



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

GHANA END OF SPRAY REPORT
SPRAY CAMPAIGN: APRIL 29 - JUNE 28, 2013

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ACRONYMS

AIRS	Africa Indoor Residual Spraying
A&P	Anemia and Parasitemia
BCC	Behavior Change Communication
BMP	Best Management Practice
CBS	Community-based Surveillance
CDC	Centers for Disease Control and Prevention
CS	Concentrated Suspension
DA	District Assembly
DEV	Data Entry Verification form
DCV	Data Collection Verification form
EE	Error Eliminator form
EPA	Environmental Protection Agency
GHS	Ghana Health Service
GHI	Global Health Initiative
HLC	Human Landing Catch
IEC	Information, Education and Communication
IRS	Indoor Residual Spraying
KCCR	Kumasi Center for Collaborative Research
LLIN	Long-lasting Insecticide Net
M&E	Monitoring and Evaluation
MaVCOC	Malaria Vector Control Oversight Committee
MOH	Ministry of Health
NIRMOP	National Insecticide Resistance Monitoring Partnership
NMCP	National Malaria Control Program
NMIMR	Noguchi Memorial Institute for Medical Research
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
PSC	Pyrethrum Spray Catch
PSDQA	Post-Spray Data Quality Assessment
PSECA	Pre-Season Environmental Compliance Assessment
QA/QC	Quality Assurance/Quality Control
SOC	Spray Operations Coordinator

SOP	Spray Operator
TOT	Training of Trainers
USAID	United States Agency for International Development
USG	United States Government
WHO	World Health Organization

EXECUTIVE SUMMARY

The President's Malaria Initiative (PMI) has been funding indoor residual spraying (IRS) in Ghana since 2008 with the aim of reducing the malaria burden, especially among children less than five years old and pregnant women. In August 2011, Abt Associates was awarded a three-year Africa-wide IRS (AIRS) project, funded by the United States Agency for International Development (USAID) under PMI.

Ghana started spraying in five districts as a pilot in 2008 and gradually scaled up to nine districts in 2011. In 2013, the number of IRS districts was decreased to four as a result of increased vector resistance to pyrethroids, necessitating the use of a significantly more expensive long-lasting organophosphate (Actellic CS). Behavior change communication (BCC) activities still continued in the five previous IRS districts to ensure that residents continued to utilize other forms of malaria prevention, especially long-lasting insecticide treated nets (LLINs), in the absence of IRS.

According to the entomological data on vector densities, IRS would be most effective between April and June. Therefore, the 2013 spray campaign was shortened from 65 days to 45 days in order to complete IRS before the rainy season started and vector density peaked. This reduction in number of spray days led to a corresponding increase in the number of spray operators (SOPs) and other seasonal staff. A new, lighter pressure pump (Goizper ik12) was also piloted in Savelugu-Nanton District and East Mamprusi District.

Local temporary staff were recruited and trained for 2013 spray operations, well before the start of spraying. Logistics and environmental compliance assessments were carried out to ensure that the standard operating procedures and BMP were followed. Stakeholder, partner planning, and community sensitization meetings were also held in order to create the necessary awareness and effective involvement of all stakeholders for successful spray operations.

A total of 192,685 structures were targeted to be sprayed in the four districts. Spraying began on April 29, 2013 and ended on June 21, 2013 in Bunkpurugu-Yunyoo District and East Mamprusi District. Spray operations ended on June 22, 2013 in Savelugu-Nanton District and on June 28, 2013 in West Mamprusi District. AIRS Ghana sprayed 197,655 structures: 4,970 more than the 192,685 targeted structures enumerated by SOPs in 2012.

TABLE I. AIRS GHANA AT A GLANCE

Number of districts covered by PMI-supported IRS in 2013	4 districts: (Bunkpurugu-Yunyoo, East Mamprusi, Savelugu-Nanton, West Mamprusi)
Insecticide	Organophosphate (Actellic 300 CS)
Number of structures covered by PMI-supported IRS in 2013	197,655
Number of structures found by SOPs during 2013 PMI-supported IRS spray season	216,876
2013 spray coverage	91.1%
Population protected by PMI-supported IRS in 2013	534,060 (including 11,617 pregnant women and 102,115 children under 5 years old)
Dates of PMI-supported IRS campaign	April 29 to June 28, 2013
Length of campaign	53 days
Number of people trained with U.S. Government funds to deliver IRS ¹	Overall: 669

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

I. INTRODUCTION

Malaria prevention and control is a major foreign assistance objective of the U.S. Government (USG). In May 2009, President Barack Obama announced the Global Health Initiative (GHI), a multi-year, comprehensive effort to reduce the burden of disease and promote healthy communities and families around the world. Through the GHI, the United States will help partner countries improve health outcomes, with a particular focus on improving the health of women, newborns, and children. PMI is a core component of the GHI. PMI was launched in June 2005 as a five-year, \$1.2 billion initiative to rapidly scale up malaria prevention and treatment interventions and reduce malaria-related mortality by 50 percent in 15 high-burden countries in sub-Saharan Africa. With passage of the 2008 Lantos-Hyde Act, funding for PMI has now been extended through fiscal year 2014. Ghana was identified as one of the African countries to benefit from PMI support in December 2006.

IRS is a major component of Ghana's current National Malaria Control (NMCP) Strategy, with the goal to protect one third of Ghana's districts with IRS by 2015. Ghana began implementing IRS with the support of PMI in 2008, by spraying five northern region districts (Tolon-Kumbungu, Savelugu-Nanton, West Mamprusi, Gushegu, and Karaga), which covered approximately 601,000 people. The number of beneficiary districts was steadily scaled up to nine by adding four new districts (East Mamprusi, Saboba, Chereponi, and Bunkpurugu-Yunyoo) by the close of 2011, covering up to approximately 941,240 people in 2012. In 2013, the number of districts was scaled down from nine to four. The four districts sprayed were Savelugu-Nanton, East Mamprusi, West Mamprusi and Bunkpurugu-Yunyoo. Table 2 gives an overview of the number of districts sprayed each year and the population protected.

TABLE 2. NUMBER OF DISTRICTS AND POPULATION PROTECTED SINCE 2008

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

The following objectives were achieved during 2013 IRS operations:

- The Ghana IRS team ensured high coverage of IRS. As in previous years, AIRS achieved greater than 90 percent coverage of sprayable structures in the targeted districts consistent with NMCP goals.
- The Ghana IRS team continued to work in partnership with the Ghana Health Service (GHS) and NMCP to plan and implement IRS operations in the targeted districts and to promote uniformity of IRS in those districts supported by Global Fund/ AngloGold Ashanti and other partners, such as Zoomlion Ghana Ltd., who were to be invited to collaborate during planning and implementation to emphasize a standardized, participatory, and comprehensive approach to IRS (joint planning, information sharing, training opportunities, shared facilities, etc.)
- The Ghana IRS team provided technical support to local staff and community members for

implementation of IRS operations. This support includes conducting training for seasonal spray staff, such as SOPs, community-based surveillance (CBS) volunteers, district data managers, etc.

- The Ghana IRS team provided financial and technical support for entomological monitoring with the support of Noguchi Memorial Institute for Medical Research (NMIMR). This included monthly entomological evaluations which were conducted by trained field technicians under the direct supervision of the Abt Entomologist, and they incorporated insecticide resistance evaluation. The Noguchi team provided quarterly technical oversight and performed the advanced molecular evaluations. The entomologic monitoring program also generated critical data on the efficiency and effectiveness of the spray program and potency of the insecticide which was used for vector control decision making.
- The Ghana IRS team continued to assist the U.S. Centers for Disease Control and Prevention (CDC) and NMIMR to monitor anemia and parasitemia (A&P) levels among children under five years of age during the dry and rainy seasons as part of a PMI operational research study. The project also supported a follow-on A&P survey in October 2013 as part of routine epidemiologic monitoring.
- The Ghana IRS team continued to oversee and support the Ghana IRS Scoping Exercise. This exercise was supposed to have been completed in 2012 but due to complications, it was carried out in 2013. The objective of this exercise was to identify in which locations in Ghana IRS could potentially have a greater impact on reducing malaria morbidity and mortality than the current northern districts. The results of this exercise will be used for future planning.
- The Ghana IRS team supported the establishment of a National Insecticide Resistance Network by working with Noguchi to finalize the Malaria Vector Control Oversight Committee (MaVCOC) concept paper and provided technical assistance to Noguchi to establish a functioning network by the end of 2013.

2. PRE-SPRAY ACTIVITIES

2.1 DISTRICT SELECTION

In 2013, the AIRS Ghana team conducted IRS in four districts in the northern region of Ghana. The four targeted districts were selected based on several factors, including (1) close proximity to each other and to major roads, allowing for efficient transportation during spraying; (2) high malaria prevalence and vulnerability of the local populations; and (3) capacity to provide valuable monitoring data to guide future IRS decisions. The target districts in 2013 were Savelugu-Nanton, West Mamprusi, East Mamprusi, and Bunkpurugu-Yunyoo.

Bunkpurugu-Yunyoo is a study district with a well-studied baseline, and where anemia and parasitemia (A&P) surveys can be continued. This data will allow us to gauge the impact of changing pesticide class on malaria prevalence.

East Mamprusi has a main hospital, Nalerigu Baptist Medical Center, which provides the best available longitudinal health facility data for tracking the impact of IRS on malaria case burdens. As compared with other hospitals in the original nine districts, Nalerigu Baptist Medical Center has by far the most voluminous and consistent malaria slide data. PMI has collected and analyzed data from 2006 to present and will continue to track this hospital's malaria indicators.

Savelugu-Nanton is an entomologic monitoring district, with data from community monitoring sites going back to 2008. The data is readily compared with nearby sites in an unsprayed district (Tamale), to assess IRS impact.

West Mamprusi was chosen mainly for logistical/economic reasons, because it lies between East Mamprusi and Savelugu-Nanton, along the main roads, providing a contiguous block for spraying. West Mamprusi is also a major source of patients for the Nalerigu hospital (approx. 15 percent of malaria cases).

Tolon-Kumbungu district was used for entomological monitoring because there is a sentinel site located there. The following table shows the approximate number of target structures and population in each of the districts for the 2013 campaign based on 2012 data:

TABLE 3. TARGETED NUMBER OF STRUCTURES AND POPULATION FOR 2013 SPRAY CAMPAIGN

District	Approximate # of Target Structures	Approximate Population
Savelugu-Nanton	43,520	102,646
West Mamprusi	61,939	152,106
East Mamprusi	49,628	127,816
Bunkpurugu-Yunyoo	37,598	88,165
TOTAL	192,685	470,733

2.2 INSECTICIDE SELECTION

The AIRS Ghana team, NMIMR, PMI, GHS, NMCP, and the MaVCOC analyzed all entomological data and based on the evidence, decided that an organophosphate, Actellic CS, would be most effective and appropriate for IRS use in the 2013 spray round. This decision was based largely on the susceptibility of the local vectors and residual effect (see section 6 of this document for susceptibility results).

Stocks of on-hand insecticide underwent quality assurance testing in Ghana prior to the beginning of spraying. Insecticides procured for the 2013 campaign were held at the port for several weeks due to communications issues with the distributor; as such, the team sent samples internationally for testing after clearing it from customs. Of the two quality assurance tests done in South Africa, one showed that the insecticides did not meet World Health Organization (WHO) standards, while the other from a different laboratory showed that the insecticide still met all standards. Additional testing done at a United Kingdom-based laboratory following the proper protocol showed that the insecticide did still meet all necessary WHO standards. Based on these results, PMI decided that AIRS could proceed with the spray campaign.

2.3 MICRO-PLANNING

Micro planning meetings were a critical element for the successful implementation of this year's IRS operations. As part of the preparations for the 2013 IRS operation, five planning meetings were held with key partners and stakeholders, including staff from the GHS, NMCP and District Assemblies (DAs). The first meeting was a regional meeting which was held in Tamale on January 21, 2013. The other four meetings were held at the district level between February 10 and 20, 2013 and were held in each of the four districts. At the district level, the planning meetings were held with the District Health Directorate and the DAs. The meetings focused on the following critical issues:

- Timing of spray operations;
- Spray campaign duration;
- Roles and responsibilities of partners;
- Insecticide selection;
- Procurement and logistics;
- Spray performance target;
- Monitoring and Supervision plan;
- Recruitment of SOPs;
- Commencement date for spray operations;
- Role of stakeholders before, during and after spray operations; and
- Sanctions for SOPs involved in pilfering insecticide or other IRS commodities.

Similar meetings were also held at district and sub-district levels to ensure that all categories of stakeholders effectively participated in the decision making process.

2.4 ENVIRONMENTAL AND LOGISTICS ASSESSMENT

For efficiency and effectiveness operations and environmental staff worked together and performed their respective assessments as a team. All 16 operational sites in the four districts were visited. The team inspected the appropriateness of the sites and noted areas that were needed for improvement.

The AIRS Environmental Compliance Officer, District Environmental Officers and officials from GHS undertook a formal joint pre-season environmental assessment and conducted compliance inspections from February 4 to 14, 2013 in all four districts. All 16 soak pits constructed in 2011 and existing storage facilities appeared to be in good condition. However, there were minor cracks in some soak pits that required cement patches. The cracked concrete floors were repaired before the start of spray operations. Widow cups and storage facility roofs that needed replacement were changed to ensure that wind-driven rains did not seep into insecticide storage facilities. A new site with a soak pit and a storage facility was also constructed in Nasuan, a Konkomba-dominated community in Bunkpurugu-Yunyoo District, to separate Konkomba SOPs from the Bimoba SOPs due to the tribal conflict between the two. Seven out of the fifteen warehouses were also painted. A letter report was written and submitted to PMI that summarized key environmental compliance indicators.

The introduction of smart phones for the purposes of collecting environmental compliance data during assessments was a significant innovation for the 2013 IRS campaign. With assistance from the AIRS Environmental Compliance Manager in Bethesda, data for pre-season, mid-season and post-season environmental compliance assessments and inspections were uploaded using an inspection checklist. This innovation facilitated easier data collection and more robust supervision.

The logistics team was led by the Operations Manager. The team's role was to assess the availability and state of all commodities needed for the 2013 campaign.

The following activities were carried out:

- Inspected storage facilities, wash bays, and soak pits, and reached consensus on strategies to ensure that all facilities met the minimum standards
- Assisted districts in strategizing on how to identify potential partners and engage all stakeholders in IRS activities.
- Quantified the IRS commodities required for 2013 spray season

2.5 PROCUREMENT

A total of 44,352 bottles of Actellic 300 CS were procured for the 2013 spray operations. Because there was a balance of 7,234 bottles left over from the 2012 spray round, the total bottles of Actellic in stock prior to the start of the campaign was 51,586, of which 35 bottles were used for pre-spray quality assurance testing. At the end of the spray season 8,267 bottles of Actellic were left in stock.

A consignment of personal protective equipment (PPE) including coveralls, nose masks, and gloves was received at the project office in Tamale in April 2013. Another package containing repair kits and pressure gauges was received on June 17, 2013. To safeguard the efficacy of the pesticides, the project procured three air conditioners to be installed in the central warehouse in Tamale.

For the complete list of materials procured internationally and locally and stock quantities, see Annex A.

2.6 HR REQUIREMENTS

The district human resource requirements consisted of two groups: (1) district core staff (Spray Operations Coordinators (SOCs), Monitoring and Evaluation (M&E) Coordinators, Information, Education and Communication (IEC) Assistants, Data Assistants, Logistics Assistants) and (2) support staff (Site Managers, Field Supervisors, Team Leaders, SOPs, Store Assistants, Pump Mechanics, washers, water fetchers and security officers).

In addition, some Ghana Health Service Implementers, community-based volunteers and individuals who could read and write were engaged by AIRS Ghana to carry out house-to-house mobilization activities.

Additional human resources were engaged to carry out entomological activities. These included mosquito collectors and supervisors.

2.6.1 TYPES OF TRAININGS AND NUMBER OF PEOPLE TRAINED

All categories of staff were adequately trained to carry out their duties as efficiently as possible. In all, 10 different trainings were organized to ensure that all staff were prepared for the 2013 spray campaign. Table 4 describes the type of trainings organized, their timing, venue, and a brief description.

Overall, a total of 1,681 people were trained to carry out different roles. Out of this, 1,448 were males and the remaining 233 (13.86 percent) were females. Details of the number of people trained at each training are provided in Table 5.

TABLE 4. TYPES OF TRAINING, DURATION, VENUE AND BRIEF DESCRIPTION OF TRAININGS

Type of Training	From	To	Venue	Brief Description
Mobilizers	23/03/13	30/03/13	In all sub-districts	Training was focused on AIRS IEC strategy. Participants were to go back to their communities to sensitize and mobilize households ahead of the 2013 spray campaign.
IEC Assistants	6/03/13	8/03/13	Radach, Tamale	Training on IEC and mobilization strategies, which include sensitization techniques, structure identification and household mobilization data collection. Participants were trained to offer training to mobilizers at the district level.
Logistics and Store Assistants	6/03/13	8/03/13	Tamale	Record and stock keeping of all inventories.
TOT for District M&E Coordinators, SOCs and GHS Staff	10/3/13	16/03/13	Radach, Tamale	Training on spraying techniques, compliance and data capture.
TOT for Site Manager and Supervisors	24/03/13	30/03/13	Walewale,	Training on spraying techniques, compliance and data capture.
SOPs	14/03/13	20/03/13	All 4 districts	Training on spraying techniques and compliance and data capture
Database	21/03/13	23/03/13	Radach, Tamale	Introduction to and use of the 2013 AIRS database for mobilization and spray data entry. Participants were also trained on the data cleaning system, data storage and security systems.
Health Worker/Poison Management	4/04/13	4/04/13	Radach, Tamale	Managing insecticide poisoning at the health facility.
Applied Entomology	17/03/13	23/03/13	Radach, Tamale	Build in-country capacity needed for the execution of an effective entomological surveillance program and also promote better understanding of the IRS program
Drivers	28/4/13	28/4/13	Tamale Office.	Defensive driving techniques, safe driving while driving a vehicle with insecticides

TABLE 5. NUMBER OF PEOPLE TRAINED AT EACH TRAINING

Categories of Persons Trained	Training on IRS Delivery								Other Trainings								TOTAL			
	TOT		Spray Operations		Data Capture		Logistics Training		IEC TOT		IEC Mobilizer Training		Medical Treatment of Intoxication Cases		Fire Security				Applied Entomology Training	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F			M	F
Spray Operations Coordinators	7	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	0
Disease Control Officers	5	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	0
District Environmental Health Officers	5	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	0
SOPs	-	-	371	119	-	-	-	-	-	-	-	-	-	-	-	-	-	-	371	119
Data Assistants	-	-	-	-	8	2	-	-	-	-	-	-	-	-	-	-	-	-	8	2
District M&E Coordinators	4	1	-	-	4	1	-	-	4	1	-	-	-	-	-	-	-	-	4	1
District Supervisors (Entomology)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	76	1	76	1
Logistics/Store Assistants	-	-	-	-	-	-	12	3	4	1	-	-	-	-	-	-	-	-	12	3
Medical Assistants/ Prescribers	-	-	-	-	-	-	-	-	-	-	-	-	32	14	-	-	-	-	32	14
IEC Assistants	-	-	-	-	-	-	-	-	4	1	-	-	-	-	-	-	-	-	4	1
IEC Implementers/ Mobilizers	-	-	-	-	-	-	-	-	-	-	793	80	-	-	-	-	-	-	793	80
Field Supervisors (Spray Operators)	24	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24	0
Store Assistants	7	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	7
Team leaders	48	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48	5
Site Managers	20	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	0
Guards	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	0	-	-	32	0

Categories of Persons Trained	Training on IRS Delivery								Other Trainings								TOTAL			
	TOT		Spray Operations		Data Capture		Logistics Training		IEC TOT		IEC Mobilizer Training		Medical Treatment of Intoxication Cases		Fire Security				Applied Entomology Training	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
TOTAL M/F	120	13	371	119	12	3	12	3	12	3	793	80	32	14	32	0	76	1	1,448	233
TOTAL trained	133		490 ²		15		15		15		873		46		32		77		1,681	

* The yellow cells indicate trainees that qualify under the PMI indicator definition “number of people trained with USG funds to deliver IRS.”³ In 2013, AIRS Ghana trained 669 temporary hires to deliver IRS under PMI’s definition. Out of the 669 temporary hires who were trained, 502 of them were retrained from the previous spray campaign.

2.6.2 NUMBER OF PEOPLE HIRED

A total of 1,387 temporary staff were hired to deliver services during the 2013 IRS campaign. Of these, 192 (13.84 percent) were female and 1,195 were males. This number includes 290 SOPs of which 40 (13.79 percent) were females and 250 (86.21 percent) were males. Details are provided in Table 6.

