 669) were trained.

Of all trained, the project hired 158 females<sup>2</sup> to deliver IRS, 30.0 percent of the total number of people hired (526). In addition the number of women hired in supervisory roles (Team Leaders, Field Supervisors, Site Managers, Logistics Assistants, IEC Assistants, and M&E Assistants) increased from 17 in 2014 to 27 in 2015, or by 58.8 percent. In the coming year, females recruited in 2015 are expected to be ready to take up supervisory roles in the 2016 campaign.

Also to improve gender integration, AIRS Ghana set up clearly marked separate shower rooms, change rooms, and toilet facilities. In addition, the program displayed the AIRS project-wide anti-sexual harassment policy at each operational site and at the main office in Tamale.

## 2.6.1 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 IRS tasks correctly. AIRS district staff train SOPs annually before spray operations begin. In all, 10 types of training were organized in preparation for the 2015 spray campaign. Table 2 describes the trainings.

**TABLE 2. SUMMARY OF 2015 AIRS GHANA TRAINING**

Type of Training	Dates	Length (days)	Location	Brief Description
IEC Training of Trainers (TOT)	25-26/02/15	2	Tamale	Covers 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	04/03/15	1	All sub-districts	Focused on 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	10-12/03/14	3	Tamale	Record and stock keeping of all inventories.
Spray Operations TOT	23-26/03/15	4	Walawale	Spraying techniques, compliance, and data capture.
Training for SOPs	08-12/04/14	5	All 5 districts	Spraying techniques, compliance, and data capture.
AIRS Database Training	09-11/03/15	3	Tamale	Introduction to and use of the 2015 AIRS

<sup>2</sup> Supervisors (3), Spray Operators (135) and Team Leader (20)

Type of Training	Dates	Length (days)	Location	Brief Description
				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	05/03/15	1	Tamale	Managing insecticide poisoning at the health facility.
Fire/ Security Training	06-13/04/15	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.
Drivers training	12-/13/04/15	2	Tamale	Defensive driving techniques, safety requirements while driving a vehicle with insecticides.
Bio Monitoring Training	31/03/15 - 02/04/15	3	Tamale	Steps and procedures involved in conducting bio monitoring. This included correct pricking and blood-drawing, and correct time and mixing of reagent. Participant were also trained on how to interpret bio monitoring results.

Overall, the project trained 1,544 people (1,252 males, 292 females). The percentage of females trained increased from 18.1 percent in 2014 to 18.9 percent in 2015. It must be noted that the proportion of females trained to deliver IRS (27.8 percent) is much higher than the overall proportion of females trained (18.9 percent) because there was an effort to encourage females to be involved in spray activities. In the future, similar efforts will be made to encourage more females to be involved in IRS support roles and, importantly, supervisory roles. The statistics presented include the people trained to implement bio monitoring. Most staff that carried out bio monitoring were also trained in other aspects of the AIRS project; only two laboratory technicians who were trained in bio monitoring were not part of another AIRS training. Details of the number of people trained for the various IRS duties and bio monitoring are provided in Table 3.

The highlighted cells in Table 3 indicate trainees who qualify under the PMI indicator definition “number of people trained with USG [U.S. Government] funds to deliver IRS.”<sup>3</sup> In 2015, AIRS Ghana trained 698 people, 504 men, and 194 women to deliver IRS under PMI’s definition.

<sup>3</sup> 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 3. NUMBER OF PEOPLE TRAINED**

Categories of Persons Trained	Training on IRS Delivery										Other Trainings																
	Training of Trainers: Spray Ops		Spray Operations		Data Entry		Logistics & Store management		IEC Training of Trainers (TOT)		IEC Mobilisers Training		Medical Treatment Intoxication Training		Fire/ Security Training		Driver's Training		Total (without Bio monitoring training)			Bio monitoring training		Total (with Bio monitoring training)			
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	TOTAL	M	F	M	F	TOTAL	
DOC	5	0																		5	0	5	4	0	5	0	5
Disease Control Officers	5	0																		5	0	5			5	0	5
District Environmental Health Officers	5	0																		5	0	5			5	0	5
Environmental Protection Agency Rep.	1	0																		1	0	1			1	0	1
Spray operators			329	168																329	168	497			329	168	497
Team Leaders			72	20																72	20	92			72	20	92
Data Assistants					12	7														12	7	19	2	3	12	7	19
District M & E Assistants					5	1														5	1	6	1	0	5	1	6
Laboratory Technician																						0	2	0	2	0	2
Logistics Assistants							4	1												4	1	5			4	1	5
Store Assistants							3	14												3	14	17			3	14	17
Medical Assistants/ Prescribers													29	2						29	2	31	7	1	29	2	31
IEC Assistants									14	2										14	2	16			14	2	16
IEC Implementers, Mobilizers											642	73								642	73	715			642	73	715
Field Supervisors (Spray Ops)	42	4																		42	4	46			42	4	46
Site Managers	16	0																		16	0	16			16	0	16
Drivers																34	0			34	0	34			34	0	34
Guards														32	0					32	0	32			32	0	32
TOTAL M/F	74	4	401	188	17	8	7	15	14	2	642	73	29	2	32	0	34	0	1250	292		16	4	1252	292		
TOTAL/ training	78		589		25		22		16		715		31		32		34		1,542			20		1,544			

## 2.6.2 NUMBER OF PEOPLE HIRED

A total of 1,471 temporary staff were hired to deliver services during the 2015 IRS campaign. Of these, 306 were females and 1,165 were males, putting the percentage of female temporary hired staff at 20.8 percent. This is about the same as in 2014, when it was 21.0 percent.

Temporary staff hired in 2015 included 446 SOPs. The number of females hired for the position of SOP in 2015 increased to 135 (30.3 percent of total SOPs) from 125 (29.4 percent) in 2014 and 40 (13.8 percent) in 2013. The increase in 2015 compared to 2014 was not as large as expected due to the particularly low numbers of female SOPs that could be recruited from KD and MMD. The AIRS Ghana team will continue to implement strategies to further increase the participation of women in 2016 and future spray campaigns. Ghana has had particular success in hiring women as Store Assistants; over 80 percent of Store Assistants hired in 2015 were women.

In addition to the positions listed in Table 4, 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 community announcements in the evening before the day of spray and on the actual day of spray. CBS Volunteers took part in stakeholder meetings at the sub-district level and through these meetings acquired information about IRS and about their mobilization roles.<sup>4</sup>

**TABLE 4. NUMBER AND TYPE OF PEOPLE TEMPORARILY HIRED**

Category	Bunkpurug Yunyoo		East Mamprusi		Kumbungu		Mamprugu Moaduri		West Mamprusi		All			
	M	F	M	F	M	F	M	F	M	F	M	F	Total	% Female
Data Assistants	1	2	3	1	1	2	2	0	3	1	10	6	16	37.5%
Finance Assistants	1	0	0	1	1	0	1	0	0	1	3	2	5	40.0%
IEC Assistants	5	0	2	2	2	0	2	0	3	0	14	2	16	12.5%
Logistics Assistants	1	0	1	0	1	0	0	1	1	0	4	1	5	20.0%
Store Assistants	0	5	2	2	0	2	1	1	0	4	3	14	17	82.4%
Mobilizers	202	13	167	23	132	9	36	3	105	25	642	73	715	10.2%
Security officers	10	0	8	0	4	0	4	0	6	0	32	0	32	0.0%
Site Managers	5	0	4	0	2	0	2	0	3	0	16	0	16	0.0%
Spray Operators	71	29	79	46	57	13	33	8	71	39	311	135	446	30.3%
Supervisors	9	1	13	0	7	0	4	0	8	2	41	3	44	6.8%
Team Leaders	15	5	17	8	11	3	6	1	19	3	68	20	88	22.7%
Washers	0	12	0	12	0	4	0	4	1	9	1	41	42	97.6%
Water Fetchers	4	1	7	1	2	2	3	0	0	4	16	8	24	33.3%
M & E Coordinators	1	0	1	0	0	1	1	0	1	0	4	1	5	20.0%
<b>Total</b>	<b>325</b>	<b>68</b>	<b>304</b>	<b>96</b>	<b>220</b>	<b>36</b>	<b>95</b>	<b>18</b>	<b>221</b>	<b>88</b>	<b>1,165</b>	<b>306</b>	<b>1,471</b>	<b>20.8%</b>

<sup>4</sup> 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.

# 3. INFORMATION, EDUCATION AND COMMUNICATION ACTIVITIES

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## 3.1 INTRODUCTION

AIRS Ghana employed several IEC strategies to ensure a successful spray operation in 2015. These strategies included stakeholder meetings, community meetings, in-school programs, house-to-house mobilization, and radio announcements, discussions, and jingles. Community education aimed at resolving concerns, misconceptions, and the fatigue that goes with packing out belongings and re-packing after spraying was done. Based on commitments from some Chiefs during the pre-spray stakeholder meetings, efforts were made to use Chief representatives and influencers (Queen Mothers and Imams, Pastors, and other respected individuals from the community) to increase acceptance.

It is important to note some changes in the IEC strategy for 2015. This included involving one IEC Assistant per operational site, to begin sensitization one month before the spray operations, and the use of Chief's Emissaries to report daily spray progress to their respective chiefs. Influencers, mainly women, were also identified and used to encourage their communities to take advantage of the IRS program.

## 3.2 PRE-SPRAY STAKEHOLDER MEETINGS

Pre-spray stakeholder meetings were held on March 12-14 in each of the 16 sub-districts in the five targeted districts. Participants included community leaders, representatives from the District Health Office and the District Assembly, influential persons in the communities, mobilizers, and community members.

The main purpose of these meetings was to get feedback to enhance IRS operations, discuss the sub-district's spray coverage from the previous years, set benchmarks for improving coverage during the 2015 spray season, and devise strategies to overcome sub-district-level challenges of previous years' operations. The meetings were also an opportunity to highlight the role of district authorities and community leaders in the provision of infrastructure and office space for IRS activities.

For the first time in Ghana, an important decision taken at this year's pre-spray stakeholder's meetings was to have Chief's Emissaries accompany spray teams. This suggestion was made by some Chiefs and their representatives who attended the stakeholder meetings. The Emissaries were to report to their Chiefs on the progress of spray operations and spray coverage in their communities. The AIRS Ghana team welcomed this idea and implemented it in as many communities as possible. The Emissaries helped to persuade households in relatively resistant communities to accept spraying.



The Disease Control Officer, Kumbungu District, making a speech at a stakeholder's meeting.



Participants at a stakeholder's meeting in Kumbungu.

### 3.3 LAUNCHING OF 2015 SPRAY CAMPAIGN

AIRS Ghana launched the 2015 spray campaign in Kumbungu District, which was last sprayed in 2012. Kumbungu was one of the districts dropped in 2013 in the cost-saving move due to the need to switch from pyrethroid to a more expensive organophosphate insecticide. Residents of Kumbungu were supportive of the return of IRS to their district. Holding the launch there was a way to confirm and assure Kumbungu residents that IRS was back in the district.

The Guest of Honor, United States Agency for International Development (USAID) Acting Mission Director Mr. Andrew Karas pledged the U.S. Government's commitment to the fight against malaria. NMCP Medical Entomologist Mrs. Aba Baffoe-Wilmot called for community leaders to support the PMI AIRS project as IRS is one of the main malaria control interventions that the NMCP fully supports.

In his speech, PMI AIRS Ghana Chief of Party (COP) Dr. Yemane Yihdego declared the vision for the 2015 IRS spray campaign as working with community leaders to improve coverage. PMI AIRS Ghana Operations Manager Mr. Ernest Fletcher explained the 2015 spray plan and how communities have been scheduled to be sprayed in a systematic manner. He also briefly took invited guests through the household preparations, and safety and compliance procedures.



Scenes from the launch of the 2015 spray campaign in Kumbungu District. At left, USAID Acting Mission Director Mr. Andrew Karas exchanges greeting with Chiefs.

### 3.4 COMMUNITY MEETINGS

Based on lessons learned from previous years, the project adjusted 2015 timelines to have one month between the end of house-to-house mobilization and the start of spray operations. This allowed for intense community engagements and enough time for community-level sensitization and mobilization before the start of spray operations.

During the one month pre-spray and throughout the spray campaign, community meetings (Table 5) were held across all communities in the 16 operational sites, especially in communities perceived to be resistant to IRS based on information from previous spray seasons and house-to-house mobilization.



Community meeting at Takuka, West Mamprusi

The target audiences and groups for these meetings were traditional leaders, religious and opinion leaders, village savings and loans associations, farmers, dressmakers, hairdressers, traders, youth, and Ataya (tea drinking) groups. The meetings aimed to sensitize communities so members would understand the IRS program, its benefits, and the need to meet the target of more than 90 percent community spray coverage in order to have a good impact from IRS. During these meetings, community leaders were assigned to ensure that needed spray targets are met. District Assembly personnel assisted with getting resource persons to be part of these meetings especially in difficult areas.

**TABLE 5. NUMBER OF COMMUNITY MEETINGS HELD AND NUMBER OF ATTENDEES**

District	No. of Meetings	Dates	Total No. of Attendees
Bunkpurugu-Yunyoo	220	March 15 – May 22	2,963
East Mamprusi	38	March 15 – May 22	580
Kumbungu	41	March 15 – May 22	2,820
Mamprugu Moaduri	60	March 15 – May 22	212
West Mamprusi	108	March 15 – May 22	1,495
<b>TOTAL</b>	<b>467</b>		<b>8,070</b>

### 3.5 COMMUNITY EDUCATION

AIRS Ghana recruited IEC Assistants one month prior to spray to carry out community education events in their designated operational sites. The events enabled communities to understand what IRS is, how it works as a preventive intervention, the malaria cycle, and how malaria affects susceptible groups such as children under the age of five, pregnant women, and the aged. IEC Assistants conducted the events door-to-door, and in churches, mosques, schools, and other public places, where it was easy to get the attention of audiences as shown in Table 6.

**TABLE 6. NUMBER OF COMMUNITY EDUCATION EVENTS**

Activity	Bunkpurugu Yunyoo	East Mamprusi	West Mamprusi	Kumbungu	Mamprugu Moaduri	Total
Door-to-door outreach	660	213	150	15	610	1,648
Information van (communities visited)	40	20	60	53	-	173
Educational outreach (primary, JHS, SHS, voc/ tech. schools visited)	96	8	12	10	18	144
Mosque and church outreach	109	25	50	15	20	219

### 3.6 RADIO PROGRAMS AND VIDEO SHOWS

Multimedia used for the 2015 IRS campaign included radio and video. The project used three radio programming approaches: spots/jingles, discussions, and announcements. Radio spots carried messages about IRS and its benefits. Topics addressed concerns of communities raised during a focused group discussion in 2014 and explained the precise steps households should take before, during, and after their homes were sprayed. The spots were aired three times a day from April 6 through May 23.

Interactive radio discussions were led by AIRS Ghana DOCs, AIRS Ghana IEC Assistants, District Assembly representatives, DHMT representatives, Pastors, Imams, leaders of youth groups, and Chiefs led the discussions. The discussions alerted communities to the upcoming spray exercise, and addressed their concerns, misconceptions, and issues with fatigue. They also educated communities about malaria, its effects, and how IRS is effective for preventing malaria. They discussed achieving the NMCP target of 90 percent or above in spray coverage per community, and household preparation, safety, and compliance. Radio announcements about communities scheduled to be sprayed were made throughout the spray period.

The project used the following radio stations: Eagle FM (covering West and East Mamprusi districts) and Simli Radio (covering Kumbungu and Mamprugu Moaduri districts). Tizaa Radio and Lom FM were also used during the campaign to cover Nalerigu and Bunkpurugu townships. As part of efforts to improve spray coverage in some communities in East and West Mamprusi and parts of Bunkpurugu-Yunyoo, especially urban areas, there was a live radio broadcast held across four districts that fell under the jurisdiction of the Overlord of Mamprugu Traditional Kingdom, The Naa Yiri. He used the broadcast to encourage the people of the Mamprugu Kingdom, especially those in Nasia, Janga, Nalerigu, Gmabaga, Langbinsi Walewale, and Takuka, where there was resistance to IRS, to accept spraying. Kumbungu District was not included in the live broadcast because it is not under the jurisdiction of the Overlord of Mamprugu.

All radio initiatives were carried out in the local language to ensure full understanding and participation of community members. Monitoring of the radio initiatives in terms of timing and adequate slots were successfully carried out by the IEC team (AIRS Ghana IEC Assistants and fulltime IEC Coordinator) at the community, district, and regional levels.

The project used video shows across the targeted districts as part of a larger community education strategy to explain to beneficiaries the effects of malaria on children under five, the malaria cycle, and the importance of IRS as a malaria control strategy in breaking this cycle. Communities were educated before and during the spray campaign. The project showed the videos in areas where AIRS Ghana had

encountered difficulties with acceptance in the past. The project aired USAID documentaries on severe malaria in children under five with permission from FHI360 (links to videos are in the footnote).<sup>5</sup> There were also videos on the malaria cycle and one produced by Hudson X-Pert sprayer. Videos were shown in the evenings at Chief palaces. Table 7 shows the number of radio programs, videos, and print materials distributed during the campaign.

**TABLE 7. IRS RADIO PROGRAMS, VIDEO SHOWS, AND IEC MATERIALS DISTRIBUTED**

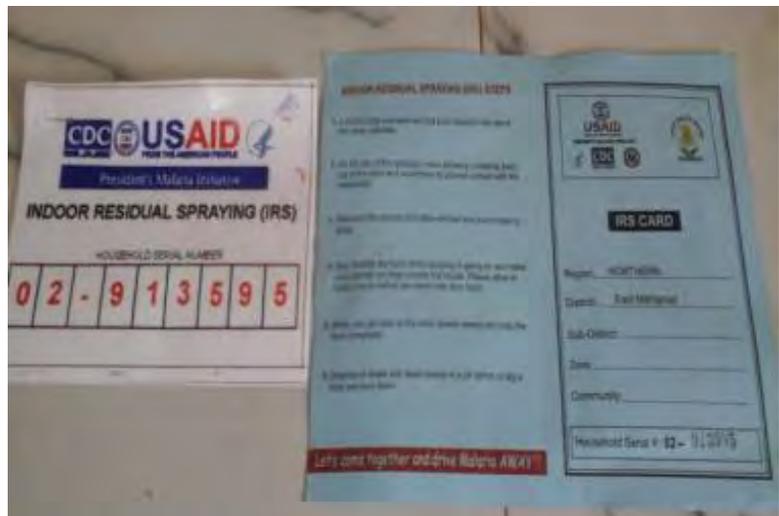
Activity	Total number
Radio spots; jingles (before, during, and after spray)	513
Radio programs (interactive shows)	11
Radio Announcements	298
Video shows	34
IRS materials distributed (to public places)*	856

\* 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 8.

### 3.7 HOUSE-TO-HOUSE MOBILIZATION

House-to-house mobilization began on March 5 and lasted for six days in all targeted districts. New household IRS cards were distributed and are to be used until 2017.