In addition to the numbers provided in the table, a total of 1,620 CBS Volunteers⁴ from the various communities were engaged for one or two days (depending on the number of days a volunteer’s community was sprayed) to help with community announcements in the evening before the day of spray and on the actual day of spray. Note that CBS Volunteers took part in stakeholder meetings at the sub-district level and through these meetings they were equipped with information about IRS and about their mobilization roles⁵.

² This figure includes all those trained in Spray Operations. A portion of the trainees were hired with some becoming SOPs, while others served as Pump Mechanics, Washers and Water Fetchers. Table 6 provides details on the exact number hired as SOPs, Pump Mechanics, Washers and Water Fetchers. The rest were trained but not hired. More people are trained than hired in case reserves are needed.

³ 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.

⁴ Ideally there are supposed to be two volunteers in each community. There are 789 communities in four districts.

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

TABLE 6. NUMBER AND TYPE OF PEOPLE TEMPORARILY HIRED

Category	Bunkpurugu-Yunyoo		East Mamprusi		Savelugu-Nanton		West Mamprusi		All		Total
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	
Data Assistants	1	1		2	1	1		2	2	6	8
Finance Assistants		1		1	1			1	1	3	4
IEC Assistants		1	1			1		2	1	4	5
Logistics Assistants		1	1			1		2	1	4	5
Mobilizers ⁶	17	215	18	178	5	216	37	155	77	764	841
Pump Mechanics		5		3		3		5	0	16	16
Store Assistant	1	3	1	2	2	1	3	2	7	8	15
Security officers		10		6		6		10	0	32	32
Site Managers		5		3		3		5	0	16	16
SOPs	14	61	13	57	3	57	10	75	40	250	290
Supervisors		6	1	6		5		9	1	26	27
Team Leaders	2	13	2	12		12	1	16	5	53	58
Washers	10	1	8		5	1	11	1	34	3	37
Water Fetchers	3	3	6		3	3	10	1	22	7	29
M&E Coordinators				1	1			2	1	3	4
Total	48	326	51	271	21	310	72	288	192	1,195	1,387

Note: The M&E Coordinator for Bunkpurugu-Yunyoo District was trained and initially hired but fell ill and could not join the project for the 2013 spray campaign. The M&E Manager and Database Manager covered this gap by alternating their schedules to support Bunkpurugu-Yunyoo District.

⁶ Mobilizers were engaged for 14 days prior to start of spray operations to conduct house-to-house mobilization. After the 14-day period, their contract ended. These Mobilizers were made up of Ghana Health Service implementers, Community Based Surveillance Volunteer (CBS Volunteers) and Non-Ghana Health Service individuals who could read and write.

3. INFORMATION, EDUCATION AND COMMUNICATION ACTIVITIES

3.1 INTRODUCTION

IEC is very important for successful implementation of an IRS campaign. The IEC activities were particularly designed to facilitate the transfer of information, knowledge and skills to beneficiaries in the IRS districts. The following are the major IEC sensitization activities which were carried out during the 2013 IRS campaign: stakeholder meetings, community level meetings, in-school programs, house-to-house mobilization, radio discussions and video shows. The engagement of beneficiaries, stakeholders and partners ensured open discussions that reached many people of different target groups and was aimed at improving acceptance.

3.2 PRE –SPRAY STAKEHOLDER MEETINGS

Pre-spray stakeholder meetings were held from April 1 to April 14, 2013 in all the target districts. The main purpose of these meetings was to harness ideas and get feedback from beneficiaries and stakeholders to enhance IRS activities. The stakeholders included community leaders, Chiefs, women leaders, representatives from the District Health Office, and representatives from the DA. The meetings also highlighted the role of district authorities in the provision of infrastructure and office space for IRS activities at the district and community level. A total of 17 pre-spray stakeholder meetings were organized in the four operational districts.

3.3 COMMUNITY MEETINGS

As the spray period progressed, community meetings were also carried out in targeted communities that were showing signs of low acceptance. These meetings were aimed at sensitizing the communities about the benefits of IRS. See Table 7 for numbers of meetings and attendance, by district.

TABLE 7. NUMBER OF COMMUNITY MEETINGS HELD AND NUMBER OF PEOPLE ATTENDING

District	# of meetings	Dates	Total Number of people in attendance
Bunkpurugu-Yunyoo	10	April - June	1,092
East Mamprusi	5	April - June	111
West Mamprusi	10	April - June	291
Savelugu-Nanton	21	April - June	2,390
TOTAL	46		3,884

3.4 RADIO PROGRAMS AND VIDEO SHOWS

There were two main radio programming initiatives used in the 2013 IRS campaign: radio spots (jingles) and radio discussions (interactive shows). Radio spots started airing on April 1, 2013, four weeks before the start of spray operations and continued three times per day throughout the spray period.

Discussions were centered on household preparation, safety, and compliance, as well as addressing other community concerns about spray activities. Both radio spots and radio discussion were in the local language to ensure full understanding of community members and the general public.

In communities where it became necessary, video shows on the malaria cycle, and pictures of community members participating in IRS activities were used to intensify education of community members. Video shows were usually in the evening.

Table 8 shows the number of radio programs and videos shows.

TABLE 8. NUMBER OF IRS RADIO PROGRAMS, VIDEO SHOWS AND IEC MATERIALS DISTRIBUTED

Activity	Total number
Radio spots; jingles (before, during, and after spray)	372
Radio programs (interactive shows)	16
Video shows	12
IRS materials distributed (to public places)	1,9047

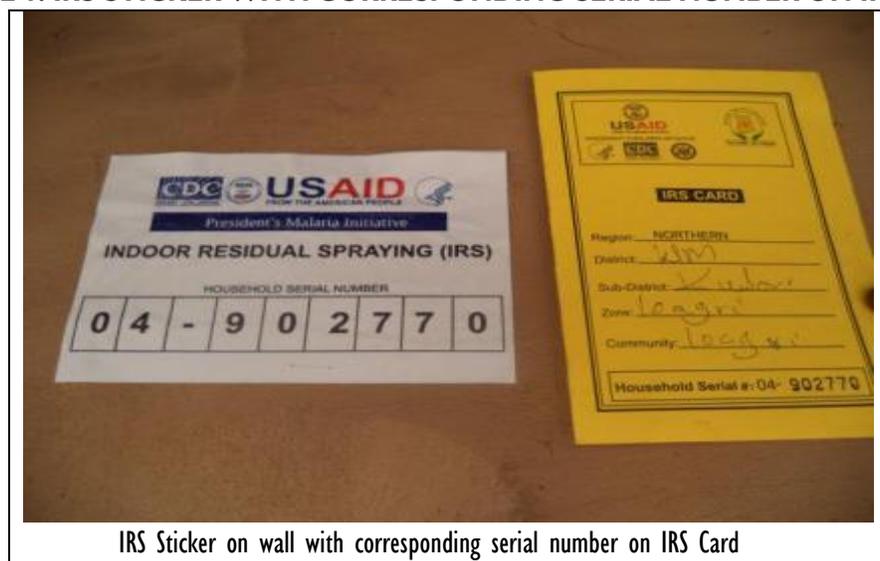
3.5 HOUSE TO HOUSE MOBILIZATION/ SENSITIZATION

House-to-house mobilization started two weeks before the start of the IRS campaign and lasted for two weeks. The program engaged mobilizers who are residents of the community; this enabled them to visit every compound or households with IRS messages. The face-to-face interaction with households demystified and corrected any misconceptions about IRS, and further educated households on their roles and responsibilities before, during and after spray activities. The mobilizers also ensured that the community members were informed of spray dates for their communities. During the house-to-house mobilization, mobilizers also collected household data, provided each household with an IRS card and placed a sticker⁸ on a smooth wall surface to give a unique identity to the compounds (See Figure 1). A total of 814 people were scouted and trained as mobilizers. Table 9 provides mobilization results.

⁷ This refers to the number of IEC materials that were pasted in public places like schools and market places. It does not include the number of IEC materials that were given to the households during the house-to-house mobilization activity. The quantity given directly to households is presented in Table 10.

⁸ The sticker was used to mark the house with their unique ID that matches their IRS card. In this way, even when the card is missing or the card owner is not available on the day of spraying, the unique ID is available. Additionally SOPs were instructed to write in the date of spray in chalk or marker near the posted sticker. This provided supervisors with a quick visual marker of spray coverage in the field.

FIGURE I. IRS STICKER WITH CORRESPONDING SERIAL NUMBER ON IRS CARD



IRS Sticker on wall with corresponding serial number on IRS Card

TABLE 9. HOUSE-TO-HOUSE MOBILIZATION RESULTS

District	Number of Households Sensitized ⁹	# Adults Reached with IRS Messages			Number of Households accepting IRS	% of Households accepting IRS ¹⁰	# of IEC/BCC Materials Distributed ¹¹
		Males	Females	Total			
Bunkpurugu-Yunyoo	13,242	24,643	28,227	52,870	13,242	100.00%	5,875
East Mamprusi	13,137	25,844	29,603	55,447	13,134	99.98%	9,093
Savelugu-Nanton	10,680	17,604	23,552	41,156	10,680	100.00%	9,066
West Mamprusi	12,496	25,607	28,934	54,541	12,480	99.87%	8,862
TOTAL	49,555	93,698	110,316	204,014	49,536	99.96%	32,896

⁹ During house-to-house mobilization, sensitization took place per household/compound rather than by structure.

¹⁰ This is the percentage of households indicating to mobilizers that they would be willing to accept IRS during the spray campaign.

¹¹ This represents the number of posters/ brochures given directly to households during the house-to-house mobilization exercise. These materials explain the benefits of IRS and the preparations that households must undertake to receive treatment, e.g., packing out their items, etc.

3.6 IEC/BCC ACTIVITIES IN THE FIVE WITHDRAWN IRS DISTRICTS

When it was decided that IRS would be withdrawn from five districts in the north in 2013, PMI, in collaboration with AIRS Ghana, ensured that the reasons for scaling back were effectively communicated to the regional and district authorities through stakeholder meetings. PMI identified LLINs as a key alternative strategy for malaria control efforts in the five dropped districts, especially after the mass distribution of LLINs across the Northern Region by the GHS and NMCP. It was proposed that AIRS Ghana conduct an enhanced IEC/Behavioral Change Communication (BCC) campaign to improve the proportion of people who use LLINs consistently and correctly. This ensures that people are still protected against malaria despite the withdrawal of IRS.

In the second and third quarters of 2013, AIRS organized district and sub-district stakeholder meetings in the five non-IRS districts. The purpose was to officially communicate the reasons for the withdrawal of IRS and to begin sensitizing the community members on the consistent use on LLINs in the absence of IRS. A total of twenty-four stakeholder meetings were held across the five districts. Since IEC/BCC activities for LLINs are broad and supported by different stakeholders, AIRS collaborated with many other entities including NMCP, GHS and NetWorks Ghana. In the fourth quarter of 2013, AIRS Ghana is supporting the dissemination of IEC materials, specifically radio programs and community drama.

4. IMPLEMENTATION OF IRS ACTIVITIES

4.1 INTRODUCTION

Implementation started with the mobilization of the various communities in the four districts. As described in section 3.5, compounds were identified by stickers and people were mobilized and sensitized on IRS. Operations started simultaneously in all the 16 operational areas in the four IRS districts. A total of 192,685 structures were targeted to be sprayed. Spraying began on April 29, 2013 and ended on June 21, 2013 in Bunkpurugu-Yunyoo and East Mamprusi districts. Savelugu-Nanton district ended spray operations on June 22, 2013 and West Mamprusi district ended spray operations on June 28, 2013. The program sprayed 197,655 structures, 4,970 more than the 192,685 targeted structures based on the number of structures found by SOPs in 2012. There was an outbreak of tribal violence in Bunkpurugu-Yunyoo, as a result spray operations were halted for one week, closing on May 2, 2013 and resuming on May 13, 2013. As Table 10 shows, despite the tribal conflict, the spray campaign in Bunkpurugu-Yunyoo ended within the targeted timeframe (less than 45 days). The other three districts had a delayed finish because the spray campaign was extended to accommodate revisits. Revisits in East Mamprusi, Savelugu-Nanton and West Mamprusi were scheduled because the three districts had not been able to spray a sufficient number of the targeted structures. See Annex B for additional analysis regarding revisit coverage.

TABLE 10. LENGTH OF SPRAY OPERATIONS FOR THE FOUR DISTRICTS

District	Number of Days of Spray Operations
Bunkpurugu-Yunyoo	39
East Mamprusi	47
Savelugu-Nanton	48
West Mamprusi	53

4.2 MONITORING & SUPERVISION

Indoor residual spraying is a very highly technical process that demands thorough supervision and monitoring in order to achieve the intended impact. Consistent with the AIRS theme for 2013, 'trust and yet verify', the Ghana AIRS team ensured that there was adequate monitoring and supervision at all levels throughout the different stages of the spray campaign (before, during and after). At the national level, the Chief of Party, Operations Manager, M&E manager, Database Manager, IEC Specialist, and the Environmental Compliance Manager formed one supervision team. The district teams were comprised of the Spray Operations Coordinator, the District M&E Coordinator, and the District Logistics Officer, while at the site level the supervisory team was comprised of the Site Manager, Field Supervisors and Team Leaders.

In order to improve the supervision, all teams used standardized AIRS supervision and monitoring tools for spray quality, environmental compliance and data verification. These tools are described further in Section 7.2.

4.3 PRE- AND MID-SEASON ENVIRONMENTAL COMPLIANCE ASSESSMENTS

The national team visited all 16 sites in the four districts to provide technical assistance to district teams. The team also used this opportunity to conduct mid-season environmental compliance assessments for all the sites. A checklist drawn from the PMI/ IRS BMP manual was used to ensure that district staff adhered to standards in terms of worker and resident safety, proper storage of insecticides, stock control and inventory procedures, effluent waste disposal, and proper spill response procedures. Special attention was given to the appropriate use of PPE, proper handling of insecticide, and mixing procedures including the triple rinse process for empty Actellic CS bottles in the four districts. During the assessments, the team observed that all the sites met the minimum standards for IRS operations.

4.4 DATA REPORTING

Spray data was collected and entered into the database on a daily basis. SOPs collected the data while Team Leaders checked and verified data cards. Further checks were completed by the Field Supervisors, District M&E Coordinators, and Data Assistants before the data was entered into the database. Weekly IRS Progress Reports were shared with Abt Home Office and PMI.

4.5 LOGISTICS AND STOCK MANAGEMENT

In line with operational standards, the AIRS Ghana program trained and hired five District Logistics Assistants and 16 Site Store Assistants to manage district and site warehouses respectively.

Records were monitored and updated using stock cards for each item with details of transactions, quantities involved, dates and destination. Regular physical stock counts were conducted by store managers to ensure that the actual stock corresponded with records on stock cards.

A weekly inventory was completed by the District Logistic 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 also reconcile central warehouse stock in Tamale with district stock.

To ensure that goods were tracked, signed copies of requests and delivery notes accompanied each transaction. The program also ensured that requisition notes were issued by the requestor and delivery notes issued in return as proof of delivery.

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 bottles returned and empty bottles returned onto the tracker, and thereafter transferred the data onto the stock cards, and the corresponding adjustments were made to match the physical stock.

4.6 VEHICLE ACCIDENTS

The campaign recorded five vehicle accidents which had the potential to disturb the IRS campaign. Some of the incidents involved damage to vehicles, but AIRS Ghana insures all of its hired vehicles, so there were no repair costs.

- **Accident in Bunkpurugu-Yunyoo District:** The first incident occurred on May 19, 2013 and involved a benz bus which was on its way to the main warehouse in Tamale to carry insecticide. This was on a Sunday, a non-spraying day. The driver lost control of the vehicle after he failed to negotiate a curve on a rough corrugated road, causing the vehicle to skid off the road into the bush. The driver was the only one involved. He sustained some slight bruises and was treated and discharged on the same day.

- **Accident in Savelugu-Nanton District:** The second accident happened on May 28, 2013 in Savelugu-Nanton district and involved a pickup vehicle carrying an IEC implementer back to the site after mobilizing a community for the following day's spraying. The accident was triggered by a front tire blow-out. The IEC implementer sustained a fractured arm, and the driver received minor bruises. Both were treated and discharged the following day.
- **Accident in Savelugu-Nanton District:** The third accident happened on May 10, 2013 in Savelugu and involved a supervisor who was riding a motor bike. He knocked down a young boy who suddenly crossed the road. Both of them sustained minor bruises and were treated and discharged the same day.
- **Accident in West Mamprusi District:** The fourth accident occurred on May 13, 2013 and involved a Site Manager from Janga Site who was riding his bike. He hit a goat on his way back from the field. He had some bruises on his face and a bleeding nose. He was treated and discharged at the Walewale District Hospital the following day.
- **Accident in West Mamprusi District:** The last accident occurred in in West Mamprusi District on May 10, 2013 and involved a Team Leader. In the process of helping to pack things out from an elderly woman's room to prepare the room for spraying, a stalk from the thatch roof pricked his eye. His hurt eye was treated at Walewale Hospital and he was discharged the following day.

5. POST-SPRAY ACTIVITIES

5.1 POST-SPRAY EVALUATION MEETINGS

At the end of the spray activities, post-spray stakeholders meetings were held in all 16 operational sites and in the four districts. Each meeting attracted about 50 participants at the site level, and about 100 participants in each of the four districts. A total of 1,071 participants attended the post-spray evaluation meetings. The meetings were used as a platform for the AIRS Ghana program and all stakeholders to interact, share best practices and discuss the way forward to improve the next IRS campaign. In all of these meetings, it was very clear that all stakeholders and the community appreciated the insecticide, Actellic, because of its ability to kill other insects in addition to anopheles mosquitoes. It was also recommended that in the next IRS campaign, Ghana Health Service staff should be incorporated in the supervision of IRS¹².

The national post-spray evaluation meeting was held in Tamale on August 22, 2013. Participants included NMCP, AngloGold Ashanti, Regional Health Directorate, District Health Directorate and Environmental Protection Agency (EPA). The objectives of this meeting were to:

- Present the performance of 2013 spray operations to stakeholders
- Share best practices and challenges from the 2013 IRS campaign
- Solicit ideas on improving the next IRS campaign.

The following were some recommendations by the stakeholders:

- That there should be greater collaboration and coordination during the planning stages between the IRS team and other decentralized departments of government to ensure that IRS activities do not conflict with other important national activities. This will make it possible for GHS and other decentralized departments to be involved in supervision.
- It was also recommended that the IEC team should review and strengthen its package of messages to ensure that there are no mixed messages.
- These activities should be intensified to reach more women. It was agreed that more women's groups should be involved in the dissemination of IEC/BCC messages. Men should also be encouraged to effectively participate in the preparation of households for spray operations.

5.2 POST-SEASON ENVIRONMENTAL COMPLIANCE ASSESSMENT

All storage facilities and soak pits at the 16 operational sites were cleaned and are kept locked with danger warning signs embossed on the fence and walls of the facilities. The facilities are guarded 24 hours per day. A post-season environmental inspection was completed (please see Annex C for more information).

¹² Ghana Health Service staff has been part of TOTs and district-level training for SOPs. However, they have not been able to participate in supervision activities during the spray campaign because of conflicting activities. In the future, there will be an intentional effort by GHS to incorporate some staff during supervision.

5.3 WASTE DISPOSAL

All solid waste materials shall be disposed of in accordance with the PMI/IRS BMP. Three main forms of solid waste were generated during the 2013 IRS campaign:

- Empty triple-rinsed bottles of Actellic CS (organophosphate)
- Used nose masks
- Well-washed damaged hand gloves and boots.

All used nose masks have been packaged into special bags and stored in the Tamale central warehouse, where they are awaiting incineration at the Kumasi Center for Collaborative Research (KCCR)¹³.

The empty Actellic 300 CS bottles were sent for recycling at Cyclus Elmina Plastic Recycling Company on August 12, 2013. The recycling was witnessed by the Environmental Compliance Officer and a representative from EPA.

The well-washed used hand gloves and punctured boots have been packaged and added to those used in 2012 and are awaiting proper disposal. So far, AIRS Ghana has not identified a company that can incinerate some type of solid waste (rubber) in Ghana, but discussions are underway with the EPA on how best to dispose of these items.

¹³ Used nose masks were originally scheduled to be taken to KCCR to be incinerated, but KCCR's incinerator is currently not functioning. As soon as they resume operation, the used nose masks will be sent for incineration.

6. ENTOMOLOGY

Entomological monitoring forms a critical component of any IRS program because it guides proper targeting of IRS through the identification of the vectors responsible for disease transmission and provides data on the relative geographical and seasonal distribution of vector mosquitoes, vector population density, and behavior. It is also key to monitoring changes in vector population density, rates of infection, and susceptibility of vectors to different insecticides; understanding the underlying resistance mechanisms if detected; influencing the selection of insecticides; and evaluating residual effects of insecticides on different types of treated surfaces.

During the period of March to July, 2013, the AIRS program worked closely with the GHS and DAs in operationalizing the entomological monitoring plan for 2013. The AIRS program also partnered with entomologists from the NMIMR to provide quarterly technical assistance and also support capacity building efforts of the program.

Some of the key entomological indicators monitored during the period included:

- Quality assurance of the IRS Program & Residual efficacy of the sprayed Actellic 300 CS formulation of Pirmiphos methyl (an organophosphate);
- Identification of species of malaria vectors in targeted districts;
- Vector distribution, behavior and seasonality; and
- Vector susceptibility to insecticides.

6.1 QUALITY ASSURANCE OF THE IRS PROGRAM & RESIDUAL EFFICACY OF THE SPRAYED ACTELIC 300CS

6.1.1 QUALITY ASSURANCE OF THE IRS PROGRAM

The work of spray teams in three beneficiary communities in Savelugu-Nanton and Bunkpurugu-Yunyoo districts were assessed using the standard WHO cone bioassay protocol.

The communities were:

- Choguni and Kambontuni in the Savelugu-Nanton District
- Bunbuna, in the Bunkpurugu-Yunyoo District

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 different surface types (cement, mud, wood) encountered in the community. Most of the walls of the residential houses in the IRS operational districts are made of either cement or mud. To obtain information about the performance of sprayed insecticide on wood surface, cone bioassays were conducted on wooden doors or windows of each room selected for the cone bioassay. Hence, separate control mosquitoes were not used for the tests conducted on wooden doors or windows.

Wild *An. gambiae* of known ages (two to five days old) collected from breeding sites in Tarikpaa, which were found to be highly susceptible to Pirmiphos methyl/Actellic CS (100 percent; Figure 2), were used for the evaluations in Savelugu-Nanton District.

To assess the spray quality on the different wall surfaces in each house, one room was selected for the test. Three walls of the room were tested, by fixing the cones at about 1.5 m high on each wall. Three cone assays were carried out in any one house (either mud or cement) together with one assay on the wooden door or window using 10 adult female *Anopheles gambiae* mosquitoes per cone. In every community tested, a total of six cement, six mud and four wooden test replicates were done.

One control cone assay was also done in each room, by fastening cardboard on unsprayed surfaces and exposing the control mosquitoes to the cardboard. To avoid the possibility of the control mortality increasing due to the effect of the Actellic 300CS formulations, the control tests were set up in unsprayed structures with fairly similar conditions (relative humidity and temperature) as the rooms being tested.

Successful spray quality tests in Choguni and Kambontuni were conducted within two weeks after spraying, using unsprayed houses for the control setup, while those in Bunkpurugu-Yunyoo District were conducted four days after spraying, using wild susceptible mosquitoes collected from Bunbuna.

6.1.2 RESIDUAL EFFICACY OF ACTELIC 300CS

The residual efficacy testing using the WHO cone wall bioassay in all the selected sentinel sites was conducted using susceptible 'Kisumu' colonies from the AIRS insectary and the insectary of the Navrongo Health Research Center. The communities tested included:

- Tarikpaa and Nanton in Savelugu-Nanton
- Bunbuna and Yunyoo in Bunkpurugu-Yunyoo
- Kukua and Wulugu in West Mamprusi

6.1.3 RESULTS

The quality assurance of IRS and the residual efficacy of insecticide were indirectly determined from the percent mortality of the exposed mosquitoes from the WHO cone bioassay tests on the different types of sprayed surfaces (mud, wood and cement). The results of the spray quality assessments are presented in the figures below. The observed 24-hour mortalities on all surfaces were 100 percent in all communities evaluated. The control mortalities on the other hand, did not exceed 20 percent but ranged between 0.0 and 5.0 percent. High percentage mortalities were also recorded from the tests performed after one month of spraying in all communities tested.

These results could mean that the spray teams deposited the right amount of insecticide on the different wall surfaces.

The residual efficacy of the sprayed Actellic 300CS will continue to be monitored every month and the results will be shared in a full entomological report.

FIGURE 1. PERCENTAGE KNOCKDOWN AND MORTALITY RATE OF WILD SUSCEPTIBLE ANOPHELES GAMBIAE AFTER 30-MINUTE EXPOSURE PERIOD AND 24-HOUR HOLDING PERIOD, FOR SPRAY QUALITY BIOASSAYS IN CHOGUNI, 10 DAYS AFTER SPRAYING WITH ACTELIC CS (SPRAYED JUNE 1, 2013 AND TESTED ON JUNE 11, 2013)

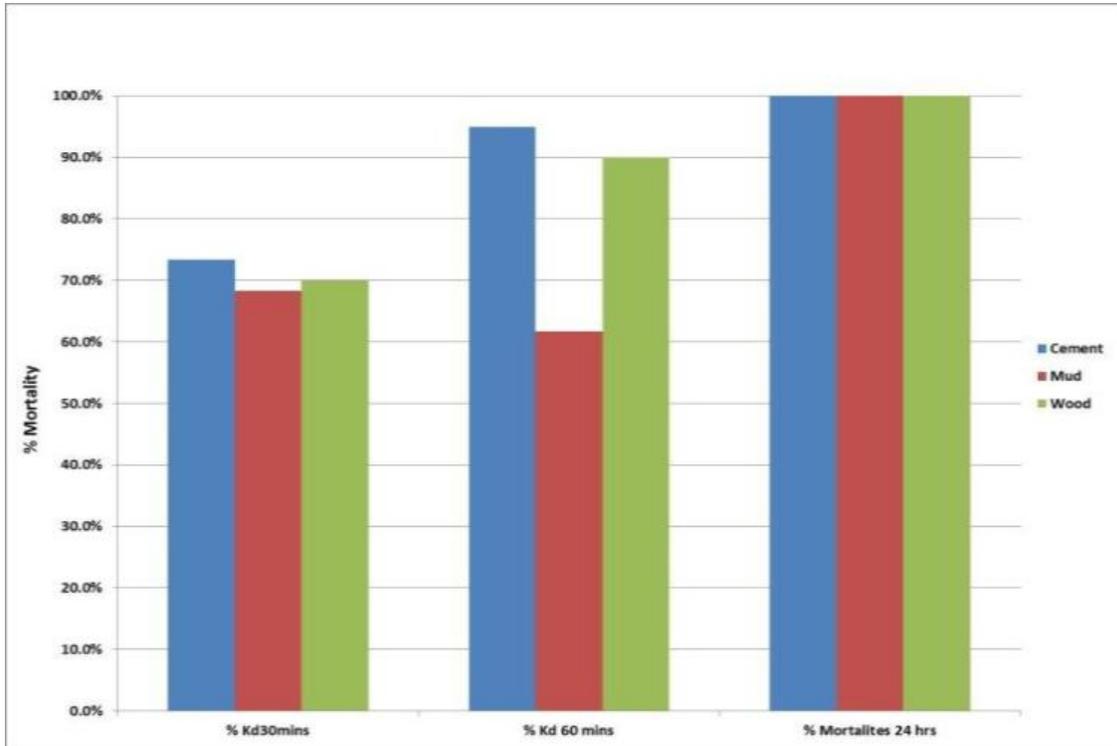


FIGURE 2. PERCENTAGE KNOCKDOWN AND MORTALITY RATE OF WILD SUSCEPTIBLE ANOPHELES GAMBIAE AFTER 30-MINUTE EXPOSURE PERIOD AND 24-HOUR HOLDING PERIOD, FOR SPRAY QUALITY BIOASSAYS IN KAMBONTUNI, 2 WEEKS AFTER SPRAYING WITH ACTELIC 300 CS (SPRAYED ON MAY 29, 2013 AND TESTED ON JUNE 11, 2013)

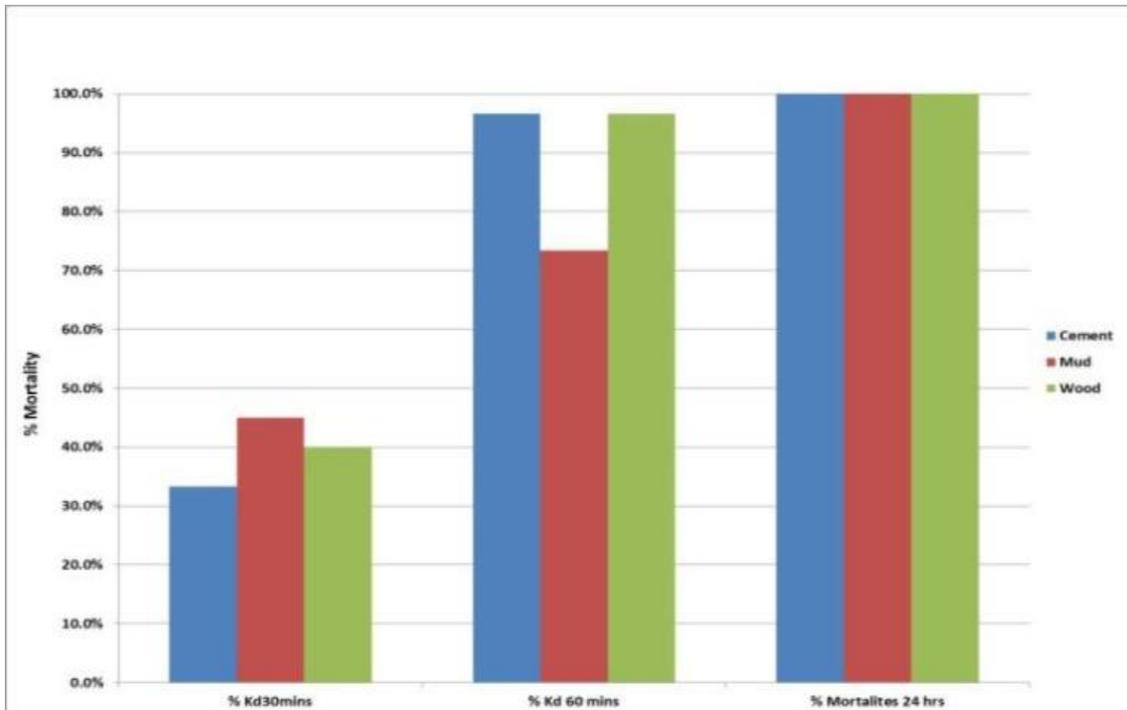


FIGURE 3. PERCENTAGE KNOCKDOWN AND MORTALITY RATE OF WILD SUSCEPTIBLE ANOPHELES GAMBIAE AFTER 30-MINUTE EXPOSURE PERIOD AND 24-HOUR HOLDING PERIOD, FOR SPRAY QUALITY BIOASSAYS IN BUNBUNA, 4 DAYS AFTER SPRAYING WITH ACTELIC 300 CS (SPRAYED ON MAY 9, 2013 AND TESTED ON JUNE 13, 2013)

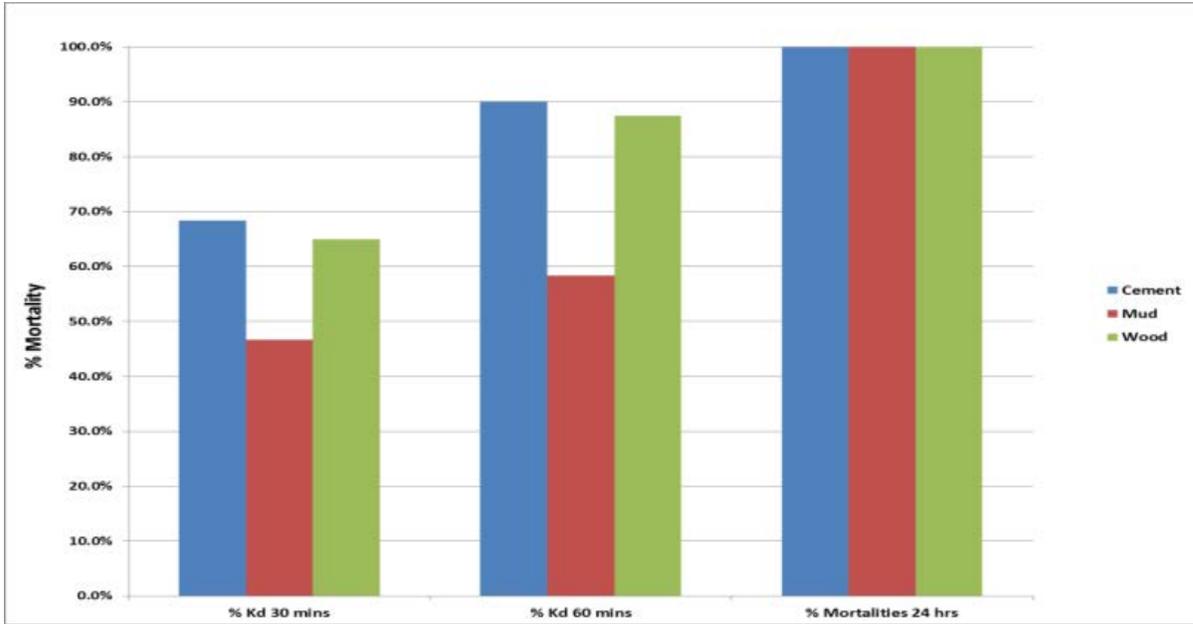
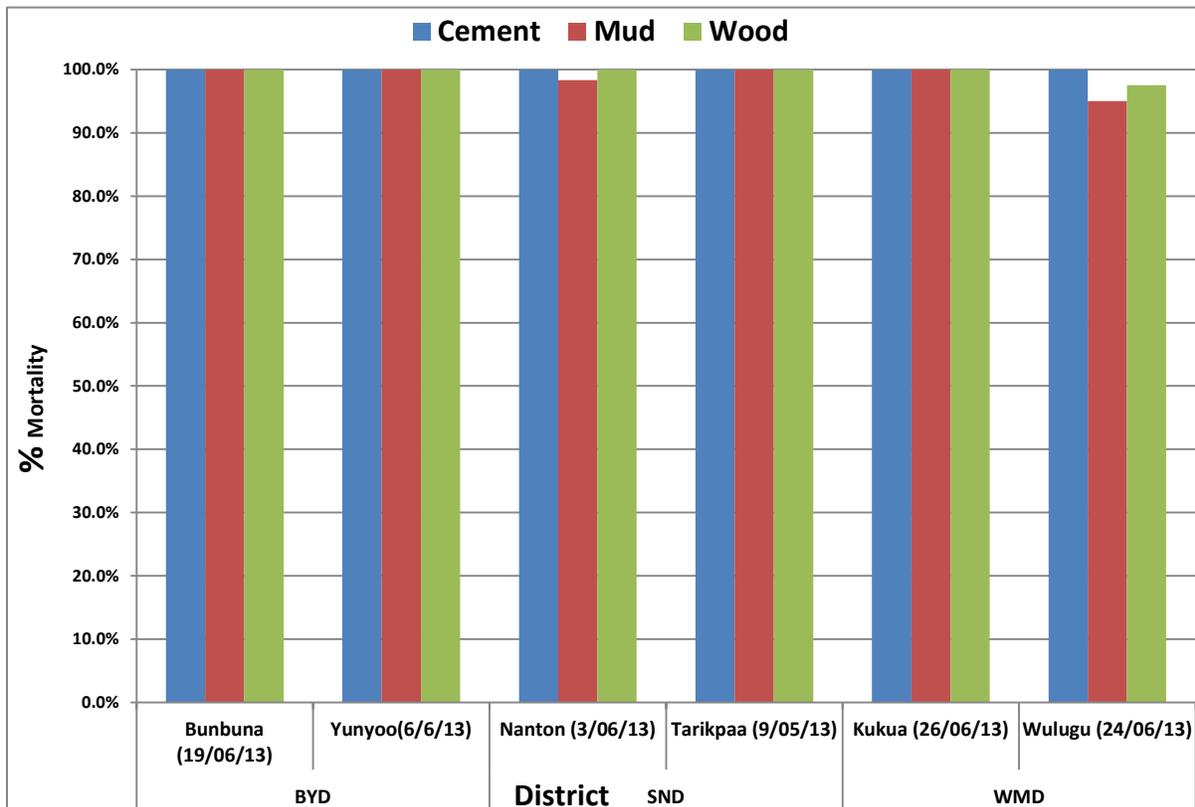


FIGURE 4: PIRIMIPHOS METHYL DECAY RATE (% MORTALITY OF ANOPHELES GAMBIAE) 1 MONTH AFTER SPRAYING IN JULY 2013



*Please note that BYD= Bunkpurugu-Yunyoo District, SND= Savelugu-Nanton District, and WMD= West Mamprusi District.

6.2 IMPACT OF SPRAY OPERATIONS

6.2.1 ASSESSING THE EFFECT OF IRS

Other entomological field surveys were conducted in selected communities in four sentinel sites to assess and understand the effect of IRS on vector species composition, their density, biting behavior of the local vectors in the area where spraying took place, and to compare with other unsprayed communities. Pre-spray 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 in each month, from March to July 2013¹⁴.

The districts and their corresponding communities selected for the entomological surveillance in 2013 include two IRS districts and two districts without IRS.

IRS Districts:

- Savelugu-Nanton District: Diare, Nanton and Tarikpaa
- Bunkpurugu-Yunyoo District: Bunbuna Nakrouk, Yunyoo, Nasuan and Sambiruk

Districts without IRS:

- Tolon-Kumbungu District: Dimabi, Gbullung and Woribugu (sprayed in 2012, but not sprayed during the 2013 spray round).
- Tamale Metropolis: Kulaa, Tugu and Yong (comparison communities)

Human landing catches were carried out to determine the biting behavior of malaria vectors in the area. In each community, eight trained mosquito collectors worked in two teams of four, working in two houses each night. In each house, two collectors worked indoors while the other two worked outdoors, for 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), in different rooms in the houses used for the HLCs the previous night. Thus, a total of eight rooms were surveyed for each community every month.

6.2.2 RESULTS

6.2.2.1 VECTOR SPECIES COMPOSITION

Both mosquito collections yielded *An. gambiae* s.l., *An. funestus* group, *An. pharoensis*, *An. rufipes* and *An. nili*, with *An. gambiae* s.l. forming about 96.63% (n= 6185) of the total number of mosquitoes collected within the period (March to July 2013) while *An. funestus* formed only 1.73% (n= 111).

6.2.2.2 BITING RATES

The results of the mean man-biting rates, presented in Figure 6, show a general increase in *Anopheles* biting densities from the pre-IRS period (March to April 2013) through the post-IRS period in the unsprayed districts. However, the biting rates in the IRS districts remained low despite the increase in mean rainfall recorded for the region.

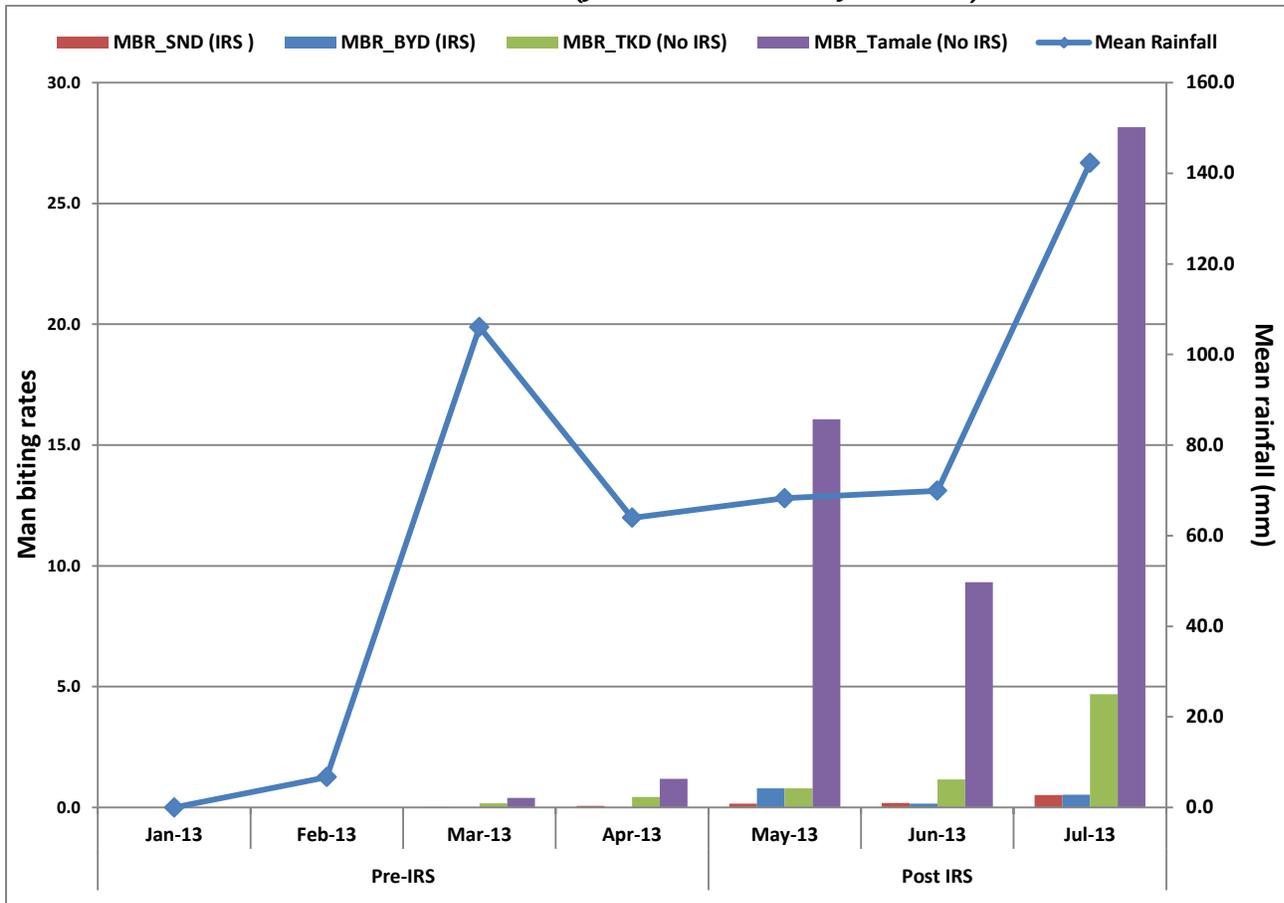
Comparing the mean man-biting rates (MBR) of the sprayed communities to that of comparison communities showed a statistically significant difference between mean number of bites received by a

¹⁴ In Bunkpurugu-Yunyoo District, mosquito collections started in May 2013 as a result of tribal conflict.

person in an IRS district (Savelugu-Nanton District and Bunkpurugu-Yunyoo District; (0.10 b/m/n for outdoor and 0.08 b/m/n for indoor) compared to biting rates for the unsprayed district (Tamale, 2.21 b/m/n for outdoor and 2.10 b/m/n for indoor) ($F_{(1,8)} = 11.051$, $p = 0.010$). Further comparison of the MBR between the IRS districts (Savelugu-Nanton District and Bunkpurugu-Yunyoo District) and Tolon-Kumbungu district also revealed a statistically significant difference ($F_{(1,8)} = 43.412$, $p = 0.000$).