The AIRS Ghana program trained and engaged a total of 715 mobilizers who reside in the targeted communities. The role they played was to visit every compound within their community with IRS messages and through a face-to-face interaction do the following: 1) demystify and correct any misconceptions about IRS, and further educate households on their roles and responsibilities before, during, and after their house was sprayed; and 2) ask households if they would accept IRS.



House sticker and IRS card used during the 2015 IRS campaign.

During enumeration, mobilizers collected household data on the number of people reached with IRS messages, provided each household with an IRS card, and placed a sticker on the wall to give a unique identity to the compound. During the spray campaign, mobilizers ensured that community members were informed in advance about spray dates for their communities. On the day of spray, mobilizers helped do door-to-door checks on households to ensure that each household was ready for spraying; in some cases, they helped households pack out their belongings.

<sup>5</sup> <https://drive.google.com/file/d/0B3skqck1FayQUE9KbTBIdUg2dIU/view?usp=sharing>  
<https://drive.google.com/file/d/0B3skqck1FayQR3FTbEMtbTdaN0U/view?usp=sharing>  
<https://drive.google.com/file/d/0B3skqck1FayQSmNiMXdZOGltcWc/view?usp=sharing>

In drawing the attention of their communities to the spray operations, mobilizers put up posters in public places such as around mosques, churches, markets, health facilities, and other meeting places. Flyers with information on household preparations, safety, and compliance were distributed to households to reinforce messages given. The team distributed more flyers in Kumbungu than elsewhere because the district had a gap in IRS and required additional reinforcement at an earlier stage. The Gong Gong, a traditional way of mobilizing communities using a drum, was heavily used this year in mobilizing communities on the evenings prior to spraying as well as on the day of spray. This was done to make sure that community members were well informed about the scheduled visit or revisit of spray teams to their communities with exception of people who traveled to remote areas and locked their rooms. Table 8 demonstrates results of house-to-house mobilization.



Mobilizers and household head interact outside a compound.



A Gong Gong beater makes spray schedule announcement.

**TABLE 8. 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	14,540	14,527	24,381	28,767	53,148	4,564
East Mamprusi	14,473	14,457	25,123	29,622	54,745	3,205
Kumbungu	7,858	7,834	20,160	22,473	42,633	14,167
Mamprugu Moaduri	3,685	3,670	7,442	8,056	15,498	980
West Mamprusi	10,887	10,877	22,914	25,926	48,840	2,561
<b>TOTAL</b>	<b>51,443</b>	<b>51,365</b>	<b>100,020</b>	<b>114,844</b>	<b>214,864</b>	<b>25,477</b>

### 3.8 MITIGATING CONCERNS ABOUT IRS

A strategy adopted prior to the start of spray operations was to work closely with Chiefs and district officials during the spray campaign. Chiefs nominated Emissaries to accompany spray teams and mobilizers to encourage their people to accept spraying. While the community was being sprayed, the Emissaries gave regular reports on spray progress to their Chief. Disease Control Officers together with

Environmental Health Officers supervised spray operations in their districts and made recommendations to the project.

A common complaint that the project together with Chiefs and district health and assembly officials had to deal with was the smell of the insecticide. This became a major concern that took a lot of education and persuasion to overcome by the combined team. Gradually, community members came to understand how the benefits of IRS outweigh the temporary annoyance of the odor.

Complaints about fatigue were dealt with by showing appreciation for efforts made by households to pack out their belongings. Emphasis again was on how the benefits of IRS outweigh the discomfort of a few hours spent packing belongings out and back into the home.

Mothers with children under the age of five and pregnant women were made aware of the threats malaria posed to their children due to their level of immunity. This was an effective way of convincing such targeted groups to accept spraying. The District Disease Control Officers were very helpful in this respect.

District Assemblies helped in identifying community-based women influencers. These women included Queen Mothers who command the respect of their communities and are well listened to. Some of these women allowed spraying of their houses for the first time and urged others do the same. In the future, this strategy will be to identify more women influencers as well as youth influencers. The youth, in particular, are a very difficult group to convince to grant access to their rooms for spraying.

District Information Services Departments also worked with the project to address concerns, misconceptions, and fatigue issues in the five targeted districts. Audio messages addressing these issues were played using public announcement systems throughout the communities.

### 3.9 MONITORING OF IEC/BCC ACTIVITIES

The project staff jointly with district officials and community leaders monitored mobilization efforts. Disease Control Officers, 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 Environmental Health Officers also supervised the adherence of households to safety information they had received on what to do during and after the spray exercise. During spray operations, Team Leaders and Field Supervisors used a daily tracker 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. Shortcomings were reported to DOCs and/or IEC Assistants, and were corrected.

## 4. IMPLEMENTATION OF IRS ACTIVITIES

### 4.1 SPRAY CAMPAIGN

AIRS Ghana implemented 2015 IRS in five targeted districts in the Northern Region (Bunkpurugu-Yunyoo, East Mamprusi, Kumbungu, Mamprugu Moaduri, and West Mamprusi). Following the IRS launch in Kumbungu District, spray operations began simultaneously on April 14 in 15 operational sites across the five districts. A conflict in Bunkpurugu town (the sixteenth operational site) started just before the start of spray operations, and spray operations there were put on hold until April 27, when clearance was received from the security forces for spraying to begin. The spray campaign was scheduled to last 30 days. However, due to low spray coverage at some operational sites, the delay in Bunkpurugu, and a temporary withdrawal of some SOPs due to bio monitoring, spray operations were extended by five days from May 18 (day 30 of spray operations) to May 23.

By the end of the campaign, SOPs had found 224,592<sup>6</sup> structures and sprayed 205,935 of them for an overall spray coverage of 91.7 percent. Table shows the targets for each district, structures found and sprayed, and the coverage. It also shows the number of spray days for each district.

**TABLE 9. 2015 STRUCTURES SPRAYED IN FIVE DISTRICTS**

District	Targeted No. of Structures (based on structures found by SOPs in 2014)	Structures Found by SOPs	Structures Sprayed	Spray Coverage	Targeted Population (based on structures found by SOPs in 2014)	Pop. Protected	No. of Spray Days
Bunkpurugu-Yunyoo	53,269	52,844	50,417	95.4%	126,661	124,592	35
East Mamprusi	66,725	66,098	60,283	91.2%	181,147	167,149	35
Kumbungu	35,954	33,546	31,333	93.4%	84,309	82,614	35
Mamprugu Moaduri	17,393	20,366	18,478	90.7%	47,147	50,016	35
West Mamprusi	58,004	51,737	45,424	87.8%	157,442	129,583	35
<b>Total</b>	<b>231,345</b>	<b>224,592</b>	<b>205,935</b>	<b>91.7%</b>	<b>596,706</b>	<b>553,954</b>	

<sup>6</sup> This figure includes estimates for the number of structures found/unsprayed 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.

## 4.2 MONITORING AND SUPERVISION

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 different stages of the spray campaign. The COP, Operations Manager, M&E Manager, Database Manager, IEC Specialist, 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.

All supervisors used standardized AIRS supervision and monitoring tools to assess the spray quality, environmental compliance activities, and spray data collection. The tools are described further in Table 10.

A monitoring and supervision schedule was developed and used during the 2015 spray campaign. The schedule showed the role of specific individuals, 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, Field Supervisors, and Site Managers.

**TABLE 10. SPRAY CAMPAIGN SUPERVISORY TOOLS**

<b>Supervisory Tool</b>	<b>Purpose and Person Responsible</b>
Morning Mobilization and Transport	<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 Clean-Up	<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 Preparation and SOP Performance Checklist	<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 Checklist	<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>

In 2015, all data collected during supervisory visits were collected using smart phones. The program procured 32 Galaxy pocket smart phones (two for each operational site) for this purpose. Site Managers

and Field Supervisors were primary users of the phones during the spray campaign. In addition, smart phones were bought for the AIRS ECO and other senior supervisors to use during supervision. Some staff had the tools installed on their personal phones. Details on smart phone data collection are provided in Section 4.5

## 4.3 DATA REPORTING

Spray data were collected and entered into the AIRS database on a daily basis. SOPs collected the data. Team Leaders checked and verified data cards. Further checks were completed by the Field Supervisors, District M&E Assistants, and Data Entry Assistants before the data were entered into the database. The project shared weekly IRS progress reports with the Home Office and PMI.

## 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 for each item with details of transactions, quantities involved, dates, and destination. Supervisors (COP, DOC, ECO, Operations Manager, Logistics Coordinator, and Site Managers) regularly conducted physical stock counts to ensure that the actual stock corresponded with records on stock cards.

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

Insecticide trackers were used each morning to record the quantities of Actellic bottles received by each Team Leader. At the close of each spray day, Store Assistants recorded the number of full and empty bottles returned in the tracker, and thereafter transferred the data onto the stock cards, and the corresponding adjustments were made to match the physical stock.

## 4.5 MOBILE DATA COLLECTION AND REPORTING (MHEALTH)

The use of mobile phones for data collection and reporting has become an integral part of many current projects. In 2015, AIRS Ghana implemented three data collection and reporting tasks with the use of mobile technology:

- SMS job aid messaging
- The daily performance monitoring tool (PMT), for spray data reporting via SMS
- Field supervision reporting using phone-based supervisory checklists

The SMS job aid was introduced and used primarily to remind spray teams of standard spraying protocols and key environmental compliance issues. Through the SMS job aid system, notices and information were sent out 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 and targeted messages were sent out to each group throughout the campaign. Table 11 gives examples of the job aid messages sent out to different categories of spray team members between May 6 and 9. Spray team members received the messages on their personal phones.

**TABLE 11. SAMPLE 2015 SPRAY CAMPAIGN JOB AID MESSAGES**

Message	Group Sent To	Time Sent
<i>Good morning! Remember the spray target is 18 or more structures per day. Thanks for the good job.</i>	SOPs	before 7AM
<i>Full PPE use remains mandatory for the duration of the spray operation.</i>	SOPs, Team Leaders	before 7AM
<i>Please remember to remove food items from the room before you spray. Only heavy, non-edible, bulky items should be packed in the center of the room and covered with the coversheet before spraying.</i>	SOPs	before 7:30AM
<i>Eating, drinking or smoking during the spraying period will result in dismissal. It is not allowed.</i>	SOPs, Team Leaders	before 7AM

Receipts of SMS job aid messages were monitored by supervisors through interactions with spray team members during field supervision. The major challenge was that some messages arrived later than expected due to slow network connectivity around some operational sites. SOPs could not read their messages because their phones were off due to frequent power outages that prevented them from charging the phones. The lesson learned will be to better time messages to the recipients and ensure that they can charge their phones while they are at the operational sites cleaning up at the end of the day. It should be noted that prior to the SMS job aid, AIRS Ghana had used the *WhatsApp* application to communicate with the DOCs and Site Managers. It served the purpose very well especially when immediate action was required.

Also for the first time in Ghana, SMS-based daily PMT to report spray data was introduced in addition to the paper-based performance tracking sheet used 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. The four key indicators reported with PMT 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 was to provide the senior management team with real-time information on daily performance and enable quick corrective decisions to improve ongoing spray operations. For example, the decision to extend the number of spray days at some of the operational sites was first discussed based on data reported through the PMT. At least two meetings with the West Mamprusi District Health Directorate were initiated based on the reports submitted through the daily SMS. Also, because of the rapid nature of reporting, the IEC teams were able to have a daily picture of what happened on the field and were able to plan which communities to revisit to ensure that coverages improved. Data reported through the PMT were shared daily with the COP, Operations Manager, and some home office staff including the Director of Operations. Once a week, the NCMP, Regional and district health management teams received summary email updates as well. The project supplied each Site Manager with a simple java-enabled phone for this purpose.

Finally, AIRS Ghana introduced a mobile version of the supervisory tools. The purpose of this 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 the Android-based smart phones using Open Data Kit, a free and open-source set of software tools. Though this technology is not new to AIRS Ghana, its usage in previous campaigns was limited to the ECO for pre-spray, during, and post-spray environmental compliance inspection. In 2015, its usage was extended to all AIRS technical staff, spray team Field Supervisors, and Site Managers. Field Supervisors used it to conduct SOP performance and homeowner preparation checks. Site Managers used it to supervise daily morning mobilization and storekeepers' performance and conduct end-of-day cleanup inspection. The ECO used the system for pre-season environmental compliance assessment (PSECA), vehicle inspection, and post-spray site inspection and certification. The AIRS technical team used the system to supervise all aspects of the

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. Some of the actions taken based on the reports from the mobile data supervisory tool include the decision to replace some of the Goizper pumps with Hudson pumps. There were lots of “pump leakage” reports. Sites that had these reports were visited for further details. Eventually, some pumps had to be changed.

Within the first two weeks of spray operations, it was observed that some supervisors were not comfortable using touch screen phones and were sending wrong reports. It was also observed that some Field Supervisors and Site Managers did not understand questions well. The project team addressed these issues fully during the campaign through refresher trainings and on-site feedback. The half-day training initially provided to supervisors and Site Managers was not enough for new users to fully understand the operation of the system.

## 5. POST-SPRAY ACTIVITIES

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### 5.1 POST-SPRAY STAKEHOLDER MEETINGS

At the end of the spray activities, the project organized post-spray stakeholders meetings in all five districts at the sub-district level (June 8 to 12<sup>th</sup>). During the meetings, AIRS Ghana shared the 2015 spray results, best practices, and lessons learned, and discussed the way forward in the next cycle of the IRS campaign. It was also an opportunity to show appreciation to all stakeholders and beneficiaries for their support. In all of these meetings, it was very clear that stakeholders and beneficiaries appreciated PMI's assistance for the various malaria control interventions and they hoped to witness a continual scale-up of the IRS program.

Some Chiefs in attendance attributed the success of the 2015 spray campaign to stronger community and institutional collaboration than in previous years. To show their commitment in the coming years, Chiefs indicated that they would summon community members who refused to spray their rooms.

One concern of the stakeholders, which may have led to refusals in some households, was the odor of the insecticide. Some participants at the stakeholder meetings urged the project to improve upon the smell of the insecticide to increase number of houses to spray.

A national post-spray evaluation meeting will be held in Tamale in August 2015. Participants will include the NMCP, AngloGold Ashanti, Regional Health Directorate, District Health Directorate, and EPA. The objectives of this meeting will be to:

- Present the performance of 2015 spray operations to stakeholders
- Share best practices and challenges from the 2015 IRS campaign

### 5.2 DEMOBILIZATION

After the 2015 spray campaign, all logistical items were moved from the various operational sites to either the district stores or the central warehouse in Tamale within two weeks of the end of operation.

Rinsing barrels were cleaned and kept at all operational sites. All waste items (including used nose masks, hand gloves, and empty Actellic 300 CS bottles) were transported to the main district stores to await proper final waste disposal. The project transported leftover stock of full Actellic 300 CS bottles (2,334 bottles) from the district warehouse to the central warehouse in Tamale. Final inventory shows that the project has a total of 11,349 bottles of Actellic left over at the end of the 2015 campaign.

Other post-spray activities are captured in chapters 6 (entomology) and 7 (environmental compliance).

# 6. ENTOMOLOGY

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This chapter summarizes activities conducted between January and May 2015. The AIRS entomology team worked closely with the GHS and District Assemblies to implement all planned field activities. AIRS Ghana also partnered with the NMIMR for support in advanced molecular evaluations.

## 6.1 SENTINEL SITES

Five districts are being used as entomological monitoring districts in 2015. Tolon Kumbungu District was split into two districts, Tolon and Kumbungu. Fourteen corresponding communities have been used as sentinel sites (including three control sites) for the entomological monitoring activities. The districts and their corresponding communities selected for the entomological surveillance are presented below:

### **IRS Districts:**

- Bunkpurugu-Yunyoo District (BYD): Bunbuna, Yunyoo, Nasuan, and Sanbiruk
- Kumbungu District (KD): Gbullung and Gupanerigu

### **Districts without IRS:**

- Savelugu-Nanton District (SND) : Diare, Nanton, and Tarikpaa (IRS was withdrawn in 2015)
- Tolon District (TD): Dimabi and Woribugu (IRS was withdrawn in 2013).
- Tamale Metropolis (TML): Kulaa, Tugu, and Yong (comparison communities)

Activities conducted during the period (January-May 2015) 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 vector density, behavior and longevity

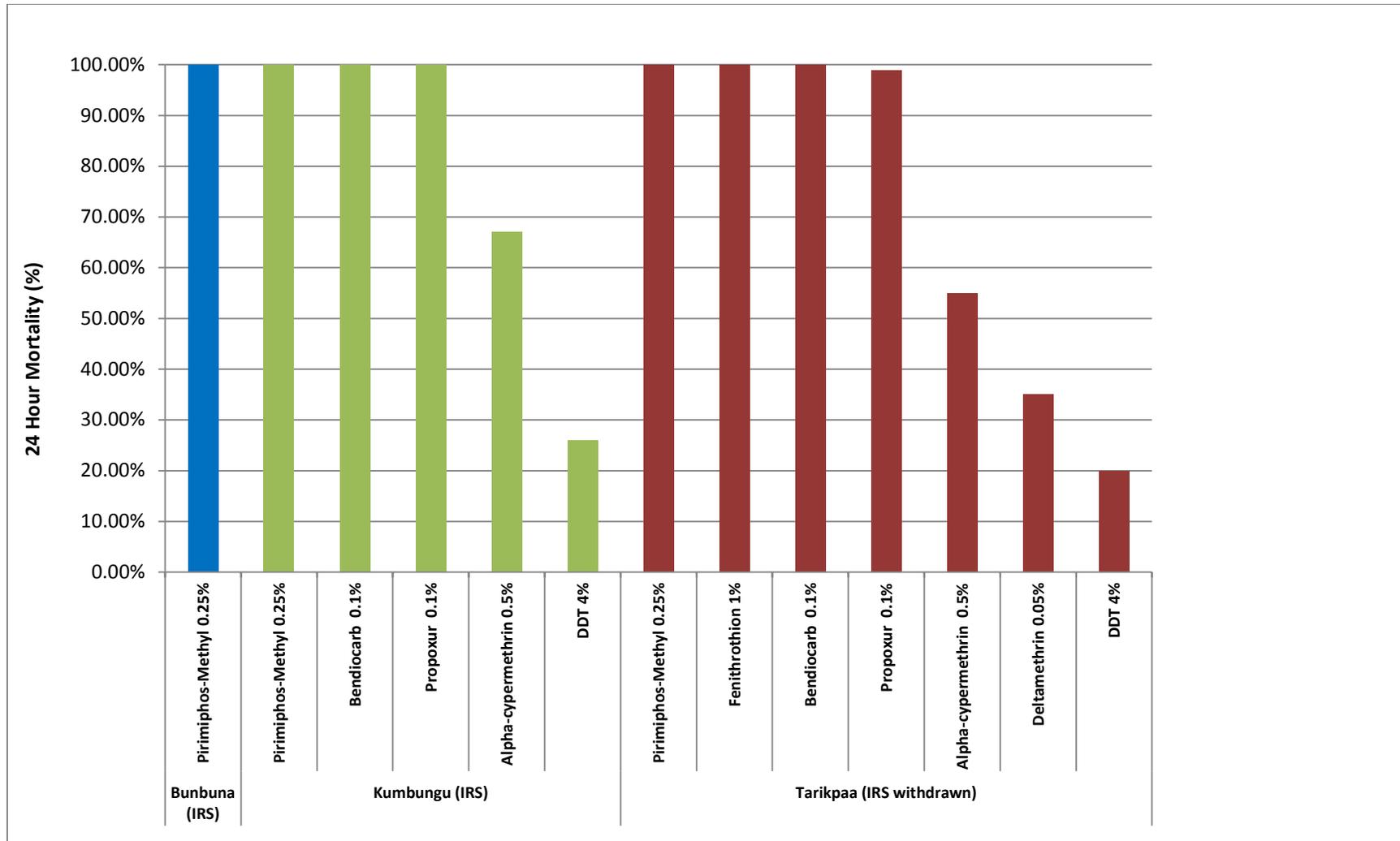
## 6.2 INSECTICIDE SUSCEPTIBILITY TESTS

Prior to the start of IRS operations, the susceptibility of local wild *An. gambiae* s.l. species collected from the IRS sentinel communities to selected World Health Organization (WHO)-approved insecticide for IRS was assessed using the WHO tube assay methodology.