The mean biting rates between the comparison communities (Tamale) and communities under the Tolon-Kumbungu District, on the other hand, showed no significant difference ($F_{(1,8)} = 3.170$, $p = 0.150$).

FIGURE 5. MAN BITING RATES OF FEMALE ANOPHELES MOSQUITOES COLLECTED EACH MONTH FROM THE SENTINEL COMMUNITIES AND AVERAGE RAINFALL RECORDED DURING THE PERIOD (JANUARY 2013 TO JULY 2013)

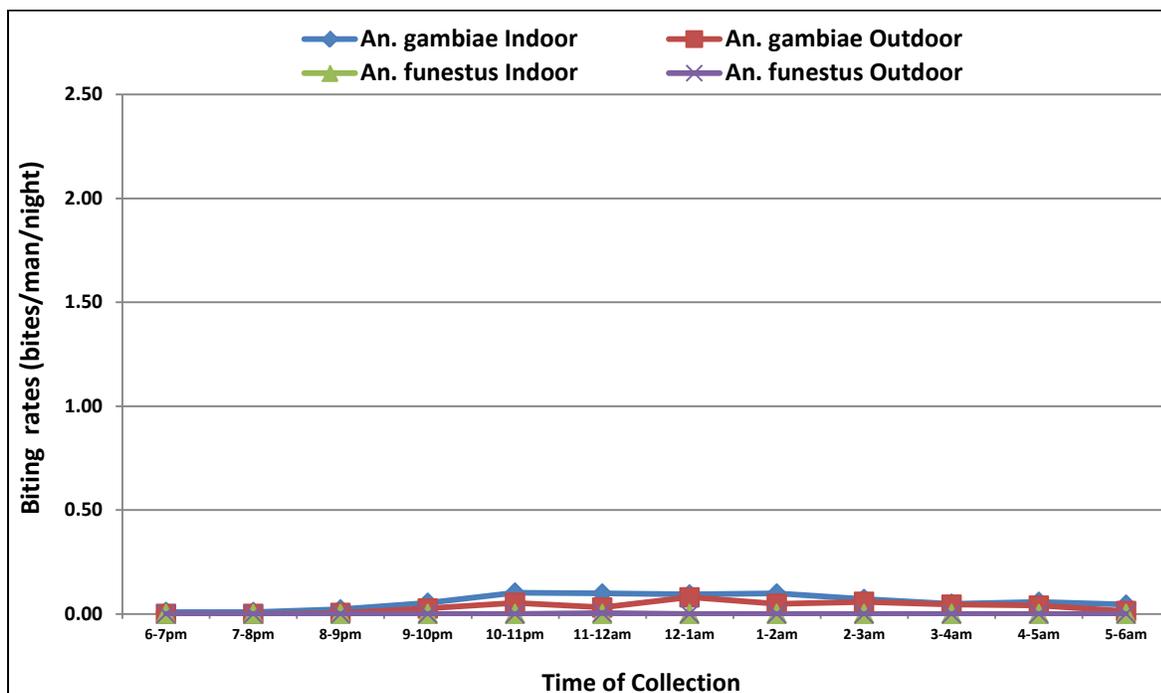
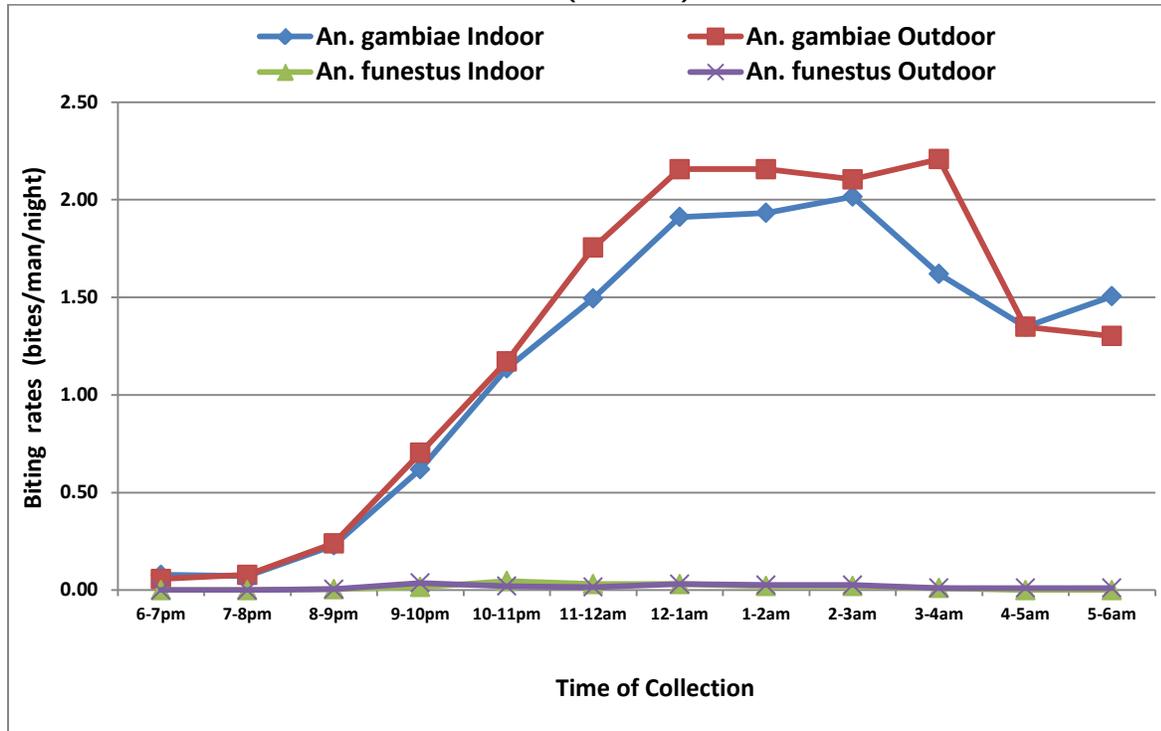


*Please note that SND= Savelugu-Nanton District, BYD= Bunkpurugu-Yunyoo District, and TKD= Tolon-Kumbungu District.

6.2.2.3 HOST-SEEKING BEHAVIOR

There was no significant difference in the Post IRS biting behavior (the preference of malaria vectors to either feed indoor or outdoor) in either the IRS districts or the unsprayed comparison districts (see figures below). (For IRS districts Savelugu-Nanton District and Bunkpurugu-Yunyoo District: $F_{(1,12)} = 3.450$, $p = 0.088$; for Tolon-Kumbungu District: $F_{(1,4)} = 9.63$, $p = 3.82$; for Tamale Metropolis: $F_{(1,4)} = 0.10$, $p = 0.925$).

FIGURE 6. HOST SEEKING BEHAVIOR (THE PREFERENCE TO EITHER FEED INDOOR OR OUTDOOR, AND PERIOD OF THE NIGHT) OF AN. GAMBIAE AND AN. FUNESTUS COLLECTED INSIDE AND OUTSIDE UNSPRAYED HOUSES IN TAMALE AND TOLON KUMBUNGU (ABOVE) AND SPRAYED HOUSES IN SAVELUGU NANTON AND BUNKUPURUGU-YUNYOO (BELOW)



6.2.2.4 PARITY RATES & GONOTROPHIC STAGES OF VECTOR SPECIES

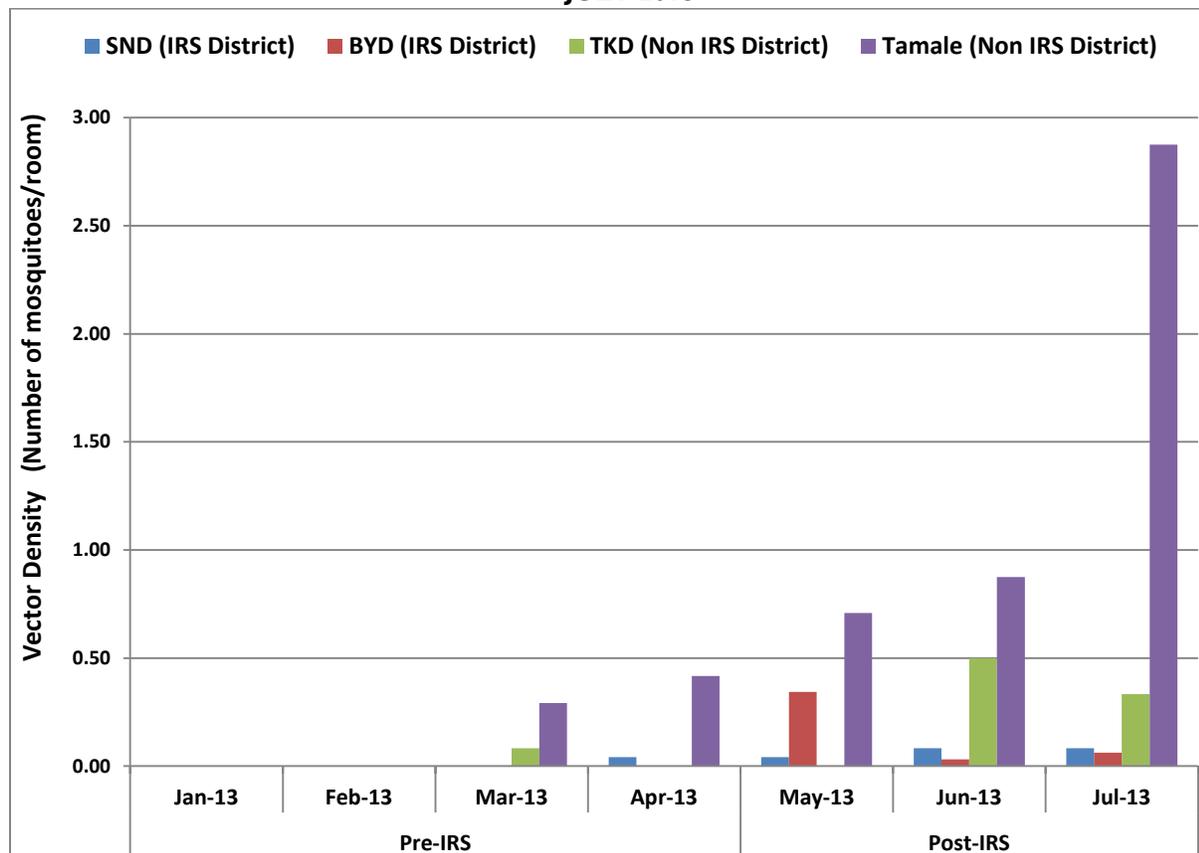
Dissections on mosquitoes collected from the study sites between May 2013 and July 2013 (post IRS), revealed a relatively higher proportion of older anopheline populations in the unsprayed communities than in IRS areas. A comparison of the proportions of parous (older) females obtained from each district, showed a significant difference in the proportion of parous females between IRS districts (mean of 38.82%) compared to Tamale metropolis with a mean parity rate of 69.82% ($F_{(1,7)} = 118.564$, $p < 0.005$) and Tolon-Kumbungu District with a mean parity of 68.07% ($F_{(1,7)} = 7.557$, $p = 0.029$). There was no significant difference in mean parity rates of mosquitoes collected from the comparison districts of Tamale (69.82%) and Tolon-Kumbungu District (68.07%) ($F_{(1,4)} = 4.100$, $p = 0.113$) where IRS was carried out in 2012, but exempted from IRS in 2013.

The data on gonotrophic stages (obtained from the PSCs) also showed that more gravid females were resting indoors in unsprayed sleeping rooms in the comparison districts than in sprayed sleeping rooms in the IRS districts, where no gravid females were collected ($F_{(1,11)} = 5.020$, $p = 0.047$).

6.2.2.5 VECTOR DENSITIES

Results obtained from the PSCs done during the post-IRS period showed that the comparison districts recorded higher vector densities than all IRS districts (Figure 8 below). However, this difference was only significant for Tamale ($F_{(1,7)} = 7.037$, $p = 0.03$), not Tolon-Kumbungu district ($F_{(1,7)} = 2.088$, $p = 0.192$), even though there was no significant difference in the vector densities of Tamale and Tolon Kumbungu ($F_{(1,7)} = 2.088$, $p = 0.210$).

FIGURE 8: INDOOR RESTING DENSITIES OF AN. GAMBIAE S.L. COLLECTED FROM SPRAYED ROOMS IN SAVELUGU-NANTON AND BUNKPURUGU-YUNYOO AND FROM UNSPRAYED ROOMS IN TAMALE AND TOLON-KUMBUNGU USING THE PSC METHOD FROM MARCH TO JULY 2013



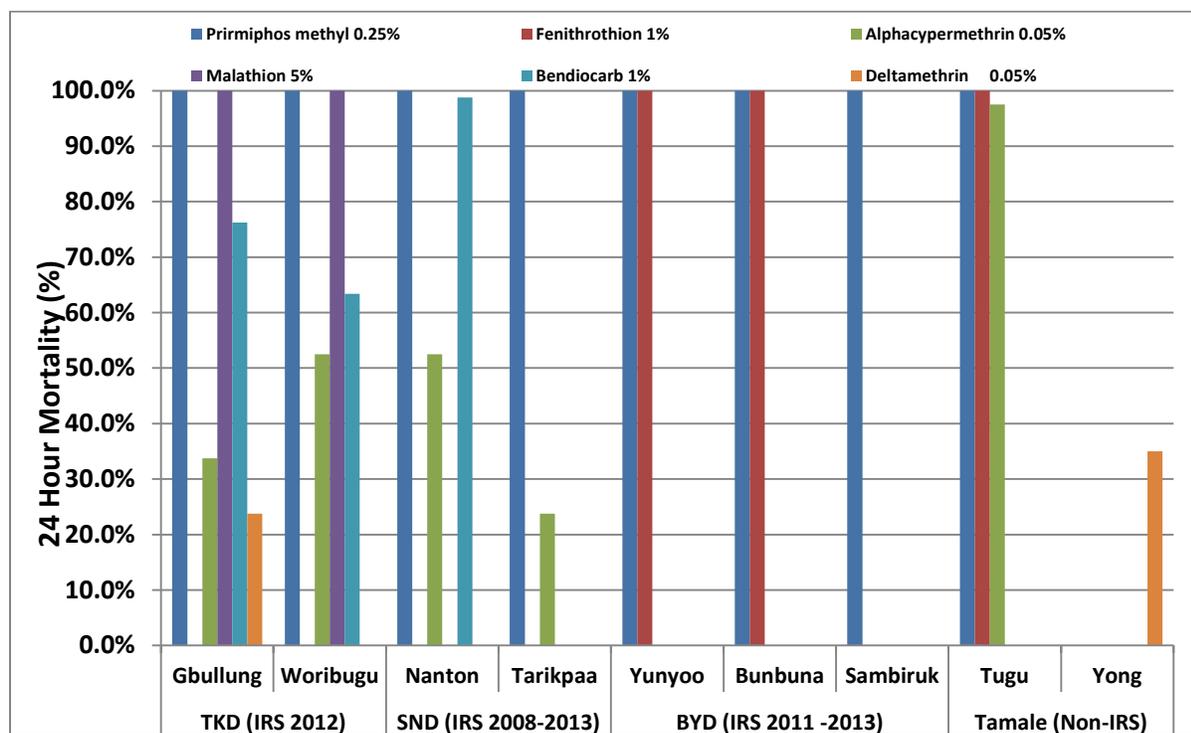
*Please note that SND= Savelugu-Nanton District, BYD= Bunkpurugu-Yunyoo District, and TKD= Tolon-Kumbungu District.

6.3 INSECTICIDE SUSCEPTIBILITY TESTS

Local *An. gambiae* s.l species collected from both IRS sentinel communities and sentinel communities were tested against selected WHO-approved insecticide for IRS, using the WHO Tube assays methodology. The insecticides tested included; 0.25% Pirimiphos methyl, 0.5% Alphacypermethrin, 0.05% Deltamethrin, 5% Malathion, and 1% Bendiocarb. The 24-hour mortalities were recorded.

The results of the insecticide susceptibility tests conducted between June and July 2013, presented in Figure 9 below, show that the local vector species from both IRS and communities tested were highly susceptible to the organophosphate insecticides tested. However, varying levels of susceptibility of local vectors to the pyrethroid class of insecticides were observed. Local *An. gambiae* from the 2012-IRS sprayed communities in Tolon-Kumbungu (with a history of about five years of pyrethroid usage for IRS) appeared resistant to alpha-cypermethrin (0.05%), deltamethrin (0.05%) and bendiocarb (1%). Pyrethroid resistance was also observed for *An. gambiae* s.l., in Savelugu-Nanton and Tamale districts (see Figure 9). Further tests have been carried out, and the results of insecticide susceptibility tests represent only the period up to the end of July 2013. The tests are ongoing and results will be updated.

FIGURE 7. INSECTICIDE SUSCEPTIBILITY STATUS OF LOCAL AN. GAMBIAE MOSQUITOES FROM ENTOMOLOGICAL SENTINEL SITES TESTED AGAINST SELECTED WHO RECOMMENDED INSECTICIDES FOR IRS



*Please note that SND= Savelugu-Nanton District, BYD= Bunkpurugu-Yunyoo District, and TKD= Tolon-Kumbungu District.

6.4 CONCLUSIONS AND RECOMMENDATIONS

It has been established that the primary objectives of IRS are to reduce and ultimately interrupt malaria transmission by reducing vector survivorship and density, and human-vector contact. It is also known

that for IRS to be effective, the local vector species should be endophilic, endophagic, as well as highly susceptible to the sprayed insecticides, which have to have been applied in an appropriate manner.

The bioassay results showed high quality of spraying by the spray teams. The relatively low vector densities, low proportion of parous (older) female *Anopheles* mosquitoes, and the absence of gravid females *Anopheles* mosquitoes in sprayed rooms could be attributed to the impact of pirimiphos methyl (Actellic 300CS) in killing high proportions of the older females *Anopheles* mosquitoes that rest in the rooms, since the local vector species in the area were highly susceptible (100 percent).

Considering the resistance to pyrethroid insecticides that seems to be developing in the local vector species from IRS beneficiary communities, the PMI-IRS program together with the major stakeholders (PMI, NMCP and NMIMR) made a prudent decision to change the insecticides from alphacypermethrin to pirimiphos methyl. Though the local *Anopheles gambiae* (the predominant vector species) in the IRS districts exhibits an equal propensity for endophagic and exophagic behavior, relatively higher proportions of them in sprayed rooms were found to be nulliparous and may not be involved in active transmission.

The entomological surveys show that AIRS Ghana's operations have contributed to reducing possible malaria transmission in the area, by reducing vector survivorship, vector density and human-vector contact in the IRS beneficiary communities compared to the non-sprayed communities within the period under review. Entomological monitoring will continue to be carried out to better understand the dynamics involved in malaria transmission in the PMI target districts.