The insecticides tested were; pirimiphos methyl 0.25 percent, alphacypermethrin 0.5 percent, deltamethrin 0.05 percent, bendiocarb 0.1 percent, propoxur 0.1 percent, fenitrothion 1% 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 between March and April are presented in Figure 1. They show that the local vector species from the IRS communities were susceptible to the pirimiphos methyl as well as the other organophosphate insecticide (fenitrothion) tested. Local *An. gambiae* s.l. from all the sites tested appeared resistant to all the pyrethroids (alpha cypermethrin and deltamethrin) tested. The tests are ongoing and results will be updated when completed.

**FIGURE I. INSECTICIDE SUSCEPTIBILITY RESULTS, LOCAL AN. GAMBIAE S.L. MOSQUITOES, THREE SITES**



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

As part of the AIRS programs' quality check, standard WHO cone assays were conducted to test the quality of work by the different spray teams and to evaluate the potency 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

The quality assurance tests were conducted in eight communities:

- Bogupaligu, Gbullung, and Gupanerigu in Kumbungu District
- Naa Nori in East Mamprusi
- Guabuliga in West Mamprusi
- Nanponti-Bauk, Bunbuna, and Yunyoo in Bunkpurugu-Yunyoo

To remove bias arising for spray operator efficiency, the project selected houses sprayed by different spray operators from 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). To obtain information about the performance of the sprayed insecticide on wood surfaces, cone bioassays were conducted on the wooden doors or windows of each room selected for the cone bioassay.

In Bogupaligu, Gupanerigu, and Gbullung (Kumbungu), wall bioassays were conducted using both laboratory raised Kisumu strain and wild female adults of *An. gambiae* s.l. reared from larvae collected from project districts. All were 2-5 days old. In Naa Nori, Guabuliga, Nanponti-Bauk, Bunbuna, and Yunyoo wall bioassays were conducted using the Kisumu mosquitoes only, since it was difficult collecting enough wild mosquito larvae from these areas and raising them for the wall bioassays. This is because the areas had not received sufficient rain and breeding habitats were scarce at the time of larval collections and the bioassays. To assess the spray quality on the different wall surfaces in each room, three walls of the room were tested by fixing the cones at a height of about 1.5 m on each wall. Three cone assays were carried out in each sampled 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 bioassay 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 300 CS formulations, the control tests were set up in unsprayed structures with fairly similar conditions (relative humidity and temperature) as the rooms been tested.

The cone exposure chamber was fastened to the selected spot on the surface to be tested with tape. 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.

The mosquitoes were all brought to the AIRS entomology laboratory where the temperature and relative humidity were maintained at 25°C-29°C and 75 percent-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 Abbott'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.

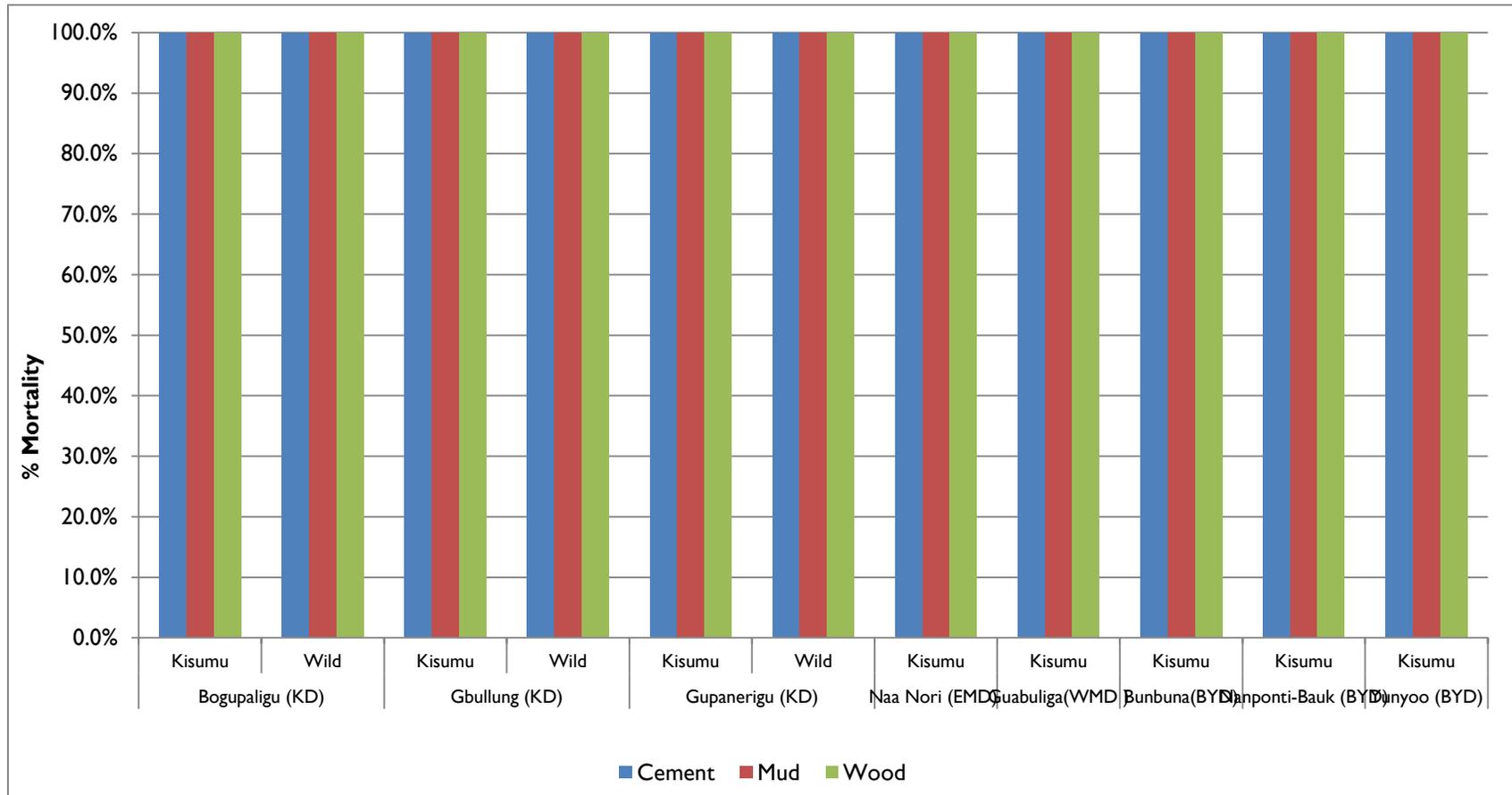
### 6.3.2 RESIDUAL EFFICACY OF ACTELIC 300 CS

In May 2015, one month after spraying, follow-up bioassays were conducted to assess the residual efficacy of pirimiphos methyl sprayed across all sites using susceptible Kisumu colonies from the AIRS insectary and the insectary of the Navrongo Health Research Center as well as wild *An. gambiae* collected from Bogupaligu, Gupanerigu, and Gbullung communities.

### 6.3.3 RESULTS

The spray quality was indirectly estimated from the percentage mortality of the exposed mosquitoes from the WHO cone bioassay on the different types of sprayed surfaces (mud, wood, and cement). The results for the tests are presented in Figures 2-10. Mortality was 100% in all houses sampled. Pirimiphos methyl was shown to have airborne effect on mosquito mortality and the contribution of the airborne effect of the insecticide might also have a contribution. However, there was no airborne effect after one month (data not shown) while mosquito mortality exposed to the sprayed walls was still 100% (see decay rate data, fig 3-10).

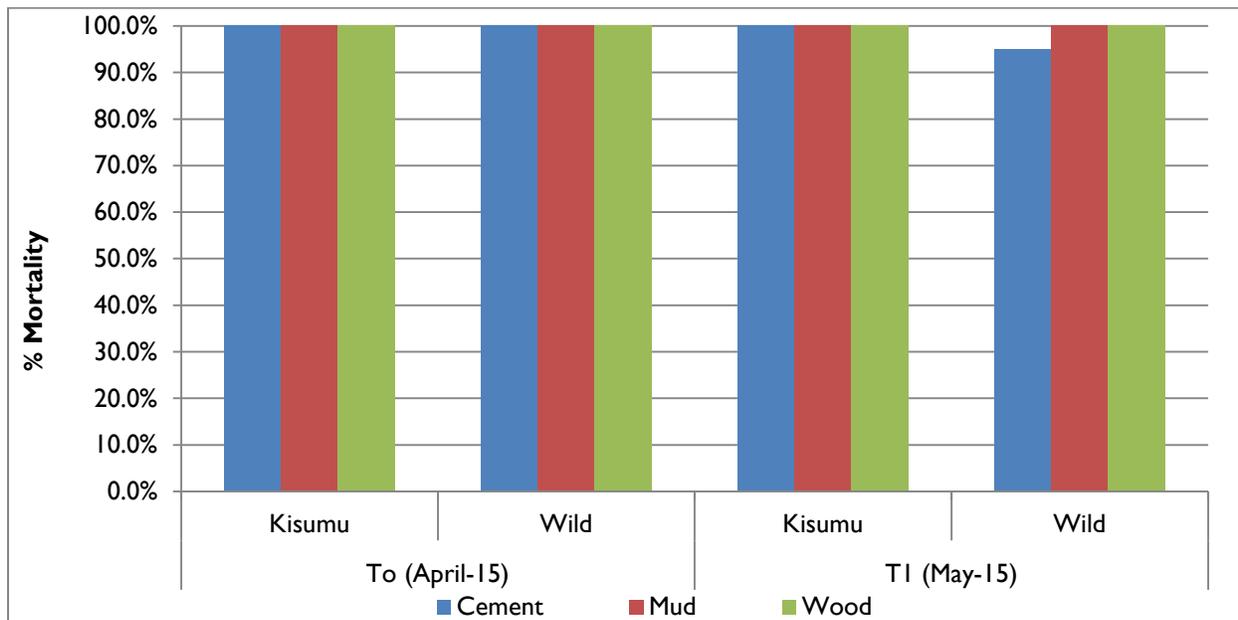
**FIGURE 2. PERCENTAGE MORTALITY OF AN. GAMBIAE S.L., CONE WALL BIOASSAYS OF 2015 SPRAY QUALITY CHECK, 1-2 DAYS AFTER SPRAY**



Note:

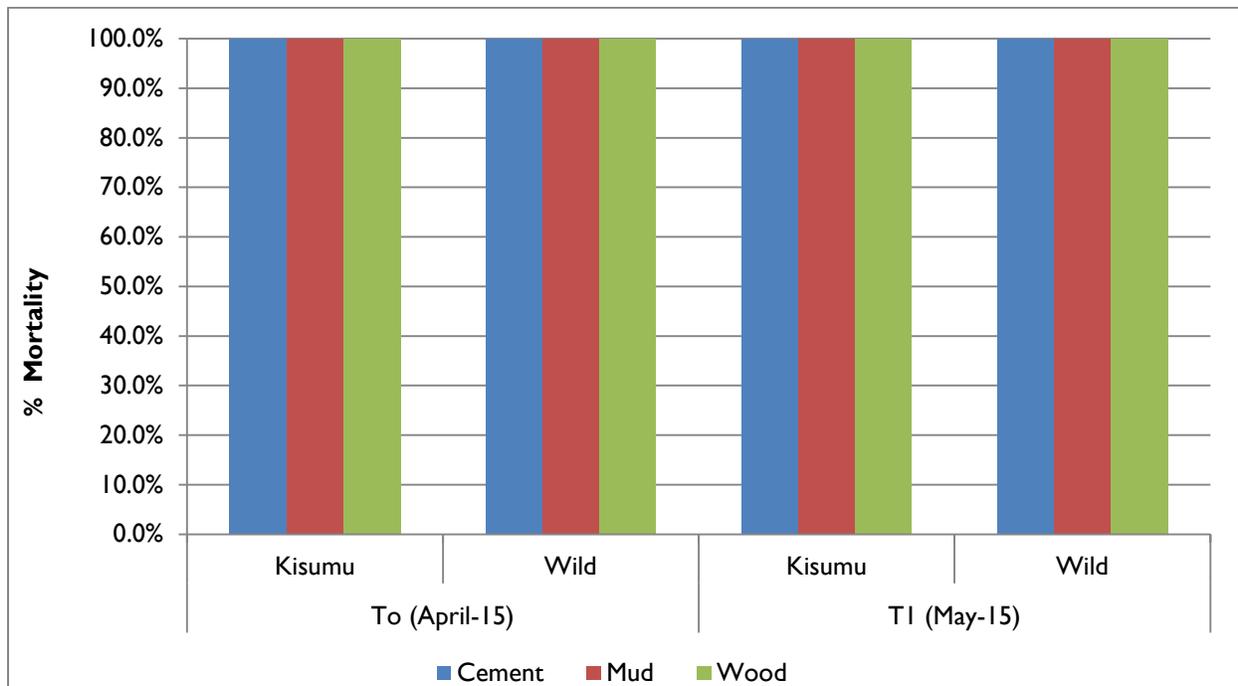
- Bogupaligu:** sprayed on 04/14/2015 and tested on 04/15-16/2015;
- Guabuliga:** sprayed on 04/16/2015 and tested on 04/17/2015;
- Naa Nori:** sprayed on 04/18/2015 and tested on 04/19/2015;
- Gbullung:** sprayed on 04/18 and 20/2015 and tested on 04/21/2015;
- Nanponti-Bauk:** sprayed on 04/20/2015 and tested on 04/21/2015;
- Bunbuna:** sprayed on 04/24/2015 and tested on 04/25/2015;
- Yunyoo:** sprayed on 04/25/2015 and tested on 04/26/2015;
- Gupanerigu:** sprayed on 04/25/2015 and tested on 04/26-27/2015.

**FIGURE 3. DECAY RATE (% MORTALITY OF WILD AN. GAMBIAE S.L. AND 'KISUMU' STRAIN AN. GAMBIAE S.S.) BOGUPALIGU, 1 MONTH AFTER SPRAY, MAY 2015**



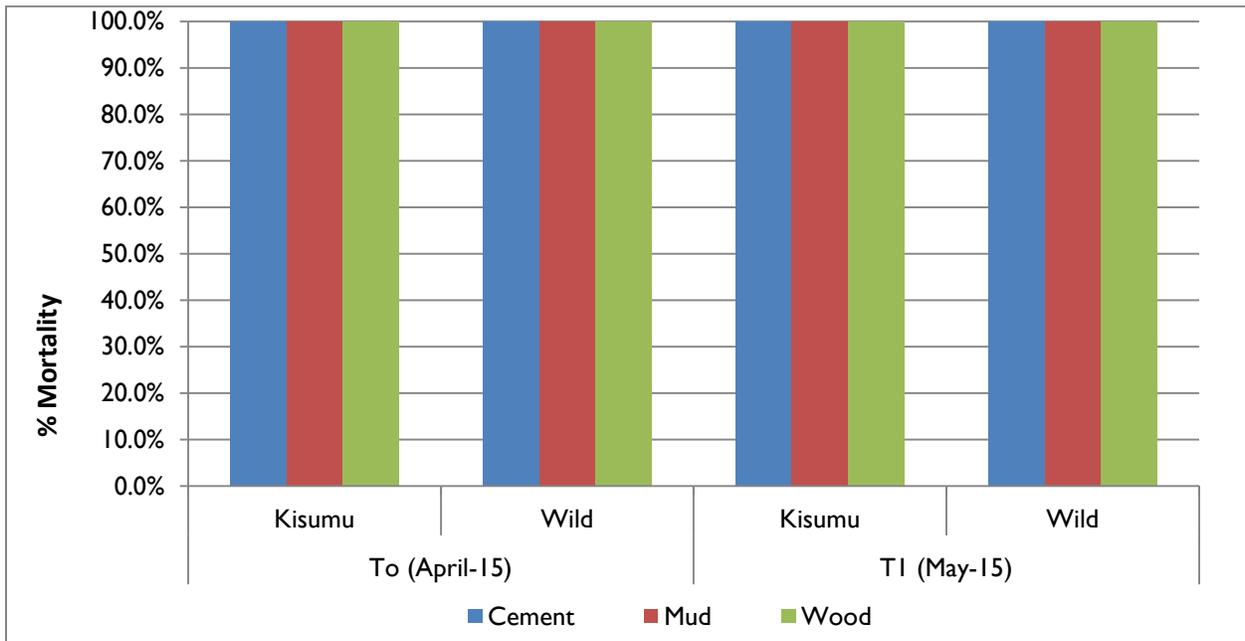
Note: sprayed on 14th April 2015.