7. MONITORING AND EVALUATION

7.1 KEY OBJECTIVES AND APPROACH

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

As outlined in the 2013 work plan, the M&E approach is 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 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;
- Communicate IRS data and information to stakeholders in a timely and clear manner.

7.2 DATA COLLECTION AND DATA MANAGEMENT

Data was collected using standardized data collection forms designed to capture all core PMI indicators. All data collection was preceded by training data collectors (mobilizers, SOPs, M&E assistants, etc.) on data capture. Mobilization data was collected by mobilizers (IEC implementers and CBS Volunteers), as well as temporary hires who were not affiliated with the Ghana Health Service.) during house-to-house mobilization. During spray operations, all spray data was collected by SOPs and subsequently verified through its data quality processes.

In 2013, the AIRS project introduced three standardized data quality assurance tools - the Error Eliminator (EE), Data Collection Verification (DCV), and the Data Entry Verification (DEV) forms - to improve supervision, and ultimately the quality, of data collection and data entry.

TABLE 11. GHANA IRS 2013 DATA COLLECTION TOOLS

Data collection tool	Used by who and when
Training Participants Registration Form	Used by lead trainer at training workshop to capture category and number of people trained, disaggregated by male and female.
BCC/IEC Mobilization Form (MO 1)	Used by IEC mobilizers during pre-spray house-to-house mobilization/sensitization activities to collect data on number of households and people reached with the IRS message.
Daily SOP Form	Used by SOPs during spray operations to capture structures found, structures sprayed and not sprayed, population protected and unprotected as well as mosquito net information.

TABLE 12. DATA QUALITY ASSURANCE TOOLS

Data Quality Assurance Tool	Purpose, Used by who and when
Error Eliminator (EE) form	<p>Purpose:</p> <ul style="list-style-type: none"> • To check the completeness and correctness of data collected in the field. • To highlight common data collection errors so they can be quickly identified with corrections being made and re-training provided by the supervisor. <p>Used by:</p> <ul style="list-style-type: none"> • Team leaders on daily basis to check 100% of the forms filled by the SOPs under their supervision. • Supervisors, District Spray Operations Coordinator, District M&E Coordinators, Operations Manager and M&E Manager also used the Error Eliminator when visiting the field.
Data Collection Verification (DCV) form	<p>Purpose:</p> <ul style="list-style-type: none"> • Used during random 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. <p>Used by:</p> <ul style="list-style-type: none"> • District M&E Coordinators, predominately • Database Manager and the M&E Manager. • A total of 3,922 households/compounds were visited using the DCV form. See Tables 15 and 16.
Data Entry Verification (DEV) form	<p>Purpose:</p> <ul style="list-style-type: none"> • To verify data entry accuracy, i.e. ensure the data in the database matches the data as noted on the data collection form. Using of the DEV form, supervisors checked, field by field, the information on randomly picked cards from the files and the information in the corresponding database entries to ensure that they matched. Any corrections needed are noted on the DEV form for the Data clerk <p>Used by:</p> <ul style="list-style-type: none"> • District M&E Coordinators, Database Manager and the M&E Manager during their visit to a data entry center. See Table 7.4.1 • A total of 2,608 lines (2,167 Detail lines and 441 Total lines) of data were verified using the DEV form. See Table 17.

Supervision of the data collection process was carried out at various levels through field visits. Table 13 tabulates the levels of data collection supervision provided.

TABLE 13. LEVELS OF DATA COLLECTION SUPERVISION

Data	Supervised by
Mobilization data	District IEC Assistant, District M&E Coordinator, Regional Level IEC Coordinator, M&E Manager, Operations Manager
Spray Data	Team Leader, Field Supervisor, District M&E Coordinator, Regional M&E Manager, Database Manager and Operations Manager.

TABLE 14. NUMBER OF HOUSEHOLDS/COMPOUNDS VISITED USING THE DCV FORM

District	# Households/Compounds visited using the DCV form
Bunkpurugu-Yunyoo	731 ¹⁵
East Mamprusi	798
Savelugu-Nanton	1,029
West Mamprusi	1,364
Total Households visited	3,922

TABLE 15. USE OF DCV FORM: COMMON ISSUES FOUND AND CORRECTIVE ACTIONS TAKEN

Errors/Issues Observed	Corrective Actions Taken
Understatement of total number of eligible structures found by SOPs. 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.	The M&E team provided correction regarding this error to SOPs, Team Leaders and field supervisors. It was emphasized that all eligible structures were to be counted whether locked or not and that during field visits, supervisors should be mindful of this common error.
Overstatement of total number of eligible structures found. In some households/ compounds, SOPs over counted the total number of structures eligible for spray by counting food stores and traditional shrines which are not eligible for IRS under spraying guidelines.	The M&E team addressed SOPs, Team Leaders and field supervisors asking them to take note of this common error and to be careful in determining the eligibility of structures before recording them.
Overstatement of total number of eligible structures sprayed. It was found that some SOPs inflated the number of structures sprayed. The motivation for this varied. In some cases it was driven by SOPs wanting to “look good” to supervisors while in other cases it was because SOPs wanted to have to avoid mop-up/revisits to the same community.	SOPs were cautioned about this error. Team Leaders and Supervisors intensified field spot checks. In extreme cases, SOPs were suspended.

¹⁵ Fewer households were visited in Bunkpurugu-Yunyoo because the M&E Coordinator for the district fell ill and before spray operations started and could not continue with the project. The M&E Manager and the Database Manager visited some compounds on their visit to the district.

Errors/Issues Observed	Corrective Actions Taken
<p>Falsification of revisit data. During mop-up activities, some supervisors provided SOPs specific data in order to better identify households/compounds requiring revisit. In some cases, SOPs used the data that was meant to facilitate spray operations to falsify revisit data.</p>	<p>The M&E team used the DCV forms to verify revisit data. SOPs who were found to be intentionally falsifying data during spray operations were dismissed while those detected after spray operations have been put on a “do not hire” list for 2014. Additionally, Team Leaders believed to be compliant in the falsification of data have likewise been placed on a 2014 “do not hire” list. It is AIRS’ goal to use the Post Spray Data Quality Audit to further validate spray data and detect any systemic errors.</p>

7.3 DATA ENTRY

AIRS employed eight Data Assistants (two per district) to enter all IRS data generated from the four districts. The project laptops procured in 2012 were used for the 2013 spray round data entry. The 2013 AIRS Ghana database was installed on each laptop. Data was entered simultaneously in each of the four districts. Data entry was carried out at two levels, first by “Totals” for quick reporting and feedback, then by “Details” for more accurate data entry and verification purposes.

7.4 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 date of mobilization.

Spray data were filed in arc files by sub-district, with the forms in each file sorted by spray date.

At the end of every day, all databases were backed up electronically. Backup was performed in three different ways: first, into a backup folder on the data entry laptop which served as the district data entry server; second into a cloud back-up system (Sugar Sync); and third onto an external flash drive that was provided to each Data Assistant.

7.5 DATA CLEANING AND USE OF THE DATA ENTRY VERIFICATION FORM

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.
- Identifying and entering missing records.

Data cleaning was done using a Microsoft Access-based IRS Cleaning/Reporting tool. The Data Assistants cleaned spray data daily throughout the spray campaign with final data cleaning completed

within 14 days of the end of the spray campaign. Mobilization Data entry and cleaning was completed approximately five weeks after spraying¹⁶.

Data entry verification was done using the Data Entry Verification form (DEV). This involved ensuring that information in the database accurately reflected the information on the Daily SOP Forms. Using of the DEV form, supervisors checked, field by field, the information on randomly picked cards from the files and the information in the corresponding database entries to ensure that they matched. Any corrections needed are noted on the DEV form for the Data clerk. For spray data, the verifications noted in Table 16 were made in each district. A total of 2,608 lines (2,167 Detail lines and 441 Total lines) of data were verified using the DEV form.

TABLE 16. RESULT ON USE OF THE DATA ENTRY VERIFICATION FORM

Data Entry Center/District	Bunkpurugu-Yunyoo	East Mamprusi	Savelugu-Nanton	West Mamprusi	Total
# of Detail Lines in database	12,574	12,053	10,602	13,988	49,217
# (%) of Detail Lines checked	552 (4.4%)	420 (3.5%)	269 (2.5%)	926 (6.6%)	2,167 (4.4%)
# (%) Detail lines corrected	20 (3.6%)	0 (0.0%) ¹⁷	22 (8.2%)	9 (1%)	51 (2.4%)
# of Total Lines in database	2,438	2,944	2,757	3,572	11,711
# (%) of Total Lines checked	94 (3.9%)	97 (3.3%)	46 (1.7%)	204 (5.7%)	441 (3.8%)
# (%) Total lines corrected	3 (3.2%)	0 (0.0%)	0 (0.0)	1 (0.5%)	4 (0.9%)

Common errors in data entry found and addressed included: incorrect spelling of household/landlord names, incorrect entry of IRS numbers, and the incorrect entry of population in sprayed and unsprayed structures. These errors were duly rectified.

TABLE 17. DATA QUALITY ASSURANCE AND CONTROL (QA/QC)

QA/QC Issue	Method/Tools for Quality Assurance
Spray data integrity	<ul style="list-style-type: none"> • Used standardized data collection forms. • Comprehensive training for spray and mobilization data capture. • Multiple levels of supervision. • SOPs are supervised directly by their Team Leaders. <ul style="list-style-type: none"> ▪ Supervisors monitor Team Leaders and verify SOP forms. ▪ District M&E Coordinators monitor and verifies data capture by SOPs, Team Leaders and Supervisors. • Structure spot checks to cross-check daily spray data captured by SOPs.

¹⁶ While it would be ideal to enter and clean all Mobilization data prior to spray, to do so is not possible because mobilization is carried out only two weeks prior to the start of spray operations. To push mobilization back several weeks to ensure that sensitization data could be entered prior to spray might mean that households would forget IRS messages.

¹⁷ Data assistants in East Mamprusi district, having been with the project for over 3 years, were well experienced. Throughout the campaign they always entered and cleaned their district's data by 9 a.m. the following day, before Data Entry Verification was carried out.

QA/QC Issue	Method/Tools for Quality Assurance
	<ul style="list-style-type: none"> • Database designed with locks and validation checks. • Use of Error Eliminator and Data Collection Verification forms to ensure complete and accurate data collection.
Mobilization Data Integrity	<ul style="list-style-type: none"> • Used standardized data collection forms. • Comprehensive training for mobilization data capture. • Multiple levels of supervision (by IEC Assistants, M&E coordinators and Spray Operations Coordinator). • Household visits for spot checks. • Database designed with locks and validation checks. • Use of Error Eliminator to ensure complete and accurate data collection.
Spray Data Entry and Management	<ul style="list-style-type: none"> • Data entry training for all Data Assistants • Prompt field data entry and transfer; data collection forms arrive at data entry sites daily and data entry is also done on a daily basis • Data verification via double-data entry <ul style="list-style-type: none"> ▪ Initial data entry of totals per data collection form ▪ Follow-up entry of details data, i.e. data per individual household/compound • Data scan for irregularities by Database Manager and IRS supervisory staff. • Use of Microsoft Access-based IRS Cleaning/Reporting tool to daily clean data. • Use of Data Entry Verification form to ensure accurate data entry.
Data Security	<ul style="list-style-type: none"> • Data collection forms are printed on durable sheets. • Paper data collection forms filed systematically in arc files. • Database is designed with passwords to restrict unauthorized entry. • Databases backed up daily to on the data entry server laptop, on Sugar Sync, and on external pen drives every day.

7.6 POST SPRAY DATA QUALITY AUDIT (PSDQA)

As part of data quality assurance strategies, AIRS Ghana will conduct an internal post spray Data Quality Audit (PSDQA). The objectives of the PSDQA are:

- Validate the spray coverage reported by AIRS Ghana for the 2013 spray round.
- Validate the proportion of people protected reported by AIRS Ghana for the 2013 spray round.
- Identify lessons learned and incorporate best practices for data collection and data entry for the remainder of the AIRS Ghana project.

AIRS Ghana aims to begin training for PSDQA data collection by the beginning of September 2013.

7.7 RESULTS

The complete list of all program indicators for the 2013 spray campaign is presented in the Monitoring and Evaluation Plan matrix in Annex D. The following sections provide summaries on the core PMI indicators and other spray indicators.

7.7.1 NUMBER OF STRUCTURES FOUND, SPRAYED AND SPRAY COVERAGE

A total of 216,876 structures were found by SOPs during 2013. SOPs found 46,131 structures in Bunkpurugu-Yunyoo, 56,387 in East Mamprusi, 45,036 in Savelugu-Nanton and 69,322 in West Mamprusi.

Across the four districts, 197,655 structures were sprayed by SOPs, yielding total spray coverage of 91.1 percent. Details of number of structures found, sprayed, and district spray coverage are presented in Table 18.

7.7.2 POPULATION PROTECTED

There were 568,059 people counted as living in the total number of structures found by SOPs. Of this number, 94 percent (534,060 people) were protected through IRS. The total number of people protected included 11,617 pregnant women and 102,115 children under the age of five years. Details are presented in Table 18.

TABLE 18. SUMMARY OF 2013 SPRAY RESULTS

District	Structures Found by SOPs	Structures Sprayed	% of Structures Sprayed	Pop. Protected	Pop. Not Protected	% of Pop. Protected	# Preg. Women (% of Pop Protected)	# Children <5 Years (% of Pop Protected)
Bunkpurugu-Yunyoo	46,131	44,600	96.7%	107,141	2,637	97.6%	1,966 (1.8%)	18,022 (16.8%)
East Mamprusi	56,387	49,646	88.0%	142,458	11,772	92.4%	3,427 (2.4%)	29,111 (20.4%)
Savelugu-Nanton	45,036	41,020	91.1%	113,068	7,533	93.8%	2,280 (2.0%)	20,747 (18.3%)
West Mamprusi	69,322	62,389	90.0%	171,393	12,057	93.4%	3,944 (2.3%)	34,235 (20.0%)
Total	216,876	197,655	91.1%	534,060	33,999	94.0%	11,617 (2.2%)	102,115 (19.1%)

7.7.3 AVAILABILITY AND USE OF MOSQUITO NETS

Across the four districts, 43,737 households reported having a total of 174,739 mosquito nets available at the time SOPs visited during the 2013 spray campaign. 8,975 pregnant women and 81,161 children under five years of age had slept under a mosquito net the night previous to the SOP's visit. See Table 19 for mosquito net indicators presented by district.

TABLE 19. NUMBER AND USAGE OF MOSQUITO NETS

District	Mosquito nets		
	Total mosquito nets Found	# (%) Preg. Women sleeping under mosquito nets the previous night	# (%) Children < 5 sleeping under mosquito net previous night
Bunkpurugu-Yunyoo	35,364	1,566 (78.3%)	15,013 (82.2%)
East Mamprusi	46,720	2,647 (74.0%)	22,343 (74.0%)
Savelugu-Nanton	36,740	1,797 (74.0%)	17,847 (82.9%)
West Mamprusi	55,915	2,965 (71.7%)	25,958 (73.2%)
Total	174,739	8,975 (73.9%)	81,161 (77.0%)

7.7.4 OTHER SPRAY INDICATORS

The four districts received a total of 44,426 bottles of Actellic CS for the 2013 spray operations from the regional stores. A total of 43,284 (97.42%) bottles were used to spray the 197,655 structures. No insecticide was reported missing or damaged, and a total of 1,142 bottles were returned to the regional stores by the districts. Each bottle of Actellic CS sprayed an average of five structures.

On average, 249 SOPs worked each day across the four districts. Each SOP sprayed an average of 18.0 structures a day with an average of 3.9 bottles of Actellic CS per day as presented in Table 20.

TABLE 20. INSECTICIDE TRACKING AND SOP PERFORMANCE

Indicator	District				
	Bunkpurugu-Yunyoo	East Mamprusi	Savelugu-Nanton	West Mamprusi	Total
Total bottles received from regional stores	9,600	10,706	10,320	13,800	44,426
Total bottles used	9,222	10,493	10,018	13,551	43,284
Total bottles damaged or lost	0	0	0	0	0
Total bottles leftover (returned to regional office)	378	213	302	249	1,142
Average number of structures sprayed per bottle	4.8	4.7	4.1	4.6	4.6
Average number of bottles per SOP per day	4.1	3.9	3.9	3.9	3.9
Average number of SOP worked per day	65	63	55	67	249
Average number of structures sprayed by SOP per day	19.7	18.4	15.9	18.0	18.0

8. CAPACITY BUILDING OF THE MINISTRY OF HEALTH

Capacity building is an ongoing process through which individuals, groups and organizations enhance their ability to identify and meet development challenges. AIRS Ghana's role is to facilitate learning. This is partially accomplished by providing resources and training. AIRS Ghana's capacity building activities are based on three key elements:

- Partnership
- Individual capacity development
- Organizational development

AIRS' 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 project development and management.

As part of the AIRS program's objective of building local capacity to undertake entomological monitoring in anticipation of the rapid scale-up of IRS across Ghana, two entomology trainings were organized with the support of entomologist from NMIMR.

The first training, which took place in March 2013, was for selected staff of the GHS, the DAs and some AIRS district staff. Its objective was to train field personnel to assist in the entomological monitoring activities in the AIRS target districts as a way of building national capacity.

The second training was on insecticide resistance monitoring and took place from July 21 to July 31, 2013, for selected GHS staff from five regions in the Northern Zone of Ghana. This training was part of PMI and the NMCP's efforts to establish insecticide resistance monitoring sites across the country. This initiative is part of a National Insecticide Resistance Monitoring Partnership (NIRMOP) strategy to manage resistance in Ghana.

A total of 25 GHS staff, comprising five Regional Biologists, ten Disease Control Officers and ten Biomedical Scientists from ten selected districts (two districts per region) were trained. The trained GHS staff will serve as the field personnel to carry out field activities in the insecticides resistance monitoring program.

To improve capacity in IRS technical provision, GHS and DA staff were part of the TOTs in preparation for 2013 IRS operations. The training equipped them with the knowledge and skills of IRS operating techniques. Together with the AIRS Ghana district team, they were key facilitators at the training of SOPs at the district level.

A total of 50 GHS personnel were also beneficiaries of the poison management training, which sought to improve their knowledge in handling cases of accidental exposure and poisoning from insecticides used for IRS.

AIRS Ghana will continue to support the NMCP in building enough capacity in country. AIRS Ghana conducted a Country Capacity Assessment in 2013, whose main objective was to evaluate the overall level of capability and capacity of host government and independent local entities to carry out the technical, operational and management functions to implement an IRS program. The results of the

assessment will be summarized in to report which will be shared with PMI and NMCP. The next step will be for AIRS, PMI and NMCP to develop a capacity building plan.

9. CHALLENGES, LESSONS LEARNED AND RECOMMENDATIONS

The following challenges, lessons learned, and recommendations were identified during the 2013 spray campaign.

9.1 CHALLENGES

1. Delay in the clearing of Actellic 300 CS through customs led to the insecticide overstay at the port in the sunlight and heat. Initially there was concern about the quality of the insecticide, but further tests in Europe proved that the insecticide was still potent. This forced the Ghana AIRS team to push back the start of spray operations by two weeks.
2. Ethnic conflicts in Bunkpurugu-Yunyoo District affected spray operations; as a result, the campaign was stopped for 10 days.
3. Initially poor IRS coverage in three districts was worrisome, but more mobilizers and packers were hired and the campaign was extended for revisits, which ensured much improvement in the coverage rates.
4. There was reluctance of some households to take out their household items, especially in the peri-urban areas.
5. The campaign recorded five vehicle accidents which had the potential to disturb the IRS campaign (described earlier).
6. Compared to other AIRS countries, the Ghana program's overall coverage is low. AIRS will review its operations in Ghana in order to try to increase the coverage rate in future spray rounds.

9.2 LESSONS LEARNED AND RECOMMENDATIONS

1. Proper coordination and communication is needed when attempting a new type of insecticide shipment (in this case it was via ship) in order to minimize the delay in customs and clearance.
2. In areas where there is poor coverage, involving more mobilizers and packers makes a difference.
3. 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.
4. It is very helpful and important to implement IEC activities on time in order to maximize their effectiveness.
5. There should be greater collaboration and coordination during the planning stages between the IRS team and other decentralized departments to ensure that IRS activities are not interrupted by other important national activities.

6. Intensify the use of radio programs to inform and educate people on IRS activities.
7. When conducting mop-up/revisits, SOPs must be closely supervised and specific household names only will be given, not IRS numbers to prevent fraudulent reporting on behalf of SOPs.

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

International Procurement

Item	Quantity before the campaign	Quantity procured	Total	Quantity Used	Quantity Damaged	Quantity remaining after campaign
Spray Pumps	489 (Hudson)	200 (Goizper)	689	370	300	389
Coveralls	1,331	268	1,599	1,126	423	1,176
Hard Hats	560	-	560	560	89	471
Head Gear	645	-	645	645	216	429
Hand Gloves	-	2,448	2,448	1,459	1,459	989
Face Shields	162	516	678	469	469	209
Nose Masks	-	21,360	21,360	18,593	-	2,767
Actellic 300 CS (bottles)	7,234	44,352	51,586	43,319 (This includes 35 bottles used for testing)	-	8,267
Pressure Gauge (for Hudson Pump)	-	120	120	-	-	120
Repair Kit (Hudson pump)	43	30	73	27	-	46

Local Procurement List

Item	Quantity Before the Campaign	Quantity Procured	Total	Quantity Used	Quantity Damaged	Quantity remaining after campaign
Neck Covers	744	662	1,406	990	334	1,072
Boots (pairs)	883	-	883	563	260	623
Fire Extinguishers	42	-	42	42	-	42
Daily SOPs Cards	-	21,000	21,000	15,900	-	5,100
BCC/IEC Mobilization Form (MOI)	-	4000	4000	4000	-	-

Local Procurement List

Item	Quantity Before the Campaign	Quantity Procured	Total	Quantity Used	Quantity Damaged	Quantity remaining after campaign
Cards)						
Spread sheet	40	1000	1,040	440	440	600
Heavy-duty Gloves	31	-	31	31	31	-
IEC Brochures	5000	5000	10,000	9800	-	200
IEC Welcome the Sprayer (posters)	4000	6000	10,000	8,500	-	1,500
IRS STEPS (posters)	5000	5000	10,000	8000	-	2000
Spray Bags	340	450	790	569	569	221
IRS Cards	-	60,000	60,000	60,000	-	-
IRS Stickers	-	60,000	60,000	60,000	-	-
Malaria Free (posters)	7000	3000	10,000	8,500	-	1,500
Aprons	-	100	100	39	39	61
Stock Cards	380	3000	3,380	1,795	-	1,585
Towels	3	722	725	450	450	275
Supervisors Checklist	-	2000	2000	527	-	1,473

ANNEX B. ADDITIONAL ANALYSIS REGARDING REVISIT COVERAGE

Introduction

As part of efforts to understand the progress of spray operations and the role that revisits play in improving spray coverage, Dr. Philip Ricks, Ghana PMI Resident Advisor, requested that the Ghana M&E team perform additional analysis on revisits to answer the following questions:

- How are revisits increasing coverage?
 - What percentage of compounds/household and structures are being covered during a revisit compared to during initial visits?
- What number and percentage of pregnant women and children under age five are covered initially and upon revisit?
- What is the median and mean for percent of structures in compounds covered initially and upon revisit, by revisit order (i.e. first revisit, second revisit, etc.)?

This report provides analysis to address the questions posed. All analysis presented is based on aggregated data as of June 24, 2013. Since the analysis was performed while data cleaning and spraying in West Mamprusi was still ongoing, the analysis was not performed on final figures; however, it does provide a good approximation of the impact of revisits.

I. Number of visits to individual compounds

A total of 43,280 compounds/households had been visited at the time of the analysis. 89.7% had been visited once, 9.5% had been visited twice, and a total of less than 1% had been visited more than twice. The per district “percentage of compounds sprayed in a single visit” ranges from 81.9% (Sevelugu-Nanton) to 97.5% (Bunkpurugu-Yunyoo). Without revisits, 4,451 (10.3%) compounds/households would have had eligible structures left unsprayed.

Table 21 provides details for each district.

Table 21: Number of visits made to individual compounds/households per district

District	Number of visits to individual compounds/households				
	1	2	3	4	5
Bunkpurugu-Yunyoo	11,953 (97.5%)	296 (2.4%)	9 (0.1%)	0 (0%)	0 (0%)
East Mamprusi	10,275 (92.2%)	826 (7.4%)	39 (0.4%)	1 (0%)	0 (0%)
Sevelugu-Nanton	7,062 (81.9%)	1,433 (16.6%)	126 (1.5%)	6 (0.1%)	0 (0%)
West Mamprusi	9,539 (84.8%)	1,549 (13.8%)	156 (1.4%)	9 (0.1%)	1 (0%)
Grand total	38,829 (89.7%)	4,104 (9.5%)	330 (0.8%)	16 (0%)	1 (0%)

NOTES:

- Figures in parenthesis are percentages denoting the percent of compounds that required each number of visits compared to the total number of compounds.
- Number of compounds/households is obtained by counting the number of unique IRS serial numbers assigned to each compound household in each district.

Revisits started as early as April 30 in Savelugu-Nanton, but became more frequent across the four districts after May 11 as seen in Table 22.

Table 22: Number of compounds visited disaggregated by “Initial Spray” and “Revisit” for each data across the four districts

Spray Date	Bunkpurugu-Yunyoo		East Mamprusi		Savelugu-Nanton		West Mamprusi	
	Initial Spray	Revisit	Initial Spray	Revisit	Initial Spray	Revisit	Initial Spray	Revisit
29-4-2013	332		261		246		269	
30-4-2013	348		284	1	224	2	389	
1-5-2013	49		317	7	59		20	
2-5-2013			264	2	241		336	1
3-5-2013			218	3	261		312	3
4-5-2013							193	3
6-5-2013			326		237		305	4
7-5-2013			309	6	284		340	21
8-5-2013			263	15	308		352	
9-5-2013			307		262		320	3
10-5-2013			310	28	313		345	4
11-5-2013					199	92	240	1
13-5-2013	397		319	3	269	7	363	17
14-5-2013	350	1	265		183		309	
15-5-2013	363		299	6	216	15	288	12
16-5-2013	371	1	330	4	207	3	272	4
17-5-2013	359	16	295	6	212	5	341	16
18-5-2013	269	1	287	2	235	10	272	21
20-5-2013	390		331		215		338	14
21-5-2013	390		283	6	248	11	247	9
22-5-2013	384	1	359	5	278	2	315	13
23-5-2013	437		325	7	240		348	10
24-5-2013	400	6	313	14	240	15	327	6
25-5-2013	480	5	293	10	201	12	353	16
27-5-2013	454	2	278	9	246	15	314	20
28-5-2013	469	2	276	4	260	24	244	17
29-5-2013	343	19	276	3	201	40	348	36
30-5-2013	423	3	257		155	2	272	63
31-5-2013	396	16	332	9	255	29	305	75
1-6-2013	477	3	239	16	217	64	346	37
3-6-2013	477		286	3	211	14	337	63
4-6-2013	454	9	257	16	272	32	286	72
5-6-2013			289	5	40	4	31	85

6-6-2013	464	6	260	19	236	20	259	26
7-6-2013	446	38	252	11	222	56	174	81
8-6-2013	395	2	231	12	87	67	222	88
10-6-2013	350	6	265	25	137	69	55	8
11-6-2013	293	10	201	35	170	101	202	23
12-6-2013	208		208	92	213	44	187	13
13-6-2013	371	3	229	76	180	17	134	26
14-6-2013	71		225	54	115	6	134	86
15-6-2013			145	60	99	26	104	56
17-6-2013	250	10			89	66	4	
18-6-2013	233	24	81	62	5	230	35	70
19-6-2013	281	43	23	111	5	217	124	170
20-6-2013					4	200	1	31
21-6-2013	121	50	26	107	11	5	58	302
24-6-2013							37	119

NOTES:

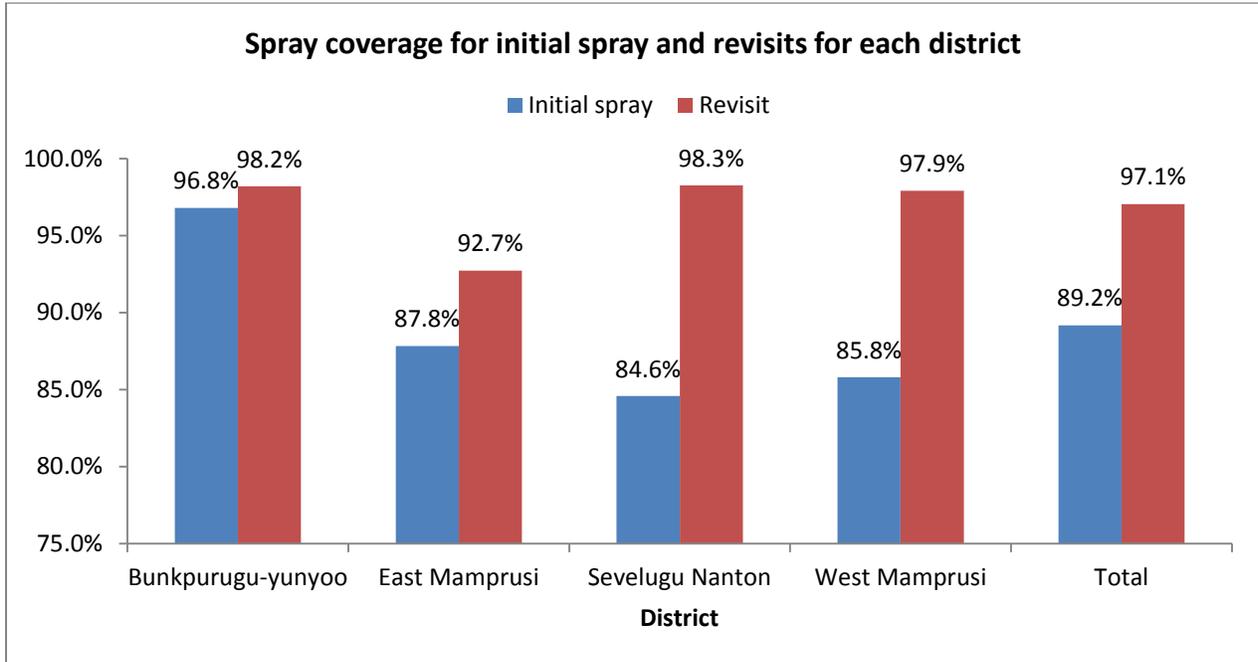
- All figures in the table refer to the number of compounds/households¹⁸ visited.
- The gap in spray operations (from May 2, 2013 to May 11, 2013) in Bunkpurugu-Yunyoo district reflects a halt on spray operations due to conflict within the area.

2. What percentage of structures is being covered during a revisit compared to during initial visits?

Spray coverage, based on the unsprayed structures found per visit, is higher for revisits than during initial spray across the entire four districts. Average spray coverage was 97% during revisits and approximately 89% during initial spray. Apart from Bunkpurugu-Yunyoo, the other three districts have an initial spray coverage of less than 90% and spray coverage of more than 90% during revisits. Overall, 97.1% of structures initially missed are sprayed upon revisit. This suggests that revisits are effective in “mopping up” initially missed structures.

¹⁸ In Ghana, an IRS card which provides a unique ID number is provided per Head of Household or Landlord; hence, revisits are denoted per compound/household.

Figure 8: Average spray coverage (based on structures found unsprayed per visit) during initial spray and revisits



The data in Table 23 denotes that without revisits, 10,891 structures (approximately 6% of all sprayed structures and 5% of all total structures found) would not be sprayed.

Table 23: Total number of sprayed structures during initial SOP visits and revisits

District	Structures Sprayed			Total Structures Found	Spray Coverage without Revisits	Spray Coverage with Revisits
	Initial Visits	Revisits	Total			
Bunkpurugu-Yunyoo	44,067	535	44,602	46,115	95.6%	96.72%
East Mamprusi	47,763	1,883	49,646	56,285	84.9%	88.20%
Savelugu-Nanton	36,122	4,123	40,245	44,447	81.3%	90.55%
West Mamprusi	56,080	4,350	60,430	68,393	82.0%	88.36%
Total	184,032	10,891	194,923	215,240	85.5%	90.56%

3. What number and percentage of pregnant women and children under five years of age are covered initially and upon revisit?

Together, total pregnant women and children under five years of age make up 21.4% of total population protected. The information in Table 24 shows that a greater proportion of pregnant women and children under five years old were covered during initial visits compared to revisits. Over 95% (11,040) of protected pregnant women and 96.3% (97,558) of protected children under five years old were covered during initial spray visits. Without revisits, a combined total of 4,235 pregnant women and children under five years old would not have been protected by IRS.

Further details are illustrated in Figures 9 and 10.

Table 24: Number of pregnant women and children under five years of age covered by initial spray and revisits

	District	Bunkpurugu-Yunyoo	East Mamprusi	West Mamprusi	Savelugu-Nanton	Grand Total
Pregnant Women	Initial spray	1,945	3,329	3,666	2,100	11,040
	Revisit	21	98	218	153	490
	TOTAL	1,966	3,427	3,884	2,253	11,530
Children < 5	Initial spray	17,845	28,400	31,829	19,484	97,558
	Revisit	177	710	1,772	1,086	3,745
	TOTAL	18,022	29,110	33,601	20,570	101,303
Total population	Initial spray	105,934	138,170	157,238	102,731	504,073
	Revisit	1,211	4,288	9,956	8,260	23,715
	TOTAL	107,145	142,458	167,194	110,991	527,788
Preg. women / Total population (%)	Initial spray	1.82%	2.34%	2.19%	1.89%	2.09%
	Revisit	0.02%	0.07%	0.13%	0.14%	0.09%
	TOTAL	1.83%	2.41%	2.32%	2.03%	2.18%
Child < 5 / Total population (%)	Initial spray	16.66%	19.94%	19.04%	17.55%	18.48%
	Revisit	0.17%	0.50%	1.06%	0.98%	0.71%
	TOTAL	16.82%	20.43%	20.10%	18.53%	19.19%

Figure 9: Percentage of pregnant women covered during initial spray and revisits

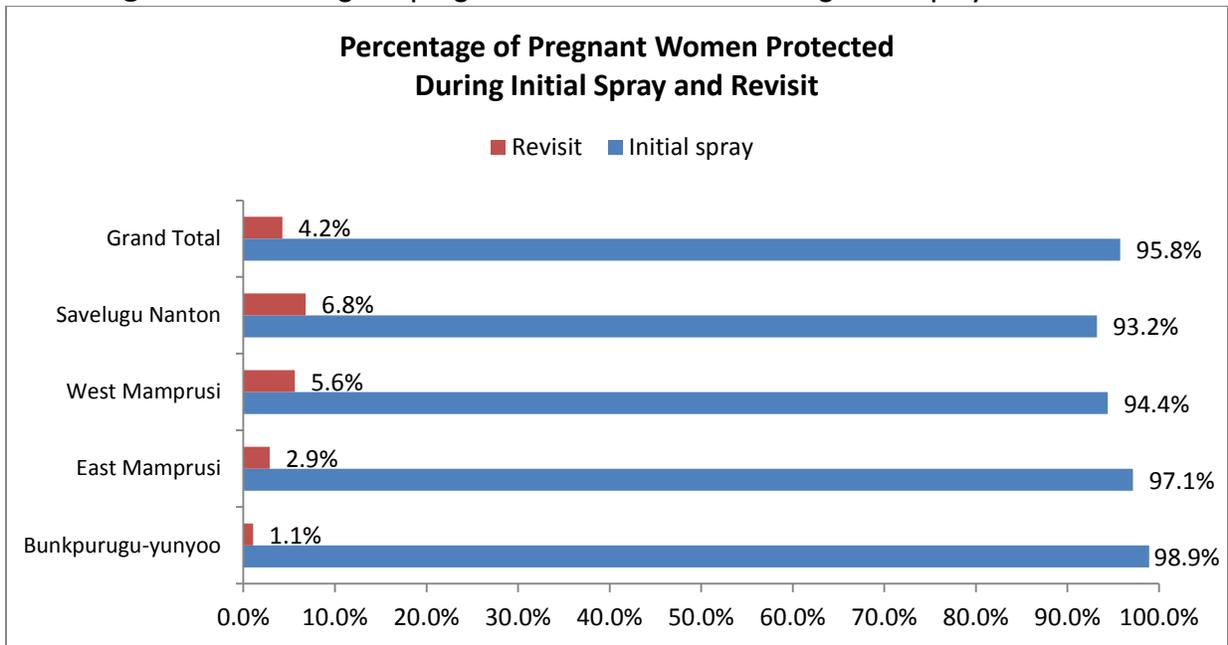
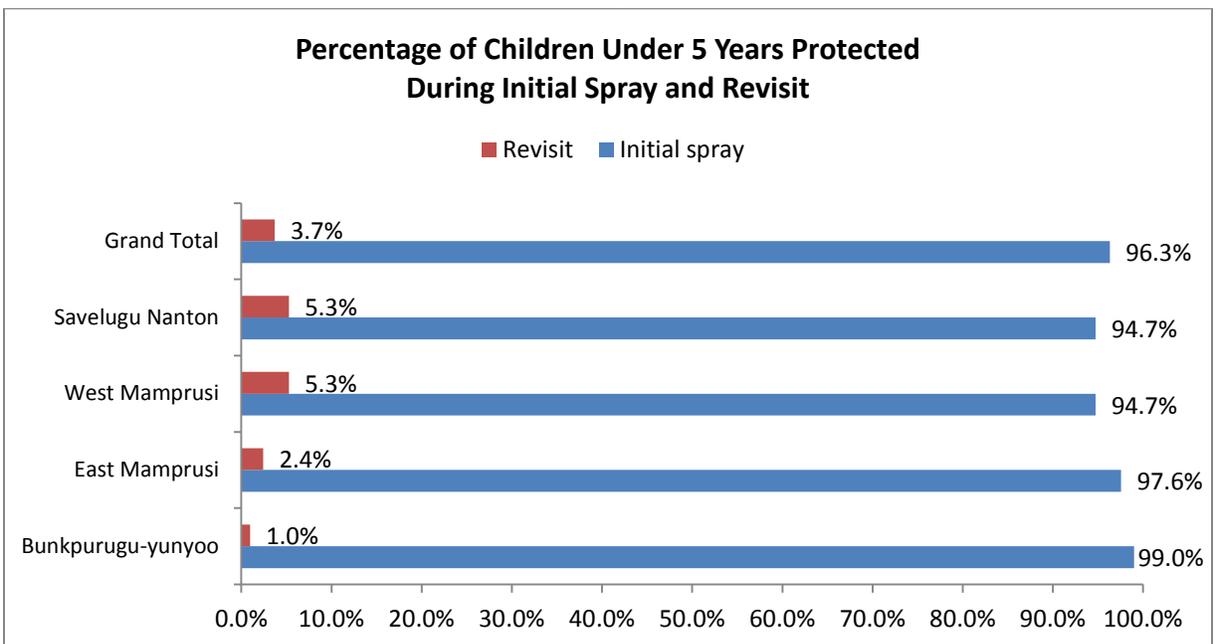


Figure 10: Percentage of children under five years of age covered during initial spray and revisits



4. What is the mean and median for percent of structures in compounds covered initially and upon revisit, by revisit order (i.e. first revisit, second revisit, etc.)

Complete analysis for the total coverage gains per visit for the districts and mean and median coverage based on compound analysis is presented in Table 25. Median spray coverage per compound across the four district is 100%, while mean spray coverage per compound ranges from approximately 83% to 96% for first visits.

Both per compound mean and median spray coverage is seen to reduce drastically from visits 2 to 4. In Savelugu-Nanton, the mean and median spray coverage per compound remained relatively higher across visits 2 through 4 compared to the other three districts.

Overall, the second visit increased campaign spray coverage by 5.05% (from 85.21% to 90.26%). Additionally, for the spray campaign as a whole, per compound that required revisit, a mean of 36.89% of initially missed structures were sprayed upon second visit. Across the four districts, for compounds that required a second visit, between 32.03% (East Mamprusi) and 43.40% (Savelugu-Nanton) of initially unsprayed structures were able to be sprayed upon the second visit.

Note, while *compound coverage* per visits 2, 3, and 4, averaged from 20.58% to 43.40%, the *structure coverage* of revisit as a whole was 97.1%.¹⁹

Revisits were essential for enabling all districts except Bunkpurugu-Yunyoo to meet the 85% PMI spray coverage target. The largest percent increases were in West Mamprusi and Savelugu-Nanton. The second visit in West Mamprusi increased the district's spray coverage by 6.31% (from 81.65% to 87.96%). Likewise, the second visit in Savelugu-Nanton increased the district's spray coverage by 9.65% (from 80.23% to 89.88%).

Table 25: Total coverage per district and mean and median spray coverage per compound, by visit

District	Overall Coverage (%)	Visit 1			Visit 2			Visit 3			Visit 4		
		Total (%)	Mean (%)	Median (%)	Total (%)	Mean (%)	Median (%)	Total (%)	Mean (%)	Median (%)	Total (%)	Mean (%)	Median (%)
Bunkpurugu-Yunyoo	96.72	95.72	96.34	100.00	0.98	36.51	33.30	0.01	27.30	28.60	0.00	0.00	0.00
East Mamprusi	88.20	84.87	87.49	100.00	3.24	32.03	28.60	0.09	22.51	20.00	0.00	0.00	0.00
Savelugu-Nanton	90.55	80.23	82.96	100.00	9.65	43.40	40.60	0.66	32.57	33.30	0.01	26.65	26.65
West Mamprusi	88.36	81.65	84.79	100.00	6.31	33.32	30.00	0.38	22.42	20.00	0.02	20.58	16.70
TOTAL	90.56	85.21	88.39	100.00	5.05	36.89	33.30	0.28	26.31	25.00	0.01	22.31	20.00

NOTE: In Table 21, one compound was visited five times. Further investigations showed that five different SOPs visited that compound on three different days (2 SOPs on 29/5/24, 2 SOPs on 30/5/13 and 1 SOP on 4/6/13). Data in Table 25 above shows revisits made by SOPs on different days. Thus, for the purposes of this analysis, the compound/household mentioned above is captured under compounds that have been visited three times.