**FIGURE 4. DECAY RATE (% MORTALITY OF WILD AN. GAMBIAE S.L. AND 'KISUMU' STRAIN AN. GAMBIAE S.S.), GBULLUNG, 1 MONTH AFTER SPRAY, MAY 2015**



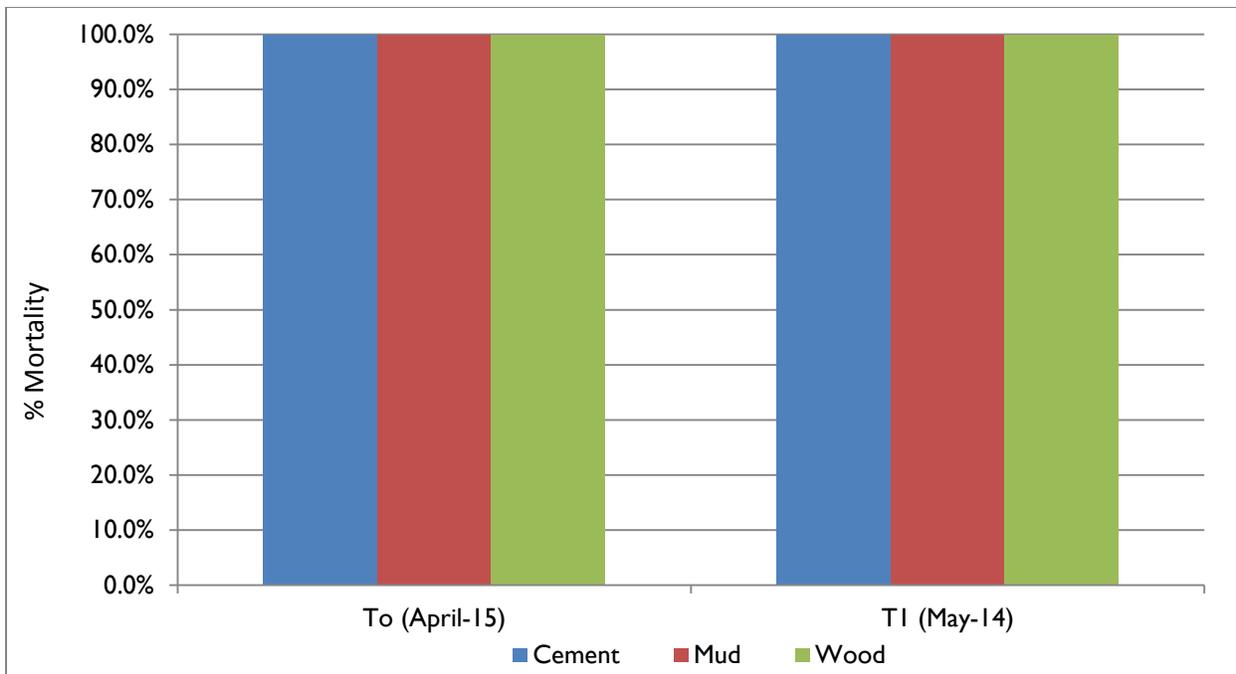
Note: sprayed on 18<sup>th</sup> and 20<sup>th</sup> April 2015.

**FIGURE 5. DECAY RATE (% MORTALITY OF WILD AN. GAMBIAE S.L. AND 'KISUMU' STRAIN AN. GAMBIAE S.S.), GUPANERIGU, 1 MONTH AFTER SPRAY, MAY 2015**



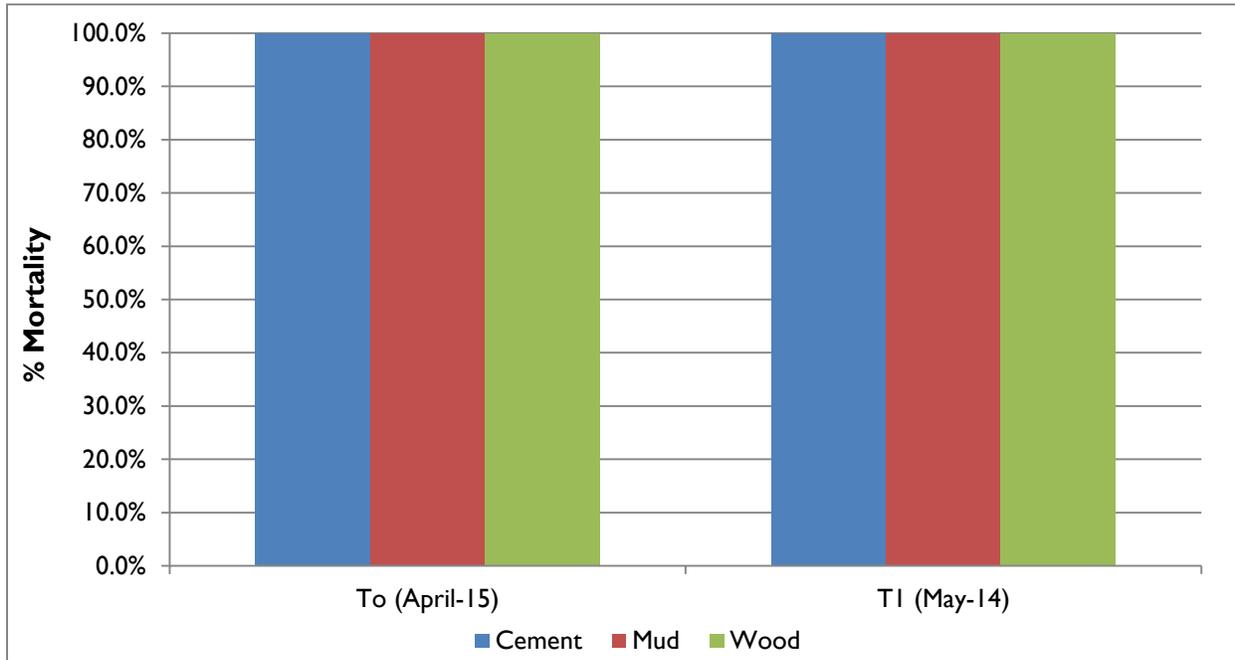
Note: sprayed on 25<sup>th</sup> April 2015

**FIGURE 6. DECAY RATE (% MORTALITY OF AN. GAMBIAE S.S. 'KISUMU' STRAIN), GUABULIGA, 1 MONTH AFTER SPRAY, MAY 2015**



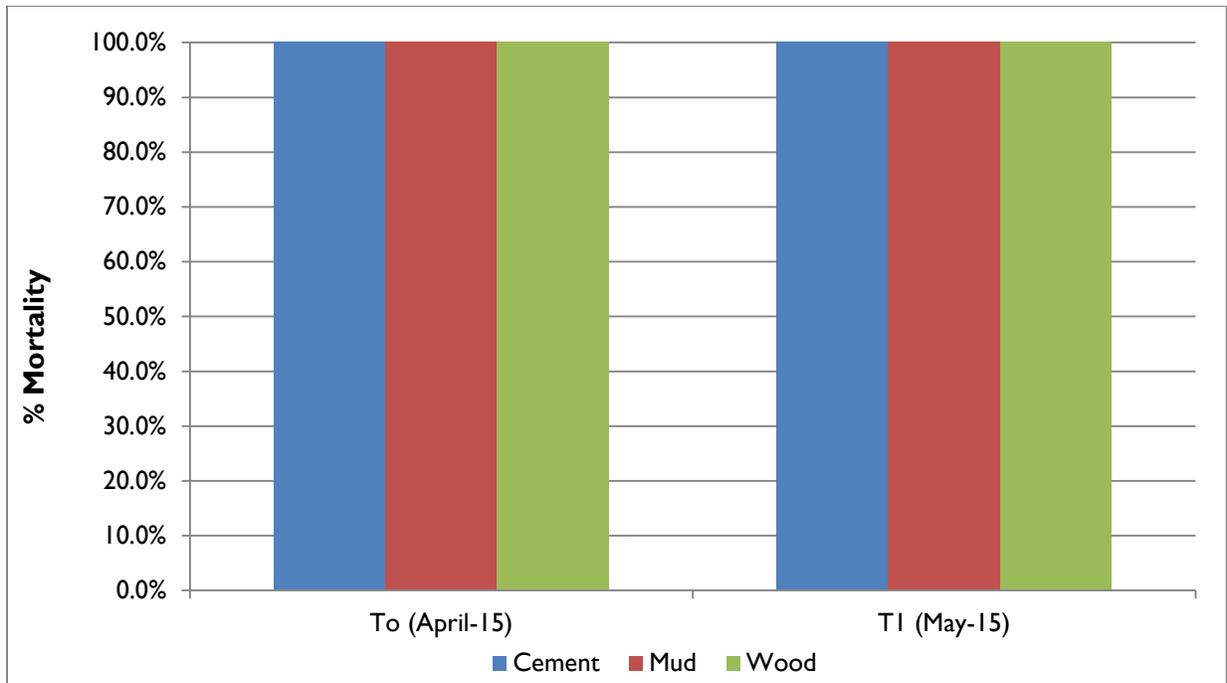
Note: sprayed on 16<sup>th</sup> April 2015

**FIGURE 7. DECAY RATE (% MORTALITY OF AN. GAMBIAE S.S. 'KISUMU'), NAA NORI, 1 MONTH AFTER SPRAY, MAY 2015**



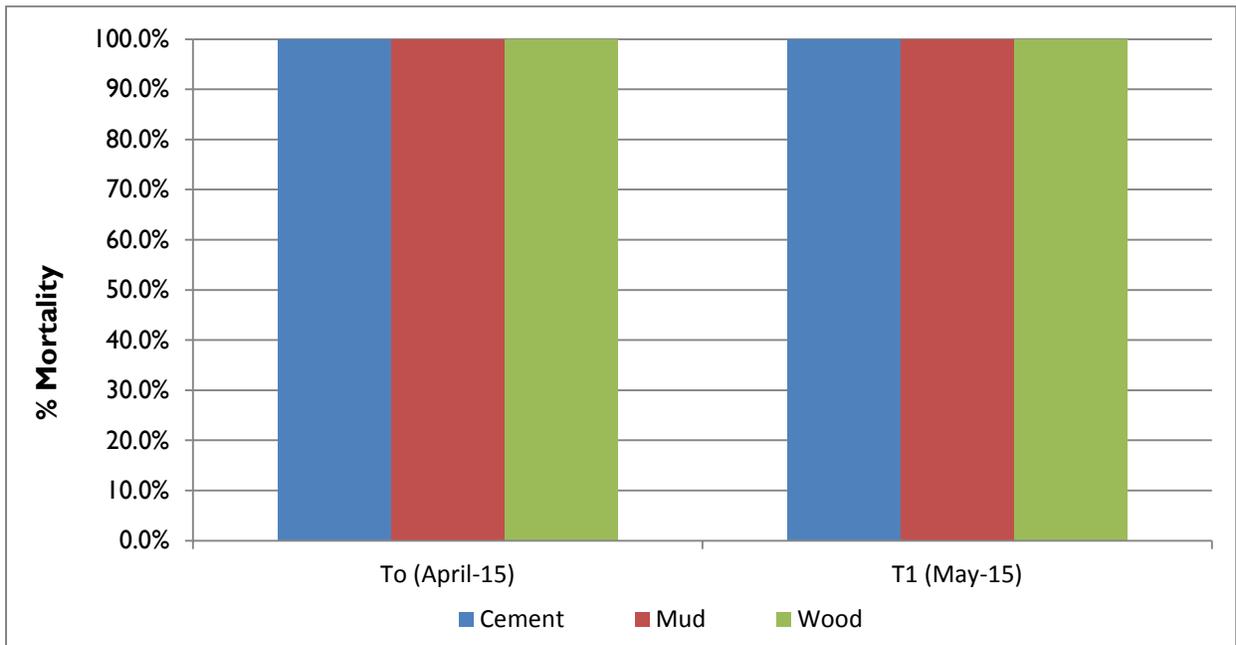
Note: sprayed on 18th April 2015

**FIGURE 8. DECAY RATE (% MORTALITY OF AN. GAMBIAE S.S. 'KISUMU' STRAIN), NANPONTI-BAUK, 1 MONTH AFTER SPRAY, MAY 2015**



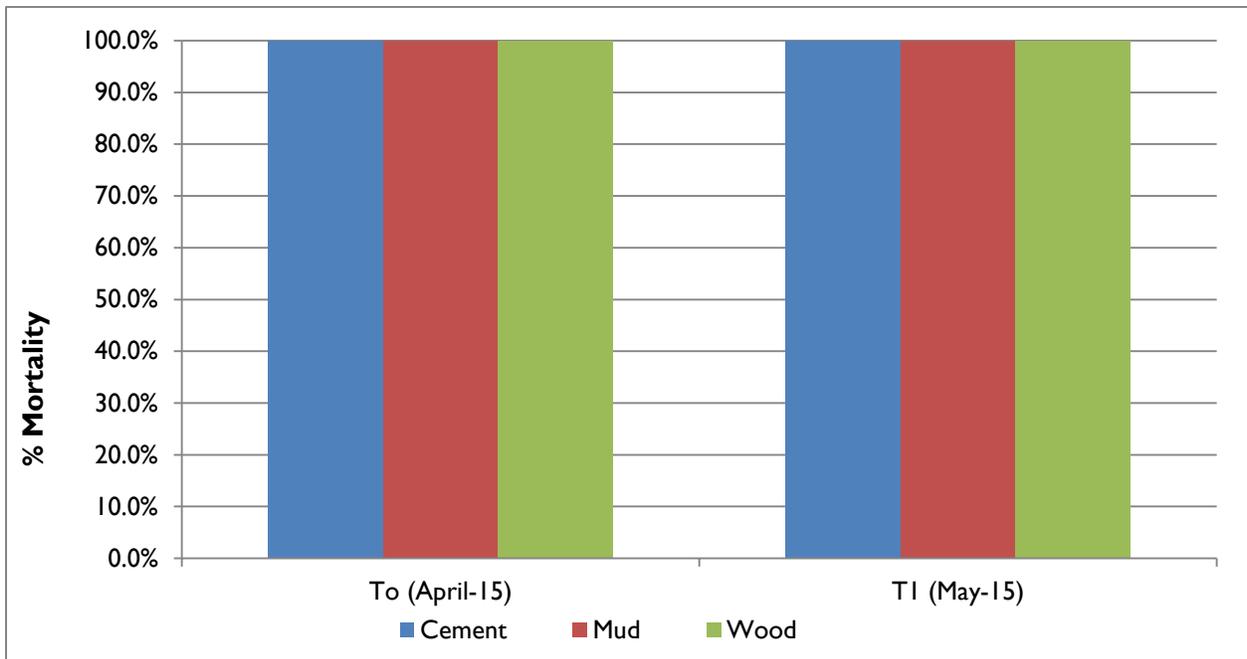
Note: sprayed on 20<sup>th</sup> April 2015

**FIGURE 9. DECAY RATE (% MORTALITY OF AN. GAMBIAE S.S. 'KISUMU' STRAIN), BUNBUNA, 1 MONTH AFTER SPRAY, MAY 2015**



Note: sprayed on 24th April 2015

**FIGURE 10. DECAY RATE (% MORTALITY OF AN. GAMBIAE S.S. 'KISUMU' STRAIN), YUNYOO, 1 MONTH AFTER SPRAY, MAY 2015**



Note: sprayed on 25th April 2015

## 6.4 INDOOR RESTING DENSITY AND BITING RATE AND PARITY

### 6.4.1 MONITORING DENSITY AND BEHAVIOR OF THE VECTOR

Mosquito collections were carried out in five sentinel districts to assess and understand the effect of IRS on species composition, density, and biting behavior of the local vectors in the areas where spraying took place, and to compare with other unsprayed communities. Pre- and post-spray mosquito collections were carried out using the Human Landing Catch (HLC) and Pyrethrum Spray Collection (PSC) methods to collect mosquitoes from the sentinel sites. Collections were done four times each month, from January to May 2015.

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 also used to determine indoor resting mosquito species and their densities. The collections were done the next morning (between 6 and 7 AM) 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 in the January to May period using HLC and PSC methods included *An. gambiae* s.l., *An. funestus* group, *An. pharoensis*, and *An. nili*. *An. gambiae* s.l. formed about 95.0 percent (n=1,285) of the total number collected (n=1,353); *An. funestus* formed 4.7 percent (n=63), *An. pharoensis* about 0.3 percent (n=4), and *An. nili* 0.1 percent (n= 1).

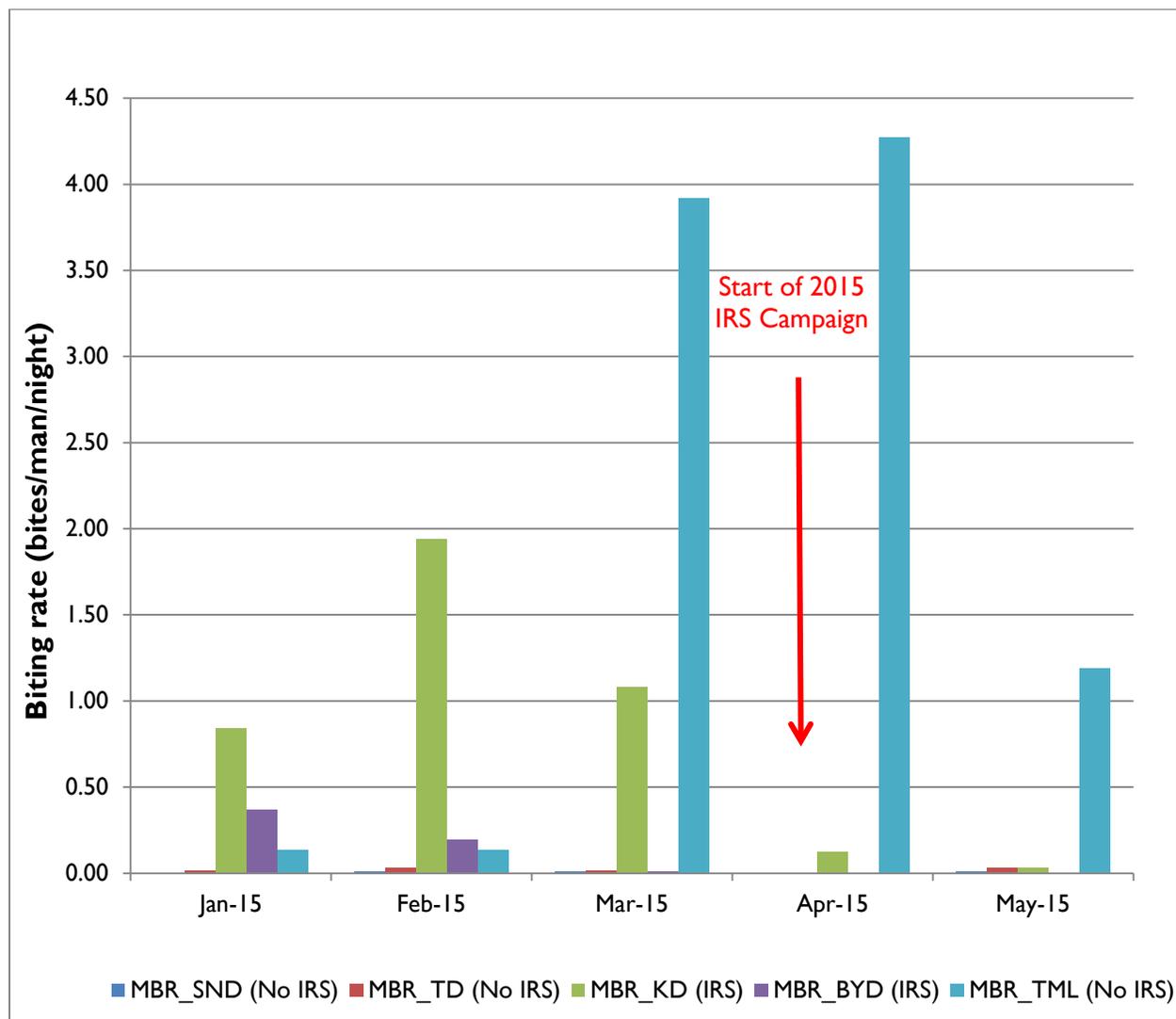
#### 6.4.2.2 BITING RATES

HLC is done in sentinel sites from 5 districts: 2 sprayed (BYD, KD), 2 from where IRS is withdrawn (SND, Tolon) and one never sprayed (Tamale). The results of the mean man-biting rates (MBR) of *An. gambiae* s.l. (the predominant vector species), presented in Table 12 and Figure 11, show *An. gambiae* s.l. biting rates (MBR) in Tamale (the unsprayed district) has increased from 1.4 bites/person/night (b/p/n) during the pre-spray season to 2.73 b/p/n during the post spray collections. MBR decreased in the sprayed districts from 0.19 b/p/n (pre-spray) to 0 (post spray) in BYD and from 0.82 b/p/n pre-spray to 0.08 b/p/n post spray in KD. MBR remained the same during the pre and post spray seasons for Tolon and SND districts. Tolon was last sprayed in 2012 and SND in 2014.