¹⁹ See section 2, Figure 8.

Conclusions

- Of the 43,280 compounds/households visited²⁰, 89.7% (38,829) were visited only once, 9.5% (4,104) were visited twice, and a total of less than 1% (347) were visited more than twice. This demonstrates that over 10% of compounds would have had eligible structures left unsprayed if it were not for the practice of “mop-up” revisits.
- Average overall initial spray coverage was approximately 89% and was below the 90% NMCP target for all districts except Bunkpurugu-Yunyoo. If there were no revisits, about 10,891 structures (approximately 6% of all sprayed structures and 5% of total structures found) would not be sprayed.
- A greater proportion of pregnant women and children under five years old were covered during initial visits (11,040 pregnant women (95.8%) and 97,558 (96.3%) children under five) compared to revisits. If revisit were not undertaken, a combined total of 4,235 pregnant women and children under five years of age would not have been protected by IRS.
- As a whole, revisits increased overall and per district spray coverage between 1% (Bunkpurugu-Yunyoo) to over 10% (Savelugu-Nanton).

²⁰ This is the total number of compounds visited from the start of spray through the June 24, when revisit analysis were performed.

ANNEX C. PRE-, MID-, AND POST-SEASON ENVIRONMENTAL COMPLIANCE ASSESSMENTS

Table 26: Summary of Pre-Season Environmental Compliance Assessments - Storage Facility and Soak Pits

Operation site	Facility located an adequate distance from schools, homes, and water bodies	Double locks on pesticide storage	Facility guarded 24 hrs/day	Windows barred and screened	Soak pit fenced, gated, and locked	Danger signs with skull and crossbones	Guards have boots, whistles, and flashlights, phones	Pesticides properly labeled ²¹	Material Safety Data Sheets (MSDS) readily available in storeroom	Extra MSDSs for transport vehicles	Adequate PPE in inventory for the number of operators expected	First aid kits for storeroom and transport vehicles fully stocked	Emergency response procedure posted in stockroom (with phone numbers)	Spill response procedure posted	Insecticides past their expiration date	Containers for waste available and clearly marked	Thermometer in storeroom	Spill kits for storeroom and for vehicles	Fire extinguisher inside and outside	Leak-proof floor	Leak-free roof	Soap and water available	Antidotes to pesticides available nearby	Storeroom supervisors know signs of poisoning and location of nearest treatment facility	Prepared to administer pregnancy tests
Moglaa	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes
Zoggu	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes
Diare	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes

²¹ N/A means that at the time of the Pre-spray inspection, that indicator could not be assessed. Those indicators were assessed during the mid-spray and post spray inspections.

Operation site	Facility located an adequate distance from schools, homes, and water bodies	Double locks on pesticide storage	Facility guarded 24 hrs/day	Windows barred and screened	Soak pit fenced, gated, and locked	Danger signs with skull and crossbones	Guards have boots, whistles, and flashlights, phones	Pesticides properly labeled ²¹	Material Safety Data Sheets (MSDS) readily available in storeroom	Extra MSDSs for transport vehicles	Adequate PPE in inventory for the number of operators expected	First aid kits for storeroom and transport vehicles fully stocked	Emergency response procedure posted in stockroom (with phone numbers)	Spill response procedure posted	Insecticides past their expiration date	Containers for waste available and clearly marked	Thermometer in storeroom	Spill kits for storeroom and for vehicles	Fire extinguisher inside and outside	Leak-proof floor	Leak-free roof	Soap and water available	Antidotes to pesticides available nearby	Storeroom supervisors know signs of poisoning and location of nearest treatment facility	Prepared to administer pregnancy tests	
Janga	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes
Walewale	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes
Kpasinkpe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes
Yizesi	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes
Kubore	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes
Langbinsi	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes
Gambaga	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes
Gbintiri	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes
Nakpanduri	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes
Nasuan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes
Yunyoo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes
Binde	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes
Bunkpurugu	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	N/A	Yes

Table 27: Summary of Mid-Spray Environmental Inspections- Storage Facility and Soak Pits

Operation Site	Date Inspection Performed (dd/mm/yr)	Are the store keepers, SOs and wash persons wearing appropriate PPE?	Do spray teams have clean PPE at the start of each work day?	Are overalls washed daily, and dried over the soak pit?	During transport, are all spray operator comfortably seated with pumps well placed between their legs in the transport vehicle?	Are spray operators fed before start of spray? (before wearing of PPE	Is the store well arranged? (height of arranged items, allowing for free movement, proper stacking of items, allowing for ventilation)	Are warning signs correctly displayed? (danger sign, insecticide safety notice)	Is there firefighting equipment (not expired)?	Are the surroundings of the store and soak pit clear of IRS solid wastes (empty sachets, masks, gloves)?	Are contents of drums 1, 3, 5 and 7 emptied into spray pumps before spray operators depart for field?
Moglaa	08/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Zoggu	08/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Diare	08/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Janga	17/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Walewale	12/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kpasinkpe	11/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yizesi	11/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kubore	11/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Langbinsi	15/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gambaga	15/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gbintiri	18/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nakpanduri	18/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nasuan	18/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yunyoo	17/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Binde	17/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bunkpurugu	17/06/13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 28: Summary of Mid-Spray Environmental Inspections- Household Preparation Before IRS

Operation Site	Have all personal belongings, animals, and sick persons been removed from the house?	Have all immovable items been moved to center of the house and properly covered with polythene sheet?	Are the residents instructed on what to do during and after spraying?
Moglaa	Yes	Yes	Yes
Zoggu	Yes	Yes	Yes
Diare	Yes	Yes	Yes
Janga	Yes	Yes	Yes
Walewale	Yes	Yes	Yes
Kpasinkpe	Yes	Yes	Yes
Yizesi	Yes	Yes	Yes
Kubore	Yes	Yes	Yes
Langbinsi	Yes	Yes	Yes
Gambaga	Yes	Yes	Yes
Gbintiri	Yes	Yes	Yes
Nakpanduri	Yes	Yes	Yes
Nasuan	Yes	Yes	Yes
Yunyoo	Yes	Yes	Yes
Binde	Yes	Yes	Yes
Bunkpurugu	Yes	Yes	Yes

Table 29: Summary of Mid-Spray Environmental Inspections- Observation of Spray Operators in the Field

Operation Site	Are SOs in full PPE? (helmet, overalls, boots, gloves, mask)	Is mixing of the insecticide witnessed by any household resident?	Are SOs spraying only the recommended surfaces?	Do SOs correctly record household details?	Is any SOs observed eating/drinking/smoking while at work?	Do SOs correctly follow the spraying techniques (standing 45cm from the wall, using vertical swaths, 5cm swath overlap, frequently shaking the can and constant observation of the pressure gauge)
Moglaa	Yes	Yes	Yes	Yes	No	Yes
Zoggu	Yes	Yes	Yes	Yes	No	Yes
Diare	Yes	Yes	Yes	Yes	No	Yes
Janga	Yes	Yes	Yes	Yes	No	Yes
Walewale	Yes	Yes	Yes	Yes	No	Yes
Kpasinkpe	Yes	Yes	Yes	Yes	No	Yes
Yizesi	Yes	Yes	Yes	Yes	No	Yes
Kubore	Yes	Yes	Yes	Yes	No	Yes
Langbinsi	Yes	Yes	Yes	Yes	No	Yes
Gambaga	Yes	Yes	Yes	Yes	No	Yes
Gbintiri	Yes	Yes	Yes	Yes	No	Yes
Nakpanduri	Yes	Yes	Yes	Yes	No	Yes
Nasuan	Yes	Yes	Yes	Yes	No	Yes
Yunyoo	Yes	Yes	Yes	Yes	No	Yes
Binde	Yes	Yes	Yes	Yes	No	Yes
Bunkpurugu	Yes	Yes	Yes	Yes	No	Yes

Table 30: Summary of Mid-Spray Environmental Inspections- Observations of Spray Operators at Operation Sites After Completing Spraying

Operation Site	At the end of the shift, are both full and empty sachets returned, counted and recorded in inventory?	Empty sachets and used masks are stored in separate designated and labeled containers in the store room?	Are 7 barrels placed and arranged on an impermeable ground or polythene sheet (for permeable grounds) along the wash bay?	Do barrels #2, 4, and 6 contain enough water for triple rinsing?	Do SOs correctly conduct triple rinsing while wearing PPE?	Are all IRS PPE and haversacks handed over to the store keeper at the end of the day's work?	Are washed pumps orderly arranged in the store?	Are SOs provided with soap to wash and bathe?	Do spray teams bathe after the day's work?	Is the insecticide usage rate and average no. of houses sprayed per SO within acceptable limits?(At least 2.5 – 3 and 10 houses/SO/day)
Moglaa	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Zoggu	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Diare	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Janga	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Walewale	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kpasinkpe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yizesi	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kubore	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Langbinsi	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gambaga	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gbintiri	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nakpanduri	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nasuan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yunyoo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Binde	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bunkpurugu	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 31: Summary of Post-Season Environmental Compliance Assessments- Inspection of Store after Collection of Logistics to the District Stores

Operation Site	Date Inspection Conducted (dd/mm/yr)	Are all the IRS items, insecticides and wastes taken back to the district store?	Does the addition of used insecticides and unused insecticides equal the beginning inventory?	Is the store cleaned before being handed over to the owners?	Is the soak pit covered and the gate closed and locked?	Are the soak pit and its surroundings left clean?	Was the working relationship between the IRS team and owners of the store good?
Moglaa	05/07/13	Yes	Yes	Yes	Yes	Yes	Yes
Zoggu	05/07/13	Yes	Yes	Yes	Yes	Yes	Yes
Diare	08/07/13	Yes	Yes	Yes	Yes	Yes	Yes
Janga	09/07/13	Yes	Yes	Yes	Yes	Yes	Yes
Walewale	09/07/13	Yes	Yes	Yes	Yes	Yes	Yes
Kpasinkpe	09/07/13	Yes	Yes	Yes	Yes	Yes	Yes
Yizesi	10/07/13	Yes	Yes	Yes	Yes	Yes	Yes
Kubore	10/07/13	Yes	Yes	Yes	yes	Yes	Yes
Langbinsi	11/07/13	Yes	Yes	Yes	Yes	Yes	Yes
Gambaga	11/07/13	Yes	Yes	Yes	Yes	Yes	Yes
Gbintiri	18/07/13	Yes	Yes	Yes	Yes	Yes	Yes
Nakpanduri	12/07/13	Yes	Yes	Yes	Yes	Yes	Yes
Nasuan	18/07/13	Yes	Yes	Yes	Yes	Yes	Yes
Yunyoo	16/07/13	Yes	Yes	Yes	Yes	Yes	Yes
Binde	16/07/13	Yes	Yes	Yes	Yes	Yes	Yes
Bunkpurugu	15/07/13	Yes	Yes	Yes	Yes	Yes	Yes

ANNEX D. GHANA MONITORING AND EVALUATION PLAN INDICATOR MATRIX

AFRICA IRS PROJECT

GHANA MONITORING AND EVALUATION PLAN INDICATOR MATRIX

UPDATED: January 10, 2014

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

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

I.1 Procurement

I.1.1 Number and percentage of international insecticide procurement orders delivered in country, at port of entry, at least 30 days prior to the start of spray operations	<p>[<i>Numerator</i>: Number of international insecticide procurements delivered in country, at port of entry, at least 30 days prior to the start of spray operations]</p> <p>[<i>Denominator</i>: Total number of international insecticide procurements]</p> <p><i>Calculation</i>: [Numerator ÷ Denominator] × 100</p>	Y1, Y2, Y3	<p><i>Data source</i>: Project records – ex: international procurement documents, air way bills, commercial Invoices</p> <p><i>Reporting frequency</i>: Each spray season (annual/ semi-annual)</p>	By Spray Campaign	AIRS	1 PO (Actellic); 100%	Round 1: 0; 0% (insecticide delivery was delayed due to manufacturer, resulting in Actellic district spray campaign being delayed)	#TBD; 100%	1 (PO; Actellic CS); 100%	1; 100%	
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Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Results					
						Year 1		Year 2		Year 3	
						Target	Results	Target	Results	Target	Results
							Round 2: N.A. ²²				
1.1.2 Number and percentage of international procurements for equipment, including PPE, received at port of entry, 30 days prior to start of spray operations.	<p>[Numerator: Number of international procurements for equipment, including PPE, at port of entry, 30 days prior to start of spray operations]</p> <p>[Denominator: Total number of international procurements for equipment, including PPE.]</p> <p>Calculation: $[\text{Numerator} \div \text{Denominator}] \times 100$</p>	Y1, Y2, Y3	<p>Data source: Project records – ex: international procurement documents, air way bills, commercial Invoices</p> <p>Reporting frequency: Each spray season (annual/ semi-annual)</p>	By Spray Campaign	AIRS	6 POs; 85%	3 of 6 POs were received 30 days prior to start of spray operations; 50%	11, 100%	13 of 17 POs were received 30 days prior to start of spray operations ; 76.5%	7, 100%	(4 of 17 POs- For Ento equipment arrived after spray operations has started)

²² Insecticide (Fendona) used in round 2 was already in stock from 2011 procurement.

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Results					
						Year 1		Year 2		Year 3	
						Target	Results	Target	Results	Target	Results
1.1.3 Number and percentage of local PPE procurement orders that are delivered to the regional warehouse 14 days before the start of spray operations	[[<i>Numerator</i> : Number of local PPE procurements delivered to the regional warehouse 14 days before the start of spray operations] [[<i>Denominator</i> : Total number of local PPE procurements.] <i>Calculation</i> : [Numerator ÷ Denominator] × 100	Y1, Y2, Y3	<i>Data source</i> : Project records- ex: delivery notes, goods receiving notes, inventory control cards <i>Reporting frequency</i> : Each spray season (annual/ semi-annual)	By Spray Campaign	AIRS	#N.A.; 80%	N.A. ²³	1, 100% (For neck covers)	2 of 2 POs, 100% (1 for neck covers, 1 for aprons)	N/A	
1.1.4 Successfully completed spray operations without an insecticide stock-out	Milestone: (Completed/Not Completed)	Y1, Y2, Y3	<i>Data source</i> : Project records <i>Reporting frequency</i> : Each spray season (annual/ semi-annual)	By Spray Campaign	AIRS	Achieved	Achieved for both Rounds	Achieved	Achieved	Achieved	
1.2 In-country Logistics, Warehousing, and Training											
1.2.1 Number and percentage of logistics and warehouse managers trained in IRS supply chain management	[[<i>Numerator</i> : Total number of logistics and warehouse managers trained in IRS supply chain management using AIRS Project resources.] [[<i>Denominator</i> : Total number of AIRS logistics and warehouse	Y1, Y2, Y3	<i>Data source</i> : Routine training records <i>Reporting frequency</i> : Semi-annually	By Spray Campaign By Gender	PMI	9; 100%	9; 100%; (7 male, 2 female; 22.2% female)	19; 100% (4 logistics assistants and 15 store assistants)	21, 100%; (8 male, 13 female; 61.9% female)	21, 100%	

²³ Due to previous management issues and lack of logistical oversight, this indicator is unable to be reported for Year 1.

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Results					
						Year 1		Year 2		Year 3	
						Target	Results	Target	Results	Target	Results
	managers.] <i>Calculation:</i> $[\text{Numerator} \div \text{Denominator}] \times 100$										
1.2.2 Number and percentage of district and operational site stores where physical inventories are verified by up-to-date stock records	<i>[Numerator:</i> Number of district and operational site stores where physical inventories are verified by up-to-date stock records] <i>[Denominator:</i> Total number of district and operational site stores audited.] <i>Calculation:</i> $[\text{Numerator} \div \text{Denominator}] \times 100$ <i>(See PIRS for details on sample size for operational audits)</i>	Y2, Y3	<i>Data source:</i> Project records-inventory audit reports <i>Reporting frequency:</i> Each spray season (annual/ semi-annual)	By Spray Campaign	AIRS	N.A.	N.A.	13, 85%	16, 100%	16, , 100%	
1.2.3 Submit up-to-date inventory records to AIRS Home Office 30 days after the end of each spray campaign	Milestone: (Completed/Not Completed)	Y2, Y3	<i>Data source:</i> Project records <i>Reporting frequency:</i> Each spray season (annual/ semi-annual)	By Spray Campaign	AIRS	N.A.	N.A	Completed	Completed	Completed	

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

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

2.1 Planning and Design of IRS Programs

2.1.1 Annual IRS country work plan developed and submitted on time	Milestone: (Completed/Not Completed)	Y1, Y2, Y3	Data source: Project records Reporting frequency: Annually		AIRS	Completed	Completed	Completed	Completed	Completed	
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2.2 Support of Safety and Health Best Practices and Compliance with USAID and Host Country Environmental Regulations

2.2.1 SEA/letter report submitted on time ²⁴	Milestone: (Completed/Not Completed)	Y1, Y2, Y3	Data source: Project records – submitted SEAs/ letter reports Reporting frequency: Each spray campaign	By Spray Campaign	AIRS	Completed	Completed	Completed	Completed	Completed	
2.2.2 Number and percentage of soak pits and warehouses/ storerooms inspected and approved prior to spraying	[Numerator: Number of soak pits and/or storehouses inspected and certified by environmental officer]	Y1, Y2, Y3	Data source: Project records – Reports submitted by environmental compliance officer	By Spray Campaign By soak pits and warehouses/st	AIRS	31 soakpits; 31 warehouses; 100%	Round 1: 31 soakpits; 31 warehouses; 100% Round 2: 4	15 soak pits; 15 warehouses; 100%	16 soakpits; 16 warehouses; 100%	16 soakpits; 16 warehouses; 100%	

²⁴ In Year 1, SEAs were due 30 days prior to the commencement of spraying and letter reports were to be submitted 14 days prior to the commencement of spraying. In Year 2 and Year 3, due dates agreed upon with Washington-PMI will be noted in each country-specific Monitoring and Evaluation Plan to assess indicator 2.2.1.

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Results					
						Year 1		Year 2		Year 3	
						Target	Results	Target	Results	Target	Results
	[Denominator: Total number of project soak pits and/or storehouses] Calculation: $[Numerator \div Denominator] \times 100$		Reporting frequency: Each spray season	orerooms			soakpits; 4 warehouses; 100%				
2.2.3 Number of government environmental and health officers trained in IRS environmental compliance	Total number of government environmental and health officers trained in IRS environmental compliance using AIRS Project resources	Y1, Y2, Y3	Data source: Project training reports Reporting frequency: Semi-annually	By Spray Campaign By Gender	AIRS	18 ²⁵	18 (18 male, 0 female)	12	10 (10 male, 0 female)	10	
2.2.4 Number of spray personnel trained in environmental compliance and personal safety standards in IRS implementation	Total number of spray personnel who attend a training in environmental compliance and personal safety standards in IRS implementation using AIRS Project resources, includes all staff who received environmental compliance training - spray operators, team leaders, washpersons, storekeepers, etc.	Y1, Y2, Y3	Data source: Project records – Training reports Reporting frequency: Each spray season	By Spray Campaign By Gender	AIRS	720	Round 1: 899 (754 males, 145 female)	330	490 (371 males, 119 female; 24% female)	550	

²⁵ Training of government environmental and health officers in IRS environmental compliance occurred as an annual event in 2012, rather than per spray campaign.

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Results					
						Year 1		Year 2		Year 3	
						Target	Results	Target	Results	Target	Results
2.2.5 Number of health workers receiving insecticide poisoning case management training	Total number of clinical personnel trained in insecticide poisoning case management using AIRS Project resources	Y2, Y3	Data source: Project records – Training reports Reporting frequency: Each spray season	By Spray Campaign By Gender	AIRS	100 ²⁶	93, (62 males, 31 females)	50	46, (32 males, 14 females)	50	
2.2.6 Number of adverse reactions to pesticide exposure documented	Total number of incidents of pesticide exposure reported that resulted in a referral for medical care	Y1, Y2, Y3	Data source: Incident report forms that are required for each incidence of pesticide exposure Reporting frequency: Each spray season	By Spray Campaign By residential/occupational exposure	AIRS	0	Round 1: 0 Round 2: 0	0	0	0	
2.2.7. Number of vehicular accidents reported	Total number of vehicular accidents reported	Y1, Y2, Y3	Data source: Vehicular incident report forms that are required for each accident Reporting frequency: Each spray season	By Spray Campaign	AIRS	0	Round 1: 0 Round 2: 0	0	4 (1 in West Mamprusi, 2 in Savelugu Nanton, 1 in Bunkpurugu Yunyoo)	0	
2.3 Support Entomological Monitoring Activities and Insecticide Resistance Strategies											
2.3.1 Number of sentinel sites supported by the AIRS project	Total number of entomological sentinel sites supported by the AIRS project	Y1, Y2, Y3	Data source: Entomological reports Reporting frequency: Annually	By Spray Campaign	AIRS	<u>Round 1:</u> 13 (10 experimental and 3 control sites)	<u>Round 1:</u> 13 <u>Round 2:</u> 2	13	13	13	

²⁶ In Ghana, health worker training occurs once per year, rather than per campaign.