**TABLE 12. PRE AND POST IRS BITING RATES OF AN. GAMBIAE S.L. COLLECTED BY 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	Mean MBR
IRS					
BYD	73	0	0.19	0.00	0.11
KD	158	10	0.82	0.08	0.53
Non-IRS					
SND	2	1	0.01	0.01	0.01
TD	4	2	0.02	0.02	0.02
TML	402	524	1.40	2.73	1.93

**FIGURE 11. MBR OF FEMALE AN. GAMBIAE MOSQUITOES, JANUARY-MAY 2015**



### 6.4.2.3 HOST-SEEKING BEHAVIOR

HLC was conducted in unsprayed houses in Tamale, Savelugu Nanton, and Tolon districts and sprayed houses in Kumbungu and Bunkpurugu-Yunyoo districts. Variations were observed in indoor biting and outdoor biting densities between the IRS and non-IRS sites (Table 13 and Figure 12). The indoor MBR of 0.064b/p/n recorded for the unsprayed districts was significantly higher than 0.019b/p/n recorded for sprayed districts (Kumbungu and Bunkpurugu-Yunyoo) ( $F_{(1,22)} = 8.572$ ,  $p = 0.008$ ). Similarly, the outdoor MBR for unsprayed areas (0.048b/p/n) was significantly higher than for the IRS districts:  $F_{(1,22)} = 4.855$ ,  $p = 0.038$ ).

The indoor/outdoor biting rates for the IRS areas did not significantly differ before IRS. In Kumbungu, however, the outdoor biting rates of *An. gambiae* s.l. increased after the district was sprayed. In Tamale, the indoor biting rates were higher than outdoor biting rates during both periods (pre- and post-IRS).

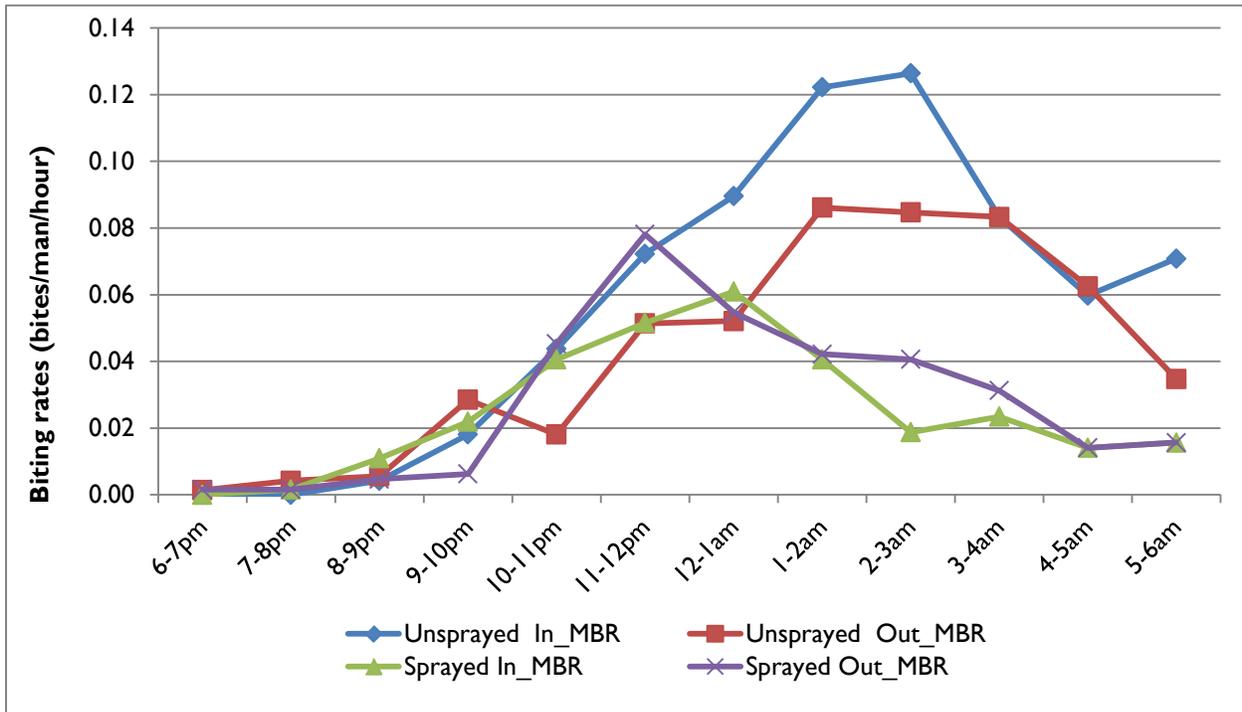
**TABLE 13. INDOOR/OUTDOOR BITING RATIO OF AN. GAMBIAE S.L., PRE- AND POST-IRS**

Sentinel Site	Pre-IRS	Post-IRS
IRS		
BYD	0.49 : 0.51	0
KD	0.48 : 0.52	0.20 : 0.80
Non-IRS		
SND	0.5 : 0.5	1.0 : 0.0
TD	0.75 : 0.25	0.50 : 0.50
TML	0.57 : 0.43	0.56 : 0.44

### 6.4.2.4 PARITY RATES OF VECTOR SPECIES

Dissections of *An. gambiae* s.l. mosquitoes collected from the study sites between January and May 2015 revealed a higher proportion of older *Anopheles* populations in the unsprayed communities and in Kumbungu District (Table 14). Bunkpurugu-Yunyoo recorded a parity rate of 28.6 percent, which was significantly different ( $p < 0.05$ ) from the mean parity rates recorded for Kumbungu (70.5 percent) and Tamale (75.3 percent). No dissections were done for Tolon and Savelugu-Nanton due to low numbers of mosquitoes collected. There was no significant difference between the mean pre-IRS parity rates and post IRS parity rates for Kumbungu and Tamale.

**FIGURE 12. HOST-SEEKING BEHAVIOR OF AN. GAMBIAE S.L. COLLECTED INSIDE AND OUTSIDE UNSPRAYED AND SPRAYED HOUSES**



**TABLE 14. PRE- AND POST-IRS DISSECTIONS FOR AN. GAMBIAE S.L.**

Sentinel Site	Pre-IRS			Post-IRS			Mean Parity
	Dissected	# Parous	Parity (%)	Dissected	# Parous	Parity (%)	
<b>IRS</b>							
BYD	21	6	28.6%	-	-	-	28.6%
KD	69	49	71.0%	10	7	70.0%	70.5%
<b>Non-IRS</b>							
TML	83	65	78.3%	130	94	72.3%	75.3%

#### 6.4.2.5 VECTOR DENSITIES

PSCs were done in sprayed rooms in Kumbungu and Bunkpurugu-Yunyoo and unsprayed rooms in Tamale, Savelugu-Nanton, and Tolon. Results showed that the comparison districts recorded higher vector densities than the IRS districts (Figure 13). Tamale recorded the highest indoor resting densities of 0.86 mosquitoes /room, whereas Kumbungu, Tolon, Savelugu-Nanton, and Bunkpurugu-Yunyoo recorded 0.10, 0.08, 0.02, and 0.01 mosquitoes /room, respectively.

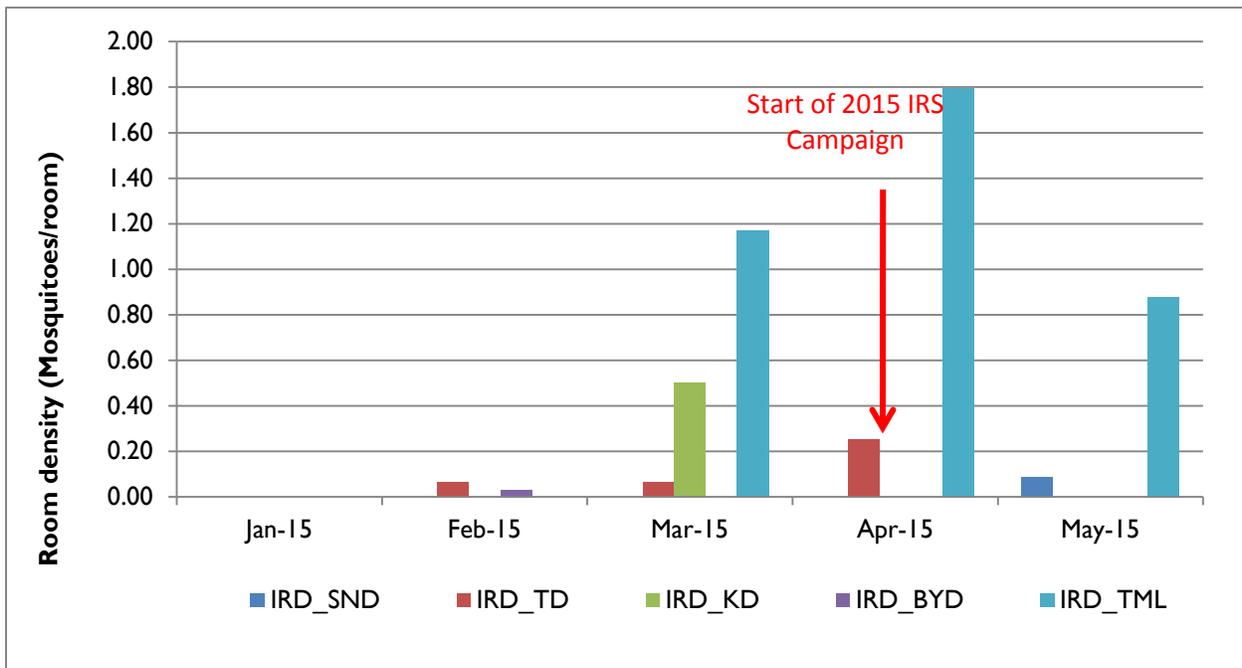
The low densities of mosquitoes recorded could be due in part to the late onset of the rains, which affect the abundance of *Anopheles* breeding sites as observed in the previous years.

Table 15 shows that room density of *An. gambiae* s.l. from the IRS areas decreased after the communities were sprayed in April. In Kumbungu, the pre-IRS indoor resting density of *An. gambiae* s.l. fell from 0.17 mosquitoes /room to 0 after spraying. Similarly, the pre-IRS indoor resting density of *An. gambiae* s.l. in Bunkpurugu also fell, from 0.01 to 0. In contrast, the indoor resting densities of *An. gambiae* s.l. from the unsprayed areas increased during the post-IRS period (April and May 2015).

**TABLE 15. PRE AND POST IRS INDOOR RESTING DENSITIES OF AN. GAMBIAE S.L., PSC METHOD**

Sentinel Site	Pre-IRS	Post-IRS	Mean IRD
IRS			
BYD	0.01	0.00	0.01
KD	0.17	0.00	0.08
Non -IRS			
SND	0.00	0.04	0.02
TD	0.04	0.13	0.08
TML	0.39	1.33	0.86

**FIGURE 13. INDOOR RESTING DENSITIES OF AN. GAMBIAE S.L. COLLECTED FROM SPRAYED ROOMS AND UNSPRAYED ROOMS USING THE PSC METHOD, JANUARY-MAY 2015**



## 6.5 CONCLUSIONS

The AIRS project has over the years aimed at reducing malaria transmission by targeting the entomological indices that affect transmission. It has been established that this can only be achieved through the high quality of spraying during the campaign.

The results of the entomological surveys show a high quality of spraying. They also show that in the IRS communities, the project recorded lower proportions of parous (older) female *Anopheles* mosquitoes. The effect on the longevity of the local mosquitoes from Bunkpurugu-Yunyoo could be attributed to the impact of pirimiphos methyl in killing high proportions of the older females *Anopheles* mosquitoes that rest in the rooms. It confirms that the local vector species in the area are still highly susceptible (100

percent) to pirimiphos methyl used for the 2015 IRS operations. The relatively higher parity rates of local vectors in Kumbungu District could be a result of the IRS withdrawal in the previous years. It may be too early to see the direct impact of IRS on parity rates (one month post-IRS). The transmission indices across all sites will be monitored over the transmission season (July to December) to ascertain the true impact of IRS on all of these indices and provide important feedback for decision making in future IRS operations.

# 7. ENVIRONMENTAL COMPLIANCE

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## 7.1 PRE-SEASON ASSESSMENT

For successful implementation of IRS, it is essential that environmental compliance procedures are in place to ensure safe and appropriate use and disposal of insecticides and other wastes. Prior to the start of any IRS program as well as to an individual spray season, an environmental assessment must be conducted to inform the environmental mitigation plan. In 2015 Ghana had to do an assessment in two parts: the Supplementary Environmental Assessment (SEA) and the PSECA.

### 7.1.1 SUPPLEMENTARY ENVIRONMENTAL ASSESSMENT

Previous IRS campaigns were covered under an SEA that was approved for Ghana in 2010 and expired in December 2014. Therefore, prior to 2015 IRS operations, AIRS Ghana had to produce a new SEA.

The ECO from the home office and the AIRS Ghana ECO with support from Ghana's EPA, NMCP, and District Environmental Health Officers conducted visits to the IRS target districts for the new SEA. The team traveled to the districts from January 26 to February 13 to evaluate ecosystems in both targeted and non-targeted IRS districts, conduct interviews with stakeholders, observe waste management and disposal plants, and inspect all 16 operational sites.

The new SEA is nationwide in scope and covers the period 2015 to 2020. A report that summarized the key environmental compliance indicators was submitted to PMI. There were no adverse findings that would prevent the implementation of IRS. PMI and USAID approved the SEA report before the start of the 2015 spray campaign.

### 7.1.2 PRE-SEASON ENVIRONMENTAL COMPLIANCE ASSESSMENT

The PSECA was conducted in two phases using smart phones. The first phase (February 16-22) consisted of visits to all 16 storage facilities and soak pits to make recommendations on improvements and renovations required. The second phase was the certification of storage facilities and soak pits. It involved revisits to all storage facilities and soak pits to ensure that recommendations made during the first phase of PSECA had been fully implemented. During the revisits, inspectors had to confirm that each operational site was ready to be used for spray operations. Based on recommendations from the first round, the following actions were taken:

- Two new soak pits were constructed in Kumbungu District (one in Dalun and another at Kumbungu). The pits were needed because the last time Kumbungu was sprayed was in 2012 and the original operational sites were no longer available. In addition, a temporary soak pit was also constructed at Singa, the 'oversea' side of Kumbungu district.
- One new soak pit was constructed in Sakogu (East Mamprusi) to add to the existing three. This was done to cut travel time from Gambaga to Sakogu.
- In West Mamprusi, the Walewale operational site was relocated from Walewale Township to Wungu. A new soak pit was constructed.

The remaining 14 operational sites needed minor renovations to bring them up to standard. These renovations included repair of cracks in the floor of the soak pit, repair of locks for insecticide storage rooms, reconstruction/ renovation of toilet and bath facilities, and general painting.

The AIRS ECO, the COP, an EPA representative, and District Health Environmental Officers in the five targeted districts conducted the final certification of storage facilities and soak pits. All recommendations made from the first round inspection had been implemented and all 16 operational sites were certified as fit for the 2015 spray operations.

## 7.2 MID-SEASON ENVIRONMENTAL COMPLIANCE ASSESSMENTS

The AIRS ECO, District Environmental Health Officers, and the USAID Environmental Health Officer visited all 16 sites to assist district teams with issues in and to ensure full environmental compliance. The team also used the visit to conduct mid-season environmental compliance assessments for all the sites using supervisory checklists. 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 appropriate use of PPE, proper 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, AIRS Ghana and supervisors provided refresher orientations and reminders throughout the spray campaign to ensure that environmental compliance requirements were always adhered to.

As part of USAID's independent assessment of environmental compliance standards of the AIRS project, a consultant from Global Environmental Management Support (GEMS) visited Ghana from April 21 to May 7 to conduct the assessment. The consultant visited 11 of the 16 operational sites. During the visit, he met with major stakeholders including the NMCP, EPA, targeted DHMTs, and IRS District Assemblies. In the field, he interviewed SOPs, supervisors, Site Managers, Store Assistants, and home owners as well as drivers and security guards. He also took the opportunity to observe the bio monitoring exercise and interviewed laboratory technicians at the Bunkpurugu health center (Bunkpurugu-Yunyoo District).

During his final debriefing meeting with the team, the consultant commended AIRS Ghana for maintaining very high standards in environmental compliance and made some recommendations for improvement that are documented in a separate report.

## 7.3 INCIDENTS

A car accident involving four SOPs and two motorbike accidents occurred. The car accident happened during SOP training (before the start of spraying) with a car assigned to the DOC. Two temporary supervisors were involved in the two motorbike incidents that happened during supervision of the spray operation. All injuries were minor, with the people involved returning to work after one to three days.

## 7.4 BIO MONITORING PILOT

The AIRS Ghana project with assistance from GEMS and PMI conducted a bio monitoring pilot for 242 selected seasonal workers (SOPs, Team Leaders, Washers, and Store Assistants) across all five districts. The purpose of the bio monitoring pilot was to obtain data directly from PMI IRS operations to determine the necessity, feasibility, and appropriate scale of potential bio monitoring in PMI countries that are spraying OPs.

In all, 27 technicians and supervisors were trained to implement the bio monitoring pilot. All AIRS technical staff, DOCs, and a representative from the USAID Tamale office along with 10 medical staff and laboratory technicians from health facilities were trained by the international bio monitoring consultant. Five data assistants were also trained on bio monitoring data entry. Two baseline tests were conducted prior to the start of the spray operations. Throughout the spray campaign, five follow-up tests were conducted every Saturday with confirmatory tests on Mondays and Wednesdays for workers who showed some level of cholinesterase depression. The result of the bio monitoring indicated that:

- There was no Ache (red blood cell cholinesterase) depression
- All cases of depression were due to plasma cholinesterase depression, a condition that is believed to be extremely sensitive and can be affected by factors other than insecticide exposure.
- No clinical symptoms of cholinesterase depression / organophosphate poisoning were observed
- All those who were affected by plasma cholinesterase depression were removed from spraying / handling insecticides and were reassigned to tasks that did not involve handling of insecticides until their cholinesterase levels improved. Most of the affected workers returned to spraying in 2-7 days after the test.

Even though all investigations and follow-ups showed that the workers were using PPE properly, it is not clear what could have led to the plasma cholinesterase depression that was observed. AIRS Ghana is preparing a full report on the findings of the bio monitoring pilot.

## 7.5 POST-SEASON ENVIRONMENTAL COMPLIANCE ASSESSMENT

All storage facilities and soak pits at the 16 operational sites have been cleaned. Post-spray environmental compliance inspections were completed on June 15-19. All sites had been well cleaned and temporarily closed according to Best Management Practice (BMP) standards. All storage facilities will remain locked and guarded by security guards until the next spray campaign. AIRS Ghana DOCs will visit all storage facilities and soak pits once a month to ensure that the facilities are still guarded and in good shape.

## 7.6 WASTE DISPOSAL

All solid waste materials will be disposed of in accordance with the PMI/IRS BMP. Three main forms of solid waste were generated during the 2015 IRS campaign:

- Empty triple-rinsed bottles of Actellic 300 CS
- Used nose masks
- Well-washed damaged gloves, boots, and plastic sheets

The project will incinerate all used nose masks at Zoil Services Limited in Takoradi in July-August 2015.

A total of 45,314 triple-rinsed Actellic 300 CS empty bottles generated by the 2015 spray campaign will be sent to Zoil Services Limited or Cyclus in July for recycling. AIRS ECO and a representative from the EPA will observe the recycling. The project will give away as a reward well-washed damaged coveralls and punctured boots to selected SOPs. AIRS Ghana will send washed plastic sheets and damaged gloves to a recycling company (Cyclus). In the past, plastic sheets and gloves were incinerated until 2013. In 2014, the plastic sheets were recycled but the gloves were incinerated. This year both washed gloves and plastic sheets will be sent to a recycling company.

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

# 8. MONITORING AND EVALUATION

## 8.1 KEY OBJECTIVES AND APPROACH

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

As outlined in the 2015 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. Table 16. Ghana IRS 2015 Data Collection Tools, describes all the data collection tools used during the 2015 spray campaign.

**TABLE 16. GHANA IRS 2015 DATA COLLECTION TOOLS**

<b>Data collection tool</b>	<b>Used by who and when</b>
Training Participants Registration Form	Used by lead trainer at training workshop to capture category and number of people trained, disaggregated by male and female.
BCC/IEC Mobilization Form	Used by IEC mobilizers during pre-spray house-to-house mobilization/sensitization activities to collect data on number of households and people reached with IRS messages.
Daily SOP Form	Used by SOPs during spray operations to capture structures found, structures sprayed and not sprayed, and population protected and unprotected as well as mosquito net information.

In 2013, the AIRS project introduced standardized data quality assurance tools, the Error Eliminator (EE) and Data Collection Verification (DCV), to improve supervision and ultimately the quality of data collection and data entry. These tools were effectively used during the 2015 spray campaigns. Table 17 describes the tools, and their purpose and users. Tables 18 and 19 show the numbers of households interviewed using the DCV form and issues uncovered and resolved, respectively. To ensure data integrity, AIRS Ghana used a number of quality assurance and control tools described in Table 20.

**TABLE 17. DATA QUALITY ASSURANCE TOOLS**

Tool	Purpose, Used by Whom and When
Error Eliminator form	<p>Purpose:</p> <ul style="list-style-type: none"> <li>• To check the completeness and correctness of data collected in the field.</li> <li>• To highlight common data collection errors so they can be quickly identified with corrections being made and re-training provided by the supervisor.</li> </ul> <p>Used by:</p> <ul style="list-style-type: none"> <li>• Team leaders on daily basis to check 100% of the forms filled by the SOPs under their supervision.</li> <li>• Supervisors, District SOC, District M&amp;E Coordinators, Operations Manager, and M&amp;E Manager also used the EE when visiting the field.</li> </ul>
Data Collection Verification form	<p>Purpose:</p> <ul style="list-style-type: none"> <li>• Used during randomized household visits to check the accuracy of data collected in the field, 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.</li> </ul> <p>Used by:</p> <ul style="list-style-type: none"> <li>• District M&amp;E Coordinators, predominately.</li> <li>• Database Manager and the M&amp;E Manager.</li> <li>• A total of 1, 501 households/compounds were visited using the DCV form. See Tables 19 and 20.</li> </ul>

**TABLE 18. NUMBER OF HOUSEHOLDS/COMPOUNDS VISITED USING THE DCV FORM**

District	No. of Households/Compounds Visited
Bunkpurugu-Yunyoo	169
East Mamprusi	170
West Mamprusi	241
Kumbungu	194
Mamprugu Moaduri	220
Total households visited	994

**TABLE 19. USE OF DCV FORM: COMMON ISSUES FOUND AND CORRECTIVE ACTIONS TAKEN**

Errors/Issues Observed	Corrective Actions Taken
<p><b>Understatement of total number of eligible structures found by SOPs.</b> It was observed that in compounds where some structures were locked, SOPs did not always count them as part of the total number of eligible structures found.</p>	<p>The M&amp;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 especially when the structure was locked.</p>
<p><b>Overstatement of total number of eligible structures found.</b> In some compounds, some new SOPs overcounted the number of eligible structures by counting the number of rooms as though they were structures. Also, some SOPs 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). Additionally, in some compounds, households convinced SOPs that structures that were under construction at the time of visit would be ready for occupancy in the next few days and thus eligible. These structures were counted as eligible with the hope that they would be ready for spraying during a revisit, but many were not completed in time to be covered and thus should not have been counted as eligible.</p>	<p>The M&amp;E team addressed SOPs, Team Leaders, and Field Supervisors, asking them to take note of these common errors and to be careful in determining the eligibility of structures before recording them. Spray teams were reminded that the eligibliy of a structure is based on evidence at the time of the visit, not on its expected future eligibility.</p>
<p><b>Overstatement of total number of eligible structures sprayed.</b> This was mainly due to structures wiith more than one room counted as sprayed when not all the rooms were sprayed</p>	<p>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.</p>
<p><b>Undercounting of number of structures sprayed:</b> 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.</p>	<p>The M&amp;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.</p>

## 8.3 DATA ENTRY

AIRS employed 16 Data Assistants (three in Bunkpurugu-Yunyoo, four in East Mamprusi, four in West Mamprusi, two in Mamprugu Moaduri, and three in Kumbungu) to enter all mobilization and spray data generated from the five districts. The project laptops were used for the 2015 spray round data entry. The database setup entailed using a server in each data entry center. The 2015 AIRS Ghana database was installed on each laptop. 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 form) for quick reporting and feedback, then by “Details” (i.e., data entry by detail data for each compound) for more accurate data entry and verification purposes.

## 8.4 DATA STORAGE

Data cards are stored in arc files (binders). Mobilization data cards were filed in separate binders by sub-district and within each binder by zone and then by community. Spray data were filed in arc files by sub-district, with the forms in each file sorted by spray date. At the end of each day, all databases were backed up electronically. Backup was performed in three different ways: first, into a backup folder on

the laptop that served as the district data entry server; second, into a cloud backup system (Sugar Sync); and third, onto an external flash drive that was provided to each Data Assistant. All computer and flash drives are secured in the IT office in Tamale.

## 8.5 DATA CLEANING

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

- Ensuring that all data cards are entered correctly by the double entry method (by Totals and by Details);
- Ensuring that all necessary corrections are made so that the Totals and Details data entry balance;
- 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 Assistants cleaned both spray and mobilization data daily throughout the spray campaign with final data cleaning completed within eight days of the end of the spray campaign.

**TABLE 20. DATA QUALITY ASSURANCE AND CONTROL**

Issue	Method/Tools for Quality Assurance
Spray data integrity	<ul style="list-style-type: none"> <li>• Use of standardized data collection forms.</li> <li>• Comprehensive training for spray data capture.</li> <li>• Multiple levels of supervision.</li> <li>• SOPs supervised directly by their Team Leaders.</li> <li>• Supervisors monitored the Team Leaders and verified SOP forms.</li> <li>• M&amp;E Manager, Database Manager, and District M&amp;E Coordinators monitor and verified data captured by SOPs, Team Leaders, and Supervisors.</li> <li>• Structure spot checks to cross-check daily spray data captured by SOPs.</li> <li>• Database designed with locks and validation checks.</li> <li>• Use of EE and DCV forms to ensure complete and accurate data collection.</li> <li>• Compare number of compounds sprayed with number of compounds mobilized, to address the issue with missed compounds.</li> </ul>
Mobilization data integrity	<ul style="list-style-type: none"> <li>• Used standardized data collection forms.</li> <li>• Comprehensive training for mobilization data capture.</li> <li>• Multiple levels of supervision (by IEC Assistants, M&amp;E Coordinators and SOC, IEC Coordinator, M&amp;E Manager, Database Manager).</li> <li>• Household visits for spot checks.</li> <li>• Database designed with locks and validation checks.</li> <li>• Use of EE to ensure complete and accurate data collection.</li> </ul>
Spray data entry and management	<ul style="list-style-type: none"> <li>• Data entry training for all Data Assistants.</li> <li>• Prompt field data entry and transfer; data collection forms arrived at data entry sites daily and data entry was also done on a daily basis.</li> </ul>

Issue	Method/Tools for Quality Assurance
	<ul style="list-style-type: none"> <li>• Data entry via double-data entry method <ul style="list-style-type: none"> <li>▪ Initial data entry of totals per data collection form</li> <li>▪ Follow-up entry of details data, i.e., data per individual household/compound</li> </ul> </li> <li>• Data scan for irregularities by Database Manager and IRS supervisory staff.</li> <li>• Use of Microsoft Access-based IRS Cleaning/Reporting tool to daily clean data.</li> </ul>
Data security	<ul style="list-style-type: none"> <li>• Data collection forms printed on durable sheets.</li> <li>• Paper data collection forms filed systematically in arc files.</li> <li>• Database designed with passwords to restrict unauthorized entry.</li> <li>• Databases backed up daily on the server laptop, on Sugar Sync and on external pen drives.</li> </ul>

## 8.6 RESULTS

A list of all program indicators for the 2015 spray campaign is presented in the M&E Plan matrix in Annex C. The following sections summarize the results for the core PMI indicators and other spray indicators.

### 8.6.1 NUMBER OF STRUCTURES FOUND AND SPRAYED AND SPRAY COVERAGE

A total of 224,592 structures were found by SOPs during the 2015 spray campaign. Across the five districts, 205,935 structures were sprayed by SOPs, for total spray coverage of 91.7 percent. Spray coverage increased from 83.8 percent in 2014 to 91.7 percent in 2015. Details of number of structures found, sprayed, and district spray coverage are presented in Table 21.

### 8.6.2 POPULATION PROTECTED

There were 585,698 people counted as living in the total number of structures found by SOPs. Of this number, 94.6 percent (553,954 people) were protected through IRS. The total number of people protected included 11,676 pregnant women and 98,525 children under the age of five years.

**TABLE 21. SUMMARY OF 2015 SPRAY RESULTS**

District	Structures Found by SOPs	Structures Sprayed	% of Structures Sprayed	Pop. Protected	Pop. Not Protected	% of Pop. Protected	Pregnant Women Protected		Children Under 5 Years	
							#	%	#	%
Bunkpurugu Yunyoo	52,844	50,417	95.4%	124,592	4,263	96.7%	2,111	1.7%	18,300	14.7%
East Mamprusi	66,098	60,283	91.2%	167,149	9,625	94.6%	3,862	2.3%	31,845	19.1%
Kumbungu	33,546	31,333	93.4%	82,614	3,675	95.7%	1,863	2.3%	14,419	17.5%
Mamprugu Moaduri	20,366	18,478	90.7%	50,016	3,573	93.3%	1,122	2.2%	9,338	18.7%
West Mamprusi	51,737	45,424	87.8%	129,583	10,608	92.4%	2,718	2.1%	24,623	19.0%
<b>Total</b>	<b>224,592</b>	<b>205,935</b>	<b>91.7%</b>	<b>553,954</b>	<b>31,744</b>	<b>94.6%</b>	<b>11,676</b>	<b>2.1%</b>	<b>98,525</b>	<b>17.8%</b>

### 8.6.3 REASONS FOR UNSPRAYED STRUCTURES

A total of 18,657 structures were not sprayed. At the end of the campaign, the two main reasons for not spraying were identified as follows: 1) SOPs found structures locked (56.2 percent, 10,471) and 2) the household refused spraying (33.2 percent, 6,187). A common reason for refusal was that household members did not like the smell of the insecticide. A common reason for structures to be locked was their owners were away (for short or protracted periods, in some cases over a year). The issue with some locked structures was handled through revisits; SOPs sprayed the structures where the owners had returned. Nevertheless, some structures remained locked through the end of the campaign and could not be sprayed. Overall, locked structures accounted for 4.7% of total structures found by SOPs during the 2015 campaign.

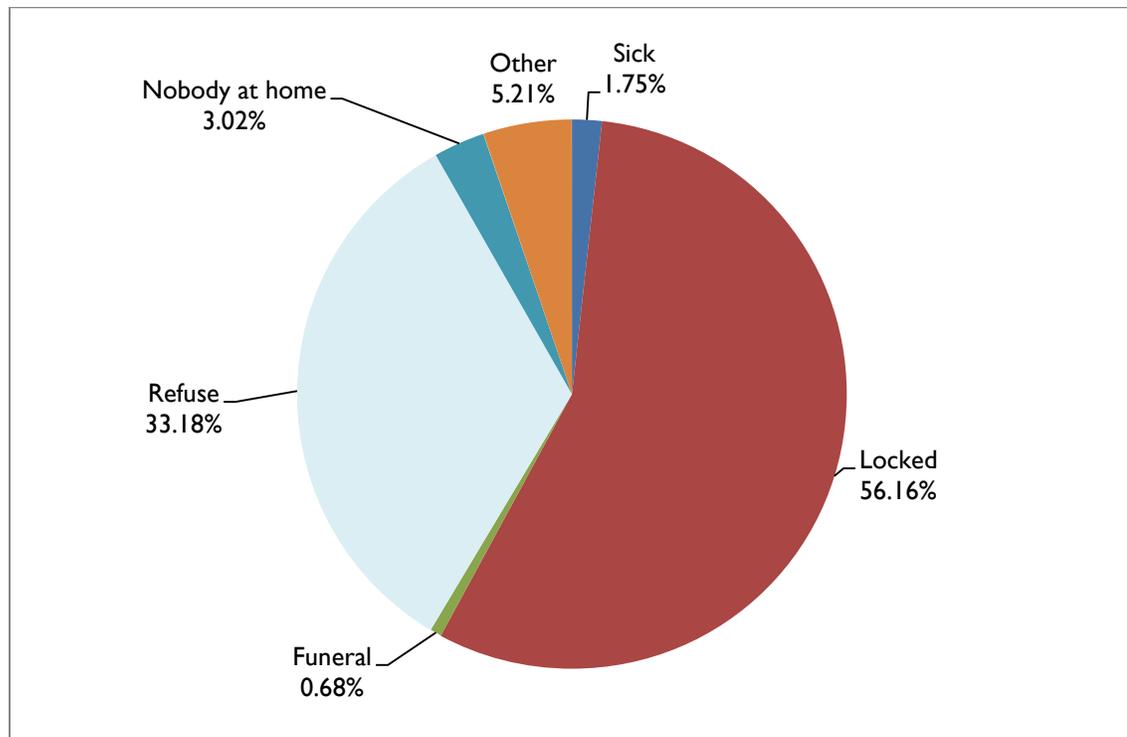
Three percent of structures (562) were not sprayed because "nobody was at home" at the time of the SOP visit. An additional 1.7 percent (326) were not sprayed because they had sick people in them and less than 1 percent (127) were not sprayed because the household was holding a funeral in the home at the time of the SOP visit. Details on the reasons why structures were not sprayed are summarized in Table 22 and illustrated in Figure 14.

**TABLE 22. REASONS FOR UNSPRAYED STRUCTURES, BY DISTRICT**

District	Sick		Locked		Funeral		Refuse		Nobody Home		Other		Sum of All Unsprayed Structures
	#	%	#	%	#	%	#	%	#	%	#	%	
Bunkpurugu-Yunyoo	79	3.3%	1,389	57.2%	11	0.5%	740	30.5%	8	0.3%	200	8.2%	2,427
East Mamprusi	71	1.2%	3,240	55.7%	33	0.6%	2,122	36.5%	204	3.5%	142	2.4%	5,811
Kumbungu	78	3.5%	1,662	75.1%	15	0.7%	330	14.9%	39	1.8%	89	4.0%	2,213
West Mamprusi	29	1.5%	1,097	58.3%	20	1.1%	419	22.3%	84	4.5%	232	12.3%	1,881
Mamprugu Moaduri	69	1.1%	3,083	48.8%	48	0.8%	2,576	40.8%	228	3.6%	309	4.9%	6,313
<b>Total</b>	<b>326</b>	<b>1.7%</b>	<b>10,471</b>	<b>56.2%</b>	<b>127</b>	<b>0.7%</b>	<b>6,187</b>	<b>33.2%</b>	<b>562</b>	<b>3.0%</b>	<b>972</b>	<b>5.2%</b>	<b>18,646*</b>

\*11 unsprayed structures were not assigned a reason.

**FIGURE 14. REASONS FOR UNSPRAYED STRUCTURES**



## 8.6.4 AVAILABILITY AND USE OF MOSQUITO NETS

Across the five districts, a total of 114,935 mosquito nets were available at the time of the SOP visit; 6,423 pregnant women and 56,131 children under five years of age slept under a mosquito net the night before the SOP visit. Table 23 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 unsprayed structures.

**TABLE 23. 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	24,462	1,095	50.2%	10,518	56.2%
East Mamprusi	30,319	1,920	47.4%	16,755	50.9%
Kumbungu	16,432	1,144	59.4%	8,645	58.4%
Mamprugu Moaduri	14,089	799	66.5%	6,383	65.2%
West Mamprusi	29,633	1,465	50.2%	13,830	53.4%
<b>Total</b>	<b>114,935</b>	<b>6,423</b>	<b>52.3%</b>	<b>56,131</b>	<b>54.9%</b>

## 8.6.5 OTHER SPRAY INDICATORS

The five districts received 47,648 bottles of Actellic 300 CS for the 2015 spray operations from the regional stores. A total of 45,314 bottles were used to spray the 205,935 structures. No insecticide was reported missing or damaged, and 2,334 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, 358 SOPs worked each day across the five districts. Each SOP sprayed an average of 16.4 structures a day with an average of 3.6 bottles of Actellic 300 CS used per day as presented in Table 24.