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Results					
						Year 1		Year 2		Year 3	
						Target	Results	Target	Results	Target	Results
						Round 2: 2					
2.3.2 Number and percentage of entomological monitoring sentinel sites measuring all five primary PMI entomological indicators	<p><i>[Numerator: Number of entomological monitoring sites measuring all five primary PMI entomological indicators]</i></p> <p><i>[Denominator: Number of entomological monitoring sentinel sites]</i></p> <p><i>Calculation: [Numerator ÷ Denominator] x 100</i></p>	Y1, Y2, Y3	Data source: Entomological reports <i>Reporting frequency: Annually</i>	By Spray Campaign	AIRS	Round 1: 13, 100%	Round 1: 13, 100%	13, 100%	13, 100%	13; 100%	
2.3.3 Number and percentage of entomological monitoring sites measuring at least one secondary PMI indicator	<p><i>[Numerator: Number of entomological monitoring sites measuring at least one secondary PMI indicator]</i></p> <p><i>[Denominator: Number of entomological monitoring sites]</i></p> <p><i>Calculation: [Numerator ÷ Denominator] x 100</i></p>	Y1, Y2, Y3	Data source: Entomological reports <i>Reporting frequency: Annually</i>	By Spray Campaign	AIRS	Round 1: 13, 100%	Round 1: 13, 100%	13, 100%	13, 100%	13, 100%	
2.3.4 Number and percentage of insecticide resistance testing sites that tested at least one insecticide from each of the	<p><i>[Numerator: Number of insecticide resistance testing sites that tested at least one insecticide from each of the</i></p>	Y1, Y2, Y3	Data source: Entomological reports <i>Reporting frequency:</i>	By Spray Campaign By Type of	AIRS	Round 1: 11, 100%	Round 1: 11, 100% ²⁸	11, 100%	4 of 11 of the total sites tested at least one	9, 100%	

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Results					
						Year 1		Year 2		Year 3	
						Target	Results	Target	Results	Target	Results
insecticide from each of the four classes ²⁷ of insecticides recommended for malaria vector control	four classes of insecticides recommended for malaria vector control. [Denominator: Number of insecticide resistance testing sites] Calculation: [Numerator ÷ Denominator] x 100		Annually	Insecticide					insecticide from each the 4 classes, 27.2% ²⁹		
2.3.5 Number of wall bioassays conducted within 2 weeks of spraying to evaluate the quality of IRS	Total number of wall bioassay studies conducted in established sentinel sites within 2 weeks of spraying to evaluate quality of IRS spraying activities	Y1, Y2, Y3	Data source: Entomological reports Reporting frequency: Per spray campaign	By Spray Campaign	PMI	Round 1: 24 for Fendona; 8 for Actellic Round 2: 8 Fendona	Round 1: 40 for Fendona; 24 for Actellic Round 2: 8 Fendona	4	12 ³⁰ (for Actelic)	24	

²⁸ Organochlorines class: DDT(4%), 1 of 11; Carbamates class: Propoxur (0.1%), 4 of 11; Bendiocarb (0.1%), 7 of 11. Organophosphates class: Melathion(5%) 4 of 11; Fenithrothion (1%), 8 of 11; Pirimiphos methyl (20mg), 2 of 11. Pyrethroids class: Detamethrin(0.05%) 3 of 11; Alpha-cypermethrin (0.4%) 11 of 11 tested; Alpha-cypermethrin (12.5mg) 2 of 11.

²⁷ Organochlorines class (DDT), Organophosphates class (Malathion, Fenithrothion, Pirimiphos Methyl), Carbamates class (Propoxur, Bendiocarb), Pyrethroids class (Detamethrin, Alpha-cypermethrin)

²⁹ Organochlorines class: DDT(4%), 4 of 11; Organophosphates class: Melathion(5%) 2 of 11; Fenithrothion (1%), 6 of 11; Pirimiphos methyl (0.25%) 8 of 11. Carbamates class: Propoxur (0.1%), 4 of 11; Bendiocarb (0.1%), 6 of 11; Pyrethroids class: Detamethrin (0.05%) 6 of 11; Alpha-cypermethrin (0.05%) 7 of 11 tested.

³⁰ The tests were done in three communities (2 communities in Savelugu Nanton and 1 community from Bunkpurugu Yunyoo). In each community, the test was carried out in 4 houses/ compounds.

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Results					
						Year 1		Year 2		Year 3	
						Target	Results	Target	Results	Target	Results
2.3.6 Number of wall bioassays conducted after the completion of spraying at every other month intervals to evaluate insecticide decay	Total number of wall bioassay studies conducted at bi-monthly intervals in established sentinel sites to evaluate the rate of insecticide decay on sprayed surfaces	Y1, Y2, Y3	Data source: Entomological reports Reporting frequency: <i>Per spray campaign</i>	By Spray Campaign	PMI	Perform bioassays at months 0,2,4,6; Fendona: 96 (8 houses tested at the 4 time periods) Actellic: 32 (8 houses tested at the 4 time periods)	Round 1: 40 Round 2: 16	48	196 ³¹ ; 136 tests with Kisumu strain and 60 tests with wild <i>Anopheles</i> mosquitoes		

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Wall bioassays using Kisumu strain				
Time	Month	Communities	Houses	Total Bioassays
0	Jul-13	6	4	24
1	Aug-13	6	4	24
2	Sep-13	6	4	24
3	Oct-13	6	4	24
4	Nov-13	6	4	24
5	Dec-13	4	4	16
TOTAL				136

Wall bioassays using Anopheles mosquitoes				
Time	Month	Communities	Houses	Total Bioassays
0	Jul-13	3	4	12
1	Aug-13	3	4	12
2	Sep-13	3	4	12
3	Oct-13	3	4	12
4	Nov-13	3	4	12
TOTAL				60

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Results					
						Year 1		Year 2		Year 3	
						Target	Results	Target	Results	Target	Results
2.3.7 Number of vector susceptibility tests for different insecticides conducted in selected sentinel sites	Total number of vector susceptibility tests conducted to gauge the effectiveness of individual insecticides proposed for use in spray operations	Y1, Y2, Y3	Data source: Entomological reports Reporting frequency: Per spray campaign	By Type of Insecticide	PMI	16	42 ³²	42	47 ³³	42	
2.4 Conduct Communications Activities and Community Mobilization											
2.4.1 Number of radio spots, talk shows, and video shows aired	Total number of radio spots and talk shows aired in target spray districts to stress the safety and benefits of IRS, ensure successful spray coverage, timely vacating of premises and adherence to IRS safety precautions by community members	Y1, Y2, Y3	Data source: Project records- receipts and invoices of payment made for radio spots/ programs Reporting frequency: Semi-annually	By Spray Campaign	AIRS	N.A. ³⁴	<u>Round 1:</u> 450 radio spots/jingles; 24 interactive radio shows; 17 video shows	Radio spot jingles: 882 Talk shows:42 Video shows: 20	Radio spot jingles: 372 Talk shows:16 Video shows: 12	Radio spot jingles: 540 Talk shows:32 Video shows: 20	
2.4.2 Number of IRS print materials disseminated	Total number of IRS educational materials developed, printed and distributed to community members in target spray districts using AIRS Project resources	Y1, Y2, Y3	Data source: Project records Reporting frequency: Semi-annually	By Spray Campaign By Type of printed material and message(s)	AIRS	90,000	<u>Round 1:</u> 65,000 (42,000 Posters; 23,000 Brochures) <u>Round 2:</u> 1,857: (1,857 Posters; 0 Brochures)	40,000 (30,000 posters, 10,000 brochures)	34,800 (25,000 posters and 9,800 brochures)	29,200 (23,000 posters and 6,200 brochures)	

³² Alpha-cypermethrin: 13; Detamethrin: 4; Pirimiphos methyl: 2; Fenithrothion: 3; Malathion: 8, Propoxur: 4; Bendiocarb: 7; DDT: 1;

³³ Alpha-cypermethrin (0.05%): 7; Detamethrin (0.05%): 6; Pirimiphos methyl (0.25%): 9; Fenithrothion (1%), 8; Malathion (5%): 2; Propoxur (0.1%): 5; Bendiocarb (0.1%): 6; DDT(4%): 4.

³⁴ No specific target was set at the time of 2012 workplanning.

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Results					
						Year 1		Year 2		Year 3	
						Target	Results	Target	Results	Target	Results
2.4.3 Number of people reached with IRS messages via door-to-door mobilization	Total number of adults reached with IRS message during pre-spray community, door-to-door mobilization	Y1, Y2, Y3	Data source: Mobilization Data Collection Forms Reporting frequency: Daily per mobilization conducted	By Spray Campaign By Gender	AIRS	486,207 (50% of target population 972,413)	Round 1: 346,382 (155,428 male, 190,954 females) Round 2: 17,172 (7,955 male, 9,217 females)	235,367	204,014 (93,698 males, 110,316 females)	284,030 ³⁵	
2.5 Spray Targeted Structures According to Technical Specifications											
2.5.1 Number of structures targeted for spraying ³⁶	Total number of structures found in targeted spray districts by Spray Operators	Y1, Y2, Y3	Data source: Daily Spray Operator Forms Reporting frequency: Daily per spray campaign	By Spray Campaign	PMI	Round 1: 383,018 ³⁷ Round 2: 15,498	Round 1: 383,142 Round 2: 17,239	192,685	216,876	216,876	
2.5.2 Number of structures sprayed with IRS ³⁸	Total number of structures in targeted spray districts where spraying was conducted	Y1, Y2, Y3	Data source: Daily Spray Operator Forms Reporting frequency: Daily per spray campaign	By Spray Campaign	PMI	Round 1: 344,716	Round 1: 355,278 Round 2: 16,354	173,416 (90% of 192,685)	197,655	195,188 (90% of 216,876)	
2.5.3 Percentage of total structures targeted	[Numerator: Total number of structures sprayed in	Y1, Y2, Y3	Data source: Daily Spray Operator Forms	By Spray Campaign	PMI	90%	Round 1: 92.7%	90%	91.1%	90%	

³⁵ This figure is 50% of the targeted population. Targeted population is 568,059, 50% is 284,029.5.

³⁶ The yearly targets for this indicator are from the applicable workplan, in this way the variation in targeted spray areas from year-to-year can be taken into account. The yearly results are the number of structures found by Spray Operators during the spray campaign.

³⁷ Given the 2012 AIRS Ghana Workplan did not provide a specific target, this figure is the number of structures found by Spray Operators during 2011 operations in the same districts targeted in 2012.

³⁸ The target per year for this indicator is based on 90% of the number of structures to be targeted for spraying (indicator 2.5.1).

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Results					
						Year 1		Year 2		Year 3	
						Target	Results	Target	Results	Target	Results
for spraying that were sprayed with a residual insecticide (Spray Coverage)	targeted districts] [Denominator: Total number of structures in targeted areas found by spray operators] Calculation: [Numerator ÷ Denominator] x 100		Reporting frequency: Daily per spray campaign				<u>Round 2:</u> 94.9%				
2.5.4 Number of people residing in structures sprayed (Number of people protected by IRS)	Total number of people residing in structures sprayed (Actual numbers are collected during spray operations; population estimates are not used.)	Y1, Y2, Y3	Data source: Daily Spray Operator Forms Reporting frequency: Daily per spray campaign	By Spray Campaign By Number of pregnant women By Number of children <5 years old	PMI	972,413 ³⁹	<u>Round 1:</u> 941,240 (22,704 pregnant women, 187,653 children under 5 years old) <u>Round 2:</u> 41,100 (710 pregnant women, 6,778 children under 5 years old)	470,733	534,060 (11,617 pregnant women, 102,115 children under 5 years old)	568,059 ⁴⁰	

³⁹ Estimate of population to be protected from 2012 AIRS Ghana Workplan.

⁴⁰ This is the 2013 population protected (534,060) plus the population in unsprayed structures (33,999) in that same year.

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

Component 3: Provide ongoing monitoring and evaluation and quality control measures

3.1 Submit Monitoring and Evaluation Plan (MEP) to PMI-GHANA	Milestone: (Completed/Not Completed)	Y1, Y2, Y3	Data source: Project records Reporting frequency: Semi-annual		AIRS	Completed	Completed	Completed		Completed	
3.2 Submit a post-spray data quality audit (PSDQA) report to the AIRS M&E specialist in the home office within 60-180 days of completion of spray operations	Milestone: (Completed/Not Completed)	Y1, Y2, Y3	Data source: Spray operations reports Reporting frequency: Per spray campaign	By Spray Campaign	AIRS	N.A. - AIRS Ghana has been chosen to carry out the PSDQA in Year 2	N.A.	Completed	On-process	TBD	
3.3 Submit a country-specific Eligible Structure Definition Document to local PMI advisors and NMCP	Milestone: (Completed/Not Completed)	Y1	Data source: Project records Reporting frequency: Semi-annually		AIRS	Completed	Completed	N.A.	N.A.	N.A.	
3.4 Supply chain review conducted by RTT	Milestone: (Completed/Not Completed)	Y1, Y2	Data source: RTT supply chain review reports Reporting frequency: Semi-annually	By Spray Campaign	AIRS	Completed	Completed	N.A.	N.A.	N.A.	

Component 4:

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

4.1 Number of guidelines/checklists/tool	Total number of implementation guidelines,	Y1, Y2, Y3	Data source: Project records – Activity reports	By Guideline/chec	AIRS	N.A.		TBD	4 (Data	TBD	
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Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Results					
						Year 1		Year 2		Year 3	
						Target	Results	Target	Results	Target	Results
s related to IRS operations developed or refined with project support	process checklists and program tools related to IRS operations developed or refined using the technical and/or financial resources of the AIRS Project		Reporting frequency: Semi-annually	list/tool					Collection Verification form, Error Eliminator, Data Entry Verification form, Ghana Spray Operations Supervisor's Checklist)		
4.2 Number of articles/best practices documents published	Total number of articles or other best-practice documents that have been published in relevant journals or through PMI/USAID communications vehicles	Y2, Y3	Data source: Project records – Activity reports Reporting frequency: Semi-annually	By Spray Campaign By IRS Technical Area	AIRS	N.A.	2 ⁴¹	TBD	3 ⁴²	TBD	

⁴¹ 2 articles: “Ghana-Angola peer mentoring builds capacity of local staff” <http://www.africairs.net/2012/11/ghana-angola-peer-mentoring-builds-capacity-of-local-staff/> and “Community members: ‘We know [IRS] is working because we can smell it’” <http://www.africairs.net/2012/12/2757/>

⁴² 2 videos: “Community Engagement is Key to Malaria Prevention,” <http://www.africairs.net/2013/09/video-community-engagement-is-the-key-to-malaria-prevention/>; “Recycling gives insecticide bottles new use,” <http://www.africairs.net/2013/09/video-recycling-gives-insecticide-bottles-new-use/>. 1 article: “Ghana: A woman’s job means more than a paycheck,” <http://www.africairs.net/2013/06/ghana-a-womans-job-means-more-than-a-paycheck/>.

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Results					
						Year 1		Year 2		Year 3	
						Target	Results	Target	Results	Target	Results
4.3 Number of best practice presentations given at national/ regional/international workshops and conferences	Total number of project-related oral and poster presentations delivered in national, regional and/or international meetings related to IRS.	Y2, Y3	Data source: Project records – Activity reports Reporting frequency: Semi-annually	By IRS Technical Area	AIRS	N.A.	1 ⁴³	TBD	6 ⁴⁴	TBD	

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

5.1 Capacity Building (Gender Inclusion)

5.1.1 Number of people trained in IRS implementation ⁴⁵	Total number of personnel trained in IRS implementation using AIRS Project resources. This figure only includes spray personnel such as spray	Y1, Y2, Y3	Data source: Project records – Training reports Reporting frequency: Semi-	By Spray Campaign By Gender	PMI	720	Round 1: 992 ⁴⁶ ; (816 male, 176 female; 17.7%)	544	669; (523 male, 146 female; 21.8%)	711	
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⁴³ AIRS Ghana – Country Lessons Presentation at AIRS Annual Conference on December 4, 2012, Tahiru Ahmed, AIRS Ghana Operations Manager.

⁴⁴ Four presentations made at the Malaria Vector Control Oversight Committee (MaVCOC). The aim of the presentations was to update the MaVCOC on the activities of the program. Q1, Q2 and Q4 presentations were by Sylvester Coleman while Q3 was presented by Ernest Fletcher on the following dates: Q1-7th March, 2013; Q2-13th June 2013; Q3-23rd August 2013; Q4-28th November 2013

Chief of Party, Peter Mumba, “Preparing an IRS Operations Budget,” Vector Control Working Group Presentation at West Africa Malaria Conference held from 12- 13th September 2013. The workshop was organized by GBCHealth’s Corporate Alliance for Malaria in Africa (CAMA) program, in partnership with the Roll Back Malaria (RBM) Vector Control Working Group West Africa.

Presentation by Chief of Party, Peter Mumba on the Ghana AIRS program to the MOP team on 14th May 2013. The purpose of the presentation was to get more information needed to prepare a Malaria Operational Plan.

⁴⁵ This indicator is sometimes termed “Number of people trained with USG funds to deliver IRS.”

⁴⁶ See Annex B, Table 4 for training details.

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Results					
						Year 1		Year 2		Year 3	
						Target	Results	Target	Results	Target	Results
	operators, team leaders, supervisors, clinicians; it excludes data clerks, IEC mobilizers, drivers, washers, porters, pump technicians, security guards, etc.		annually	Percentage of Women Trained							
5.1.2 Number of people trained to deliver or support IRS in target districts	Total number of people trained using AIRS Project resources to implement/support elements of IRS in target districts. This figure includes all cadre that serve a role in IRS.	Y1, Y2, Y3	Data source: Project records – Training reports Reporting frequency: Semi-annually	By Spray Campaign By Gender By Role (e.g., spray operator, storekeeper) Percentage of women trained	AIRS	~2,010	<u>Round 1:</u> 1,458; (1,258 male, 200 female; 13.7% female) <u>Round 2:</u> 85 (69 males: 16 females: 18.8%)	2,442	1,681; (1,448 male, 233 female; 13.9% female)	1,617	
5.1.3 Number of personnel trained as IRS implementation trainers	Total number of personnel trained in Training of Trainers (TOT) for IRS delivery	Y1, Y2, Y3	Data source: Project records – Training reports Reporting frequency: Semi-annually	By Spray Campaign By Gender Percentage of women trained	AIRS	120	99 (95 male, 4 female; 4.0%)	164	133; (120 male, 13 female; 9.8%)	111	
5.1.4 Number of government environmental and/or health officials trained in IRS oversight	Total number of national and sub-national/district government environmental and/or health officials who are trained in oversight of IRS implementation using AIRS Project resources	Y1, Y2, Y3	Data source: Project records – Training reports Reporting frequency: Semi-annually	By Spray Campaign By Gender Percentage of Women Trained Type of	AIRS	N.A.	18 (18 males, 0 female; 0% female) - 9 Disease Control Officers, 9 District Environmental Health Officers	8	10 (10 males, 0 female; 0% female) - 5 Disease Control Officers, 5 District Environmental Health	20	

Performance Indicator	Indicator Definition	Project Year(s) Reporting	Data Source(s) and Reporting Frequency	Disaggregate	PMI/ AIRS Indicator	Annual Targets and Results					
						Year 1		Year 2		Year 3	
						Target	Results	Target	Results	Target	Results
				government official (e.g. environmental/ health)				Officers			
5.1.5 AIRS conducted a capacity assessment	AIRS Ghana program conducted an assessment of IRS capacity among national and sub-national/district government health officials	Y1, Y2	Data source: Project records – Capacity assessment reports Reporting frequency: Semi-annually		AIRS	Completed	Pending	Completed	Completed	Completed	
5.1.6 Number of capacity-building MOUs signed by AIRS, NMCP and partners/ institutions	Total number of Memoranda of Understanding (MOU) on provision of local capacity building finalized and signed between AIRS, the National Malaria Control Program, and other local partners and institutions	Y1, Y2, Y3	Data source: Project records – MOUs Reporting frequency: Semi-annually	By Spray Campaign	AIRS	N.A.	N.A.	TBD	0	TBD	