**TABLE 24. INSECTICIDE TRACKING AND SOP PERFORMANCE**

Indicator	District					
	Bunkpurugu-Yunyoo	East Mamprusi	Kumbungu	Mamprugu Moaduri	West Mamprusi	Overall
Total bottles received from regional stores	11,280	13,700	7,440	4,308	10,920	47,648
Total bottles used	10,898	13,413	6,800	3,879	10,324	45,314
Total bottles damaged or lost	0	0	0	0	0	0
Total bottles left over (Returned to regional office)	382	287	640	429	596	2,334
Average number structures sprayed per bottle	4.6	4.5	4.6	4.8	4.4	4.5
Average number of bottles per SOP per day	4.1	3.6	3.7	4.2	3.0	3.6
Average number of SOP worked per day	76	106	52	26	98	358
Average number of structures sprayed by SOP per day	19.1	16.2	17.2	19.9	13.3	16.4

## 8.7 POST-SPRAY BENEFICIARY SATISFACTION SURVEY

As part of efforts to better understand the satisfaction of beneficiaries concerning the implementation of IRS, AIRS Ghana conducted a Beneficiary Satisfaction Survey (BSS). The objectives of the survey were:

- To assess beneficiary IRS knowledge, acceptance and satisfaction of the 2015 spray campaign
- To identify methods of IRS messaging to better guide the 2016 mobilization efforts in order to expand the beneficiary reach and increase spray coverage.

The BSS was conducted between June 19 and 24, 2015. The findings and details of the BSS will be shared with the PMI team in a separate report.

## 9. CAPACITY BUILDING OF THE MINISTRY OF HEALTH

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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 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 (technical) advocacy, organizational management, and program development and management.

Based on the IRS capacity assessment conducted in 2013, a capacity-building plan was developed for NMCP and GHS staff. Under the plan, in 2014 AIRS Ghana conducted trainings for government, NMCP, and GHS staff that focused on management and supervision of IRS. AIRS Ghana also presented the AIRS supervisory tools on environmental compliance, operations, and M&E to the NMCP. The goal of these trainings was to encourage government officials to participate in supervising IRS more effectively and to use the supervisory tools if and when they implement IRS on their own.

After the training, it was agreed by the local PMI team, the NMCP, and AIRS Ghana that in 2015, capacity building GHS (NMCP) staff would be limited to be mentored by staff that were trained in 2014. The trained staff would be assigned to different components of the AIRS Ghana program (operation, EC, IEC/BCC, etc.) to ensure that they make use of the knowledge acquired during the trainings and to develop practical skills during the implementation of the IRS campaign.

Disease Control Officers and Environmental Health Officers in the targeted districts were assigned to the 2015 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. District Environmental Health Officers also worked closely with the AIRS DOCs and the AIRS ECO to ensure environmental compliance during the 2015 spray campaign.

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

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.

PMI through AIRS Ghana has been supporting the National Insecticide Resistance Monitoring Partnership, 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

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The following challenges, lessons learned, and recommendations were identified during the 2015 spray campaign.

## 10.1 CHALLENGES

1. A conflict started in Bunkpurugu town (Bunkpurugu-Yunyoo) just before the start of spray operations. This was not an ethnic conflict, but rather an internal dispute within the chieftaincy family. As a result, spray operations at that operational site were delayed until clearance was given by the security services. Spray teams worked under very strict curfew hours. Solution: To compensate for the delay, five SOPs were mobilized from other sites that had finished spraying on time and the Bunkpurugu operation was completed.
2. Within the first two weeks of spraying, a major challenge was malfunctioning pumps, particularly Goizper pumps. Though these pumps had been serviced before the spray campaign started, the majority of them malfunctioned due to worn-out parts. The frequent screwing and un-screwing during washing worn out some of the plastic parts. The project has been using 200 of the Goizper pumps for three spray campaigns (2013, 2014, and 2015). The remaining 80, the project has used for two campaigns (2014 and 2015). Solution: Leakage was temporarily sorted with plumber gum, and some Goizper pumps were replaced with Hudson pumps. East Mamprusi, Mamprugu Moaduri, and Kumbungu districts used Goizper pumps. In Mamprugu Moaduri, 19 out of 45 Goizper pumps were replaced with Hudson pumps. At the Kumbungu site, 18 out of 50 Goizper pumps were replaced with Hudson pumps. Working parts of the Goizper pumps that were replaced were sent to East Mamprusi to be used to replace broken or worn out Goizper pump parts there.
3. AIRS experienced low IRS coverage in some sub-districts, especially in urban areas in Nalerigu (East Mamprusi) and Walewale (West Mamprusi). The team worked hard to ensure that coverage improved in these sub-districts. Solution: One of the strategies used was to generate data for communities and compounds with low coverage (less than 90 percent). The reports were used by district teams to develop revisit plans and follow-up on specific compounds to ensure that revisits were effective. Also, the AIRS Ghana team worked with stakeholders at different levels to enhance and strengthen IEC activities. Efforts to improve coverage in East and West Mamprusi included a live broadcast by the representative of the Naa Yiri (King of the Mamprugu Kingdom) to appeal to the people of the Mamprugu Kingdom to give spray access to their rooms.
4. Reduced daily output: As a result of the implementation of the bio monitoring, SOPs were being deployed late during the testing days and some SOPs with temporary cholinesterase depression had to be reassigned to non-spraying duties. Solution: The lost man hours were made up by extending the number of spray days.
5. Some positions on the Ghana PMI AIRS team were not filled before spray operations started or were filled only just before the start due to the transition to Task Order Six. Also, a number of the posts were held by either new staff or existing staff new to the post. Solution: The team worked hard to bring the new staff to the level of competency required by the project.

6. The number of traffic incidents (one car and two motorbike accidents) was unacceptably high. All three accidents were most likely due to driver negligence. Solution: Strict supervision measures were introduced and temporary staff handling cars and motorbikes were warned to increase the safety while on the road.
7. Bio monitoring had an effect on the team's workload, spray schedule, and the duration of the spray operation. Solution: If the bio monitoring continues, AIRS Ghana will conduct a detailed planning exercise to inform all involved parties on human and other resources required.

## 10.2 RECOMMENDATIONS

1. With worn-out parts on Goizper pumps causing the pumps to malfunction, as many Hudson pumps as possible should be repaired to replace some of the Goizper pumps. Also, Ghana has a stock of unused eight-liter Hudson pumps. It is recommended that control flow valves for Hudson pumps be obtained and fitted onto the eight-liter Hudson pumps so that they can be used in future spray campaigns.
2. Although district-level stakeholder engagement is a good way to improve collaboration and eventually improve spray coverage, community-level communication especially with community-level leaders – Chiefs, opinion leaders, and respected community elders – is a far more effective way to increase spray coverage. Future collaboration efforts should focus more on community-level rather than district-level engagement.
3. If future IRS operations are to include biomonitoring, the number of SOPs trained should have a 10% or more buffer. This will ensure that there will be enough replacements if some SOPs have to be reassigned to other duties due to biomonitoring results.
4. IEC/ BCC activities should be intensified. More women and women's groups should be involved in the dissemination of IEC/BCC messages and men should be encouraged to effectively participate in the preparation of households for spray operations.
5. The effectiveness of radio programs should be assessed and the programs maintained if the survey shows them to be an effective communication tool.
6. Targeted radio programs should be organized in a way that Senior Chiefs and other leaders give specific messages on IRS and communities are mobilized to listen.
7. A session on defensive driving/ riding techniques should be included in both TOT and SOP trainings.
8. Assignment of NMCP/GHS staff should continue in future spray campaigns to help build practical experience on IRS implementation. Disease Control Officers carried out some supervision and the Environmental Health Officers observed end of the day clean up and general EC, however, their focus in 2015 was on community mobilization. It was good, but they should be involved early to gain practical experience and understanding in planning and implementation of IRS. Need NMCP/GHS to provide their embedded staff for a greater length of time.
9. The number of women who were elevated to a supervisory role increased from the 2014 to the 2015 spray campaign. However, the total number of females did not increase. Efforts should be made to increase the number of women taking part in IRS.
10. In 2016, the number of training days for Spray Operators for Kumbungu district should be a minimum of 6 days. Moreover, all new SOPs from other districts also should have at least 6 days of training with focus on spray techniques, data recording, personal protection and EC.

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

**TABLE A-I. IRS 2015 INTERNATIONAL PROCUREMENT ITEMS**

Item	Balance from 2014	Quantity procured	Total	Quantity used	Quantity damaged	Quantity remaining after campaign	Remarks
<b>Pesticide</b>							
Actellic 300 CS	3747	52928	56675	45314	0	11349	12 bottles were used by Entomology for resistance tests
<b>PPE</b>							
Coverall	985	480	1465	1241	509	956	Most of the coveralls were old and therefore were damaged easily.
Boot	634	242	876	689	87	723	
Face Shield	1099	0	1099	842	861	238	
Hand Gloves	133	3120	3253	1460	1453	1796	
Hard Hat	549	64	613	594	63	550	
Head Gear	599	252	851	637	130	721	
Heavy Duty Gloves	58	87	145	85	58	87	
Nose Mask	2368	23880	26248	22650	0	3598	

Item	Balance from 2014	Quantity procured	Total	Quantity used	Quantity damaged	Quantity remaining after campaign	Remarks
<b>Pumps &amp; Accessories</b>							
<b>Hudson pumps &amp; accessories</b>							
Hudson (8 Ltr)	434	0	434	0	0	434	These are pumps are available from pre-2015 spray rounds. They were not used because Actellic 300 CS is not made for pumps without CFV. Now that we have CFV for Hudson pumps, they will be repaired and used in place of some of the Goizper pumps.
Hudson (10 Ltr)	238	0	238	232	46	192	
Hudson (12 Ltr)	51	0	51	51	11	40	
CFV	0	300	300	0	0	300	
Lance Tube	87	0	87	30	2	55	
Nozzle Cap	146	0	146	0	0	146	
Nozzle Body	146	0	146	0	0	146	
Pressure Gauge	98	0	98	71	0	27	
Repair Kit	28	87	115	10	0	105	
Shutoff Valve Body Cap	296	0	296	0	0	296	
Strainer	200	0	200	50	0	150	
Valve Cap	25	0	25	0	0	25	

Item	Balance from 2014	Quantity procured	Total	Quantity used	Quantity damaged	Quantity remaining after campaign	Remarks
<b>Goizper pumps &amp; accessories</b>							
Goizper pumps	280	0	280	250	191	89	Goizper pumps had major damage on parts that are not easily replaceable during spray campaign. Most of the damage is with the plunger and the discharge hole where water is let out after washing.
1066 LDE Fan Yell (Nozzle tip)	135	286	421	219	0	202	
Handle (Trigger)	257	250	507	319	0	188	
Holes	302	0	302	0	0	302	
IK-12 VC Service Kit	0	50	50	35	0	15	
Lance Tube	0	26	26	26	0	0	
Metallic Adopter	17	0	17	0	0	17	
Pressure Regulator (CFV)	259	168	427	330	0	97	
Tube with Nuts 0.6M (Strainer)	10	64	74	30	0	54	
Bio monitoring Test Kit							
Analyzer	7	8	15	7	0	15	
AchE Kit	17	23	40	23	17	0	
PchE Kit	16	20	36	20	16	0	

**TABLE A-2. IRS 2015 LOCAL PROCUREMENT ITEMS**

Item	Balance from 2014	Quantity procured	Total	Quantity used	Quantity damaged	Quantity remaining after campaign
<b>PPEs</b>						
Apron	56	0	56	55	51	5
Cotton Socks	65	509	574	572	0	2
Neck Cover	851	600	1451	1206	301	1150
<b>IRS Reusable</b>						
Calculator	98	10	108	82	50	58
Fire Extinguisher	40	0	40	38	0	40
Padlock	0	0	0	0	0	0
Pliers	8	0	8	7	1	8
Rinsing Cup	184	276	460	407	265	195
Spray Bag	450	530	980	561	235	745
Spread Sheet	67	989	1056	565	565	491
Staple Machine	19	0	19	15	13	6
<b>IRS Consumables</b>						
Nozzle Brush	450	0	450	437	0	13
Towel	60	599	659	659	0	0
<b>Print Materials</b>						
Club T Shirt	0	150	150	150	0	0
Daily Spray Operator's Card	2224	17776	20000	18429	0	1571
End of Day Cleanup Supv Checklist	592	0	592	0	0	592
Enday of Day Clean-up Checklist	3592	0	3592	0	0	3592
Error Elimin/ Team Leader Card	0	6400	6400	5789	0	611
Home Owner Prep. Checklist	3360	0	3360	0	0	3360

Home Prep Supervisory Checklist	360	0	360	0	0	360
IEC Brochures	3900	0	3900	3900	0	0
PMI/AIRS Anti-Sexual Harassment	0	17	17	17	17	0
IEC Supervisor Card	0	0	0	0	0	0
IEC Welcome the Sprayer	8644	0	8644	8644	0	0
IRS Card/ Stickers	0	66120	66120	66120	0	0
IRS STEPS	8480	0	8480	8480	0	0
Malaria Free Poster	5309	0	5309	5309	0	0
MOI Cards	0	6000	6000	4000	0	2000
Morning Mobi Supervisory Checklist	650	0	650	0	0	650
Performance Tracker	0	20	20	20	0	0
SOP Morning Mobilization Checklist	3610	0	3610	0	0	3610
Stock Card	0	2300	2300	1970	0	330
Store Keeper Performance Checklist	3650	0	3650	0	0	3650
<b>Bio monitoring Consumables</b>						
Alcohol Swab Pad	0	2450	2450	2280	0	170
Atropine Inj.	40	240	280	100	0	180
Cotton Roll	0	10	10	5	0	5
Disposable Container	0	37	37	35	0	2
Exam Gloves (Non-powdered)	0	2350	2350	1150	0	1200
Gauze Bandage	0	60	60	24	0	36
Paster Stripes	0	1850	1850	1507	0	343
Sterile Lancet	0	2650	2650	2500	0	150
Masking Tape	0	10	10	10	0	0
<b>Mobile Phone For Reporting</b>						
Samsung Chat 222	0	18	18	0	0	18
Samsung Galaxy Pocket	0	32	32	31	1	31

# ANNEX B. GHANA IRS ENVIRONMENTAL MITIGATION AND MONITORING REPORT

Mitigation Measure	Status of Mitigation Measures	Outstanding Issues Relating to Required Conditions	Remarks
<b>Ia. Pre-contract inspection and certification of vehicles used for pesticide or spray team transport.</b>	Pre-contract inspection and certification of vehicles was conducted on April 12-13. All vehicles that were contracted met all criteria. A total of 37 vehicles were inspected before they were used for the 2015 spray operations.	No outstanding issues	During the inspection, vehicles that did not meet any of the criteria were replaced.
<b>Ib. Driver training.</b>	All 34 project and rented vehicle drivers were trained in Tamale on April 12. Topics included safety measures for transporting insecticides and safe driving techniques.	No outstanding issues	
<b>Ic. Cell phone, PPE, and spill kits on board during pesticide transportation.</b>	All drivers had cell phones as a pre-requisite before their vehicles were rented. Also, drivers were given a set of PPE to use when transporting insecticides and/ or spray team members. Each vehicle used for the transport of pesticides was equipped with a spill kit. A total of 9,654 morning mobilization vehicle inspections were conducted throughout the 2015 spray campaign. On 9,229 occasions, the vehicle had all required PPE and spill kits. On 425 occasions, the vehicle did not have all required PPE and spill kits, and corrective action was taken before the vehicles left for the field.	No outstanding issues	Spill kit were provided after certification and training.
<b>Id. Initial and 30-day pregnancy testing for female candidates for jobs with potential pesticide contact.</b>	On April 6-7 (before recruitment), initial pregnancy tests were conducted on all female candidates applying for positions as SOPs, Washers, Team Leaders, and Store Assistants. 30 days after the initial test (May 3-7), a second pregnancy test was done. In the initial test (for Team Leaders and SOPs), 188 tests were conducted. After 30 days of spraying, 170 tests were conducted (for Team Leaders, SOPs, and Store Assistants)	No outstanding issues	Females found to be pregnant during the second test were re-assigned to duties unrelated to pesticides 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.

Mitigation Measure	Status of Mitigation Measures	Outstanding Issues Relating to Required Conditions	Remarks
<b>Ie. Health fitness testing for all operators.</b>	Passing a pre-spray general physical/ medical examination is required for spray personnel. All spray personnel candidates had such an exam, on April 6-7: 595 were examined and 589 were declared to be medically fit for training as spray team members.	No outstanding issue	The exam included checking blood pressure, respiratory system, pulse, vision, ear nose and throat, chest condition, and Locometer system. The exam was conducted by qualified Medical Assistants from government health facilities. Candidates who did not pass were not hired. All physical examination records are available on file.
<b>If. Procurement of, distribution to, and training on the use of PPE for all workers with potential pesticide contact.</b>	Both international and local procurements for PPE were done on time. The PPE were received and distributed to all operational sites on time before the start of spray campaign. Also, all candidates with potential pesticides contact were fully trained on correct PPE use.	No outstanding issue	
<b>Ig. Training on mixing pesticides and the proper use and maintenance of spray pumps.</b>	At both TOT and district-level SOP trainings, the trainers 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 Environmental Health Officers in the targeted districts) were trained. A total of 667 people were trained.	No outstanding issue	
<b>Ih. Provision of adequate facilities and supplies for end-of-day cleanup.</b>	Each operational site had an adequate storage facility that was either provided by government or rented from an individual. All facilities were compliant, and had the materials required for clean-up. A total of 9,464 end of day inspections were conducted. 29 of the 9,464 inspections indicated inadequate facility and supplies; immediate corrective actions were taken.	No outstanding issue	Adequate water, barrels, wash basins, and detergents were available at all times at each operational site.
<b>Ii. Enforce clean-up procedures.</b>	All clean-up procedures were inspected as scheduled. Pump clean-up procedures were done in the soak pits as required and supervised by the Site Managers every day throughout the spray campaign. Washing or bathing were supervised by Team Leaders and Field Supervisors. ECOs, COP, DOCs, and operations managers supervised clean-up procedures when present at any operational site. 9,464 end of day inspections were conducted. 9,435 of them reported compliant	No outstanding issues	

Mitigation Measure	Status of Mitigation Measures	Outstanding Issues Relating to Required Conditions	Remarks
	procedures and only 29 reported non-compliant procedures.		
<b>2a. IEC campaigns to inform homeowners of responsibilities and precautions.</b>	Homeowners were fully informed about their roles, responsibilities, and precautions mainly through house-to-house mobilization. In addition, community meetings, radio jingles, and discussions highlighted the roles, responsibilities, and precautions for homeowners before, during, and after their homes are sprayed.	No outstanding issues	Please refer to Chapter 3 of this report for details on IEC strategies that were implemented.
<b>2b. Prohibition of spraying of houses that are not properly prepared.</b>	All houses/ structures that were sprayed were properly prepared. All homeowners, SOPs, Team Leaders, and Field Supervisors were trained on how to prepare structures before spraying is done. Out of 32,010 homeowner preparation inspections carried out, 31,518 indicated that homeowners and SOPs were compliant. However, 492 of the inspections showed some form of non-compliant issues. In all non-compliant cases, actions were taken to address the situation.	No outstanding issues	
<b>2c. Two-hour exclusion from house after spraying.</b>	SOPs reminded households to wait two hours after spraying before they open the rooms to allow circulation of air for at least 30 minute before cleaning. Homeowners were advised to bury dead insects and wash their hands with soap and water after cleaning.	No outstanding issues	
<b>2d. Instruct homeowners to wash itchy skin and go to health clinic if symptoms do not subside.</b>	All homeowners were instructed to wash with plenty water and soap if any household member experienced itching skin, and to visit the nearest clinic if itching persisted. No itching was reported.	No outstanding issues	
<b>3a. Indoor spraying only.</b>	SOPs sprayed only the indoor of sleeping rooms. This included inner walls, ceiling, and eaves of all sleeping rooms.	No outstanding issues	
<b>3b. Training on proper spray technique</b>	All SOPs and Team Leaders were trained on standard spray techniques. This included emphasizing 1 meter distance away from the “sprayable” surface, keeping the nozzle tip 45cm from the “sprayable” surface, and spraying at the correct speed. There was constant supervision in the field to ensure that SOPs adhere to all BMPs.	No outstanding issues	It is recommended that the number of days for SOP training should be a minimum of six days, especially for new SOPs.

Mitigation Measure	Status of Mitigation Measures	Outstanding Issues Relating to Required Conditions	Remarks
<b>3c. Maintenance of pumps.</b>	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	There should be at least one pump mechanic in each district to service the pumps on weekly basis.
<b>4a. Choose sites for disposal of liquid wastes according to PMI BMPs.</b>	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.	No outstanding issues	
<b>4b. Construct soak pits with charcoal to adsorb pesticide from rinse water.</b>	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 2 ×1×1 meters. They were sloped toward the bio bed. Construction was supervised by AIRS ECO and EPA.	Discussions on the construction of mobile soak pits at Singa operational site (Kumbungu district)	There are discussions to consider mobile soak pits for Singa. This discussion will be concluded before planning for 2016 spray campaign.
<b>4c. Maintain soak pits as necessary during season.</b>	All soak pits were either newly constructed or refurbished to BMP standards. During the entire spray period, there was no need to do any form of renovation. All soak pits lasted throughout the spray campaign.	No outstanding issues	
<b>4d. Inspection and certification of solid waste disposal sites before spray campaign.</b>	All solid waste generated will be incinerated at a waste management and recycling company in Takoradi called Zoil Services Limited. Site inspections were done by the COP, Operations Manager, ECO, and Finance and Administrative Manager in early January 2015. The site was also visited by an ECO from the project home office, Albert Acquaye, during the SEA. The facility had all needed registrations and equipment that meet BMP standards.	No outstanding issues	The facility has been duly certified by EPA in the past and is currently under review for a renewal of certification.
<b>4e. Monitoring waste storage and management during campaign.</b>	Wastes were stored and managed according to PMI BMPs during the spray campaign. There were clearly labeled sacks/ boxes for keeping used nose masks, hand gloves, and all other waste that was generated.	All solids including triple-rinsed empty Actellic 300 CS bottles are currently being stored in warehouses in Tamale. They are yet to be transported to Zoil Services Limited for final disposal. This is expected to be done in early July 2015.	
<b>4f. Monitoring disposal procedures post-campaign.</b>	Waste disposal will be done at Zoil Services Limited, which has already been inspected and meets requirements for waste disposal. The ECO will monitor the post-spray campaign solid waste procedure.	Yet to be sent to ZOIL Services Limited, Takoradi	Action yet to be taken. It is planned for July 2015.

Mitigation Measure	Status of Mitigation Measures	Outstanding Issues Relating to Required Conditions	Remarks
<b>5a. Maintain records of all pesticide receipts, issuance, and return of empty sachets/bottles.</b>	Records of all pesticides receipts, issuance, and returned empties were kept on stock cards with a backup in a ledger books at the regional, district, and operational site level.	No outstanding issues	
<b>5b. Reconciliation of number of houses sprayed vs. number of sachets/bottles used.</b>	In Ghana, the average number of structures sprayed per bottle is 4.5-5. This indicator was calculated daily throughout the spray campaign to ensure that insecticides usage is consistent with number of structures sprayed.		
<b>5c. Visual examination of houses sprayed to confirm pesticide application.</b>	Team Leaders, Field Supervisors, Senior Supervisor, and M&E team performed regular spot checks in sprayed houses to verify/ confirm insecticides application. This was mainly done through visual examination of sprayed walls, eaves, and ceilings.	No outstanding issues	
<b>5d. Perform physical inventory counts during the spray season.</b>	ECO, Logistics and Procurement Coordinator, District Logistics Assistants, DOCs, Store Assistants, Operation Manager, and COP performed regular inventory counts throughout the spray campaign across all the operational sites. No missing inventory was recorded.	No outstanding issues	All inventory stock cards are available and were used for final inventory reconciliation.

# ANNEX C. GHANA MONITORING AND EVALUATION PLAN INDICATOR MATRIX

**AIRS Project**  
**Ghana Monitoring and Evaluation Plan Indicator Matrix**  
**UPDATED: June 12, 2015**

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
<b>Component I: Establish cost-effective supply chain mechanisms and execute logistical plans</b>								
<b>I.1 Procurement</b>								
1.1.1 Number and percentage of insecticide procurements that had a pre-shipment quality assurance/ quality control test at least 60 days prior to spray campaign	<i>Data source:</i> Project records – insecticide procurements  <i>Reporting frequency:</i> Each spray campaign	By Spray Campaign	1; 100%	1; 100%	TBD; 100%		TBD; 100%	
1.1.2 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	<i>Data source:</i> Project records – international procurements  <i>Reporting frequency:</i> Each spray campaign	By Spray Campaign	1; 100%	1; 100%	TBD; 100%		TBD; 100%	
1.1.3 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	<i>Data source:</i> Project records  <i>Reporting frequency:</i> Each spray campaign	By Spray Campaign	1; 100%	0; 0% (was not delivered 30 days prior to spray)	TBD; 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
1.1.4 Number and percentage of local procurements of PPE delivered 14 days before the start of spray operations	<i>Data source:</i> Project records <i>Reporting frequency:</i> Each spray campaign	By Spray Campaign	1; 100%	1; 100%	TBD; 100%		TBD; 100%	
1.1.5 Successfully completed spray operations without an insecticide stock-out	<i>Data source:</i> Project records <i>Reporting frequency:</i> Each spray campaign	By Spray Campaign	Completed	Completed	Completed		Completed	
<b>1.2 In-Country Exemption and Custom Clearance Process</b>								
1.2.1 Complete exemption and clearance process within the minimum 2 weeks	<i>Data source:</i> Project records <i>Reporting frequency:</i> Each spray campaign	By Spray Campaign	Completed	Completed	Completed		Completed	
<b>1.3 In-Country Logistics, Warehousing, and Training</b>								
1.3.1 Number and percentage of logistics and warehouse managers trained in IRS supply chain management	<i>Data source:</i> Training records <i>Reporting frequency:</i> Each spray campaign	By Spray Campaign By Gender	21; 100%	22; 100%	TBD; 100%		TBD; 100%	
1.3.2 Number and percentage of base stores where physical inventories are verified by up-to-date stock records	<i>Data source:</i> Project records <i>Reporting frequency:</i> Each spray campaign	By Spray Campaign	16; 100%	16; 100%	TBD; 100%		TBD; 100%	
1.3.3 Submit up-to-date inventory records 30 days after the end of each spray campaign	<i>Data source:</i> Project records <i>Reporting frequency:</i> Each spray campaign	By Spray Campaign	Completed	Completed	Completed		Completed	

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
<b>Component 2: Implement safe and high-quality IRS programs and provide operational management support</b>								
<b>2.1 Planning and Design of IRS Programs</b>								
2.1.1 Annual PMI AIRS country work plan developed and submitted on time	<i>Data source:</i> Project records <i>Reporting frequency:</i> Annually	By Spray Campaign	Completed	Completed	Completed		Completed	
2.1.2 Percentage reduction in project operational expenses per structure from the previous year, excluding insecticide costs	<i>Data source:</i> Project financial records <i>Reporting frequency:</i> Annually	By Spray Campaign	5%	TBD	5%		5%	
<b>2.2 Support of Safety and Health Best Practices and Compliance with USAID and Host Country Environmental Regulations</b>								
2.2.1 SEA/letter reports submitted on time based on schedule agreed upon with the-PMI COR team	<i>Data source:</i> Project records – submitted SEAs/ letter reports <i>Reporting frequency:</i> Each spray campaign	By Spray Campaign	Completed	Completed	Completed		Completed	
2.2.2 Number of spray personnel trained in environmental compliance and personal safety standards in IRS implementation <sup>7</sup>	<i>Data source:</i> Project records – Training reports <i>Reporting frequency:</i> Each spray season	By Spray Campaign By Gender	648	651 <sup>8</sup> (459 male, 192 females; 29.5% female)	TBD		TBD	
2.2.3 Number of health workers receiving insecticide poisoning case management training	<i>Data source:</i> Project records – Training reports <i>Reporting frequency:</i> Each spray season	By Spray Campaign By Gender	44	31 (29 male, 2 female; 6.5% female)	TBD		TBD	

<sup>7</sup> This includes Site Managers (16), Field Supervisors (46), Team Leaders (92) and Spray Operators (497).

<sup>8</sup> Site Managers 16 (16M, 0F), Field Supervisors 46 (42 M, 4 F), Team Leaders 92 (72M, 20F), SOPs 497 (329M, 168F)

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
2.2.4 Number of adverse reactions to pesticide exposure documented	Data source: Incident report forms  Reporting frequency: Each spray campaign	By Spray Campaign  By Residential/ Occupational Exposure	0	0	0		0	
2.2.5 Number and percentage of soak pits and storehouses inspected and approved prior to spraying	Data source: Project records – Reports submitted by district environmental officers  Reporting frequency: Each spray season	By Spray Campaign  By Soak Pit  By Storehouse	16; 100%	16; 100%	TBD; 100%		TBD; 100%	
<b>2.3 Conduct Communications Activities and Community Mobilization</b>								
2.3.1 Number of radio spots and talk shows aired	<i>Data source:</i> Project records  Reporting frequency: Per spray campaign	By Spray Campaign	472 jingles 28 talk shows <sup>9</sup>	513 jingles 11 talk shows 298 radio announcements	TBD		TBD	
2.3.2 Number of IRS print materials disseminated	Data source: Project records  Reporting frequency: Semi-annually	By Spray Campaign  By Type of printed material and message(s)	26,333	26,333(22,433 posters and 3,900 brochures)	TBD		TBD	

<sup>9</sup> There will be 444 jingles and 28 radio talk shows for year 1.

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	Data source: Mobilization Data Collection Forms  Reporting frequency: Daily per mobilization conducted	By Spray Campaign  By Gender	289,353 <sup>10</sup>	214,864	TBD		TBD	
<b>2.4 Spray Targeted Structures According to Technical Specifications</b>								
2.4.1 Number of structures targeted for spraying	Data source: Previous spray campaign data, enumeration data (targets); Daily Spray Operator Forms (results)  Reporting frequency: Daily per spray campaign	By Spray Campaign	231,345	224,592	TBD		TBD	
2.4.2 Number of structures sprayed with IRS	Data source: Daily Spray Operator Forms  Reporting frequency: Daily per spray campaign	By Spray Campaign	196,643 <sup>11</sup>	205,935	TBD		TBD	
2.4.3 Percentage of total structures targeted for spraying that were sprayed with a residual insecticide (Spray Coverage)	Data source: Daily Spray Operator Forms  Reporting frequency: Daily per spray campaign	By Spray Campaign	85%	91.7%	85%		85%	
2.4.4 Number of people residing in structures sprayed (Number of people protected by IRS)	Data source: Daily Spray Operator Forms  Reporting frequency: Daily per spray campaign	By Spray Campaign  By Gender  By pregnant	596,706	553,954 (11,676 pregnant women, 98,525 children)	TBD		TBD	TBD

<sup>10</sup> 50% of targeted population for 2015 campaign, 596,706

<sup>11</sup> 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
		women By children <5 years		under 5 years)				
<b>Component 3: Ongoing Monitoring and Evaluation and Quality Control Measures</b>								
3.1 Submit PMI-approved M&E plan to PMI-Ghana for approval	Data source: Project records Reporting frequency: Semi-annual	By Spray Campaign	Completed	Completed	Completed		Completed	
3.2 Conduct a post-spray data quality audit within 60 days of completion of spray operations	Data source: Spray operations reports Reporting frequency: Per spray campaign	By Spray Campaign	Completed	N/A	Completed		Completed	
<b>Component 4: Contribute to Global and Country-Level IRS Policy Setting and Develop and Disseminate Experiences and Best Practices</b>								
4.1 Number of guidelines/checklists/tools related to IRS operations developed or refined with project support	Data source: Project records – Activity reports Reporting frequency: Semi-annually	By Spray Campaign By Guideline /checklist/tool	TBD	N/A	TBD		TBD	
4.2 Number of articles/best practices documents published	Data source: Project records – Activity reports Reporting frequency: Semi-annually	By Spray Campaign By IRS Technical Area	TBD	TBD	TBD		TBD	
4.3 Number of best practice presentations given at national/regional/international workshops and conferences	Data source: Project records – Activity reports Reporting frequency: Semi-annually	By Spray Campaign By IRS Technical Area	TBD	Ongoing	TBD		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
4.4 Number of enterprises engaged through public-private partnerships	Data source: Project records – Activity reports  Reporting frequency: Semi-annually	By Spray Campaign	TBD	N/A	TBD		TBD	
<b>Component 5: Contribute to the Collection and Analysis of Routine Entomological and Epidemiological Data</b>								
<b>5.1 Support Entomological Monitoring Activities and Insecticide Resistance Strategies</b>								
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 )	Data source: Entomological reports (End of Spray report)  Reporting frequency: Annually	By Spray Campaign	14	14	TBD		TBD	
5.1.2 Number and percentage of entomological monitoring sentinel sites measuring all the five primary PMI entomological monitoring indicators	Data source: Entomological reports  Reporting frequency: Annually	By Spray Campaign	14, 100%	14, 100%	TBD		TBD	
5.1.3 Number and percentage of entomological monitoring sites measuring at least one secondary PMI indicator	Data source: Entomological reports  Reporting frequency: Annually	By Spray Campaign	14, 100%	14, 100%	TBD		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	Data source: Entomological reports  Reporting frequency: Annually	By Spray Campaign	10, 100%	3: 30% ongoing	TBD		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
5.1.5 Number of wall bioassays conducted within 2 weeks of spraying to evaluate the quality of IRS	Data source: Entomological reports Reporting frequency: Per spray campaign	By Spray Campaign	24, 100%	44,	TBD		TBD	
5.1.6 Number of wall bioassays conducted after the completion of spraying at monthly intervals to evaluate insecticide decay	Data source: Entomological reports Reporting frequency: Per spray campaign	By Spray Campaign	128, 100%	52 (done so far) - Ongoing	TBD		TBD	
5.1.7 Number of vector susceptibility tests for different insecticides conducted in selected sentinel sites	Data source: Entomological reports Reporting frequency: Per spray campaign	By Spray Campaign By Type of Insecticide	40, 100%	13 done so far <sup>12</sup> Ongoing	TBD		TBD	

<sup>12</sup> Pirimiphos methyl 0.25% (3); Fenitrothion 1% (1); Alpha-cypermethrin 0.5% (2); Deltamethrin 0.05% (1); Propoxur 0.1% (2); Bendiocarb 0.1% (2); DDT 4% (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
<b>5.2 Support Epidemiological Malaria Data Collection and Analysis</b>								
5.2.1 Collect routine epidemiological data	Data source: Project Reports Reporting Frequency: Annually	By Spray Campaign	N/A	N/A	TBD		TBD	
5.2.2 Number of targeted health facilities with routine epidemiological malaria data collection supported by the PMI AIRS Project	Data source: Epidemiological reports Reporting frequency: Annually	By Spray Campaign	N/A	N/A	TBD		TBD	
<b>Component 6 (Cross-cutting): Capacity Building, Knowledge Transfer, Gender Inclusion</b>								
<b>6.1 Increasing the Role of Women and Addressing Gender Barriers</b>								
6.1.1 Number of people trained to deliver IRS in target districts*	Data source: Project records – Training reports Reporting frequency: Semi-annually	By Spray Campaign  By Gender  Percentage of Women Trained	707	698 (504 male, 194 females; 27.8% females)	TBD		TBD	
6.1.2 Total number of people trained to support IRS in target districts	Data source: Project records – Training reports Reporting frequency: Semi-annually	By Spray Campaign  By Gender  Percentage of women trained	1,629	1,544(1,252 males, 292 females; 18.9% females)	TBD		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 of women recruited for IRS employment	Data source: Project records – Recruitment reports reports  Reporting frequency: Semi-annually	By Country  By Percentage of women recruited	258 <sup>13</sup>	306 (20.8%)	TBD		TBD	
6.1.4 Number of people trained as IRS Training of Trainers	Data source: Project records – Training reports  Reporting frequency: Semi-annually	By Spray Campaign  By Gender  Percentage of women trained	82	78 (74 males, 4 females; 5.1% females)	TBD		TBD	
6.1.5 Total number of people hired to support IRS in target districts	Data source: Project records – Contracts signed  Reporting frequency: Semi-annually	By Spray Campaign  Gender  Percentage of women hired	678	1,471 (1,165 males, 306; 20.8% females)	TBD		TBD	
6.1.6 Number of women hired in supervisory roles in target districts (includes site supervisors, team leaders, M&E assistants and others who supervise seasonal staff) <sup>14</sup>	Data source: Project records – Contracts signed  Reporting frequency: Semi-annually	By Spray Campaign  Percentage of women hired	17 <sup>15</sup>	27 <sup>16</sup>	TBD		TBD	

<sup>13</sup> 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.

<sup>14</sup> People counted includes: Site Managers, Field Supervisors, IEC Assistants, M&E Assistants, Logistics Assistants, and Team Leaders

<sup>15</sup> 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 females.

<sup>16</sup> Site Managers (0), Field Supervisors (3), IEC Assistants (2), M&E Assistants (1), Logistics Assistants (1) and Team Leaders (20)

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
6.1.7 Number of staff (permanent and seasonal) who have completed gender awareness training	Data source: Project records – Training reports  Reporting frequency: Semi-annually	By Spray Campaign  Gender  Percentage of women hired	22 <sup>17</sup>	20 <sup>18</sup>	TBD		TBD	
<b>6.2 Capacity Building</b>								
6.2.1 Number of government officials trained in IRS oversight	Data source: Project records – Training reports  Reporting frequency: Semi-annually	By Spray Campaign  By Gender  Percentage of Women Trained	10	11 (11 males, 0 females; 0% female)	TBD		TBD	
6.2. Implement all activities outlined in their yearly Capacity Building Action Plan	Data source: Project records – Capacity assessment reports  Reporting frequency: Semi-annually	By Spray Campaign	Completed	Completed partially (2 out of 3 activities completed); one to be done soon.	Completed		Completed	
6.2.3 Ghana government implements at least one aspect of the IRS program independently.	Data source: Project records – memoranda of understanding  Reporting frequency: Semi-annually	By Spray Campaign	N/A	N/A	TBD		TBD	

<sup>17</sup> 22 permanent staff will be trained in year 1

<sup>18</sup> 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.

