PMI | Africa IRS (AIRS) Project

Indoor Residual Spraying (IRS 2) Task Order Four

GHANA END OF SPRAY REPORT

SPRAY CAMPAIGNS: APRIL 23- JULY 31, 2012;

OCTOBER 29- NOVEMBER 24, 2012

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Acronyms

AIRS	Africa Indoor Residual Spraying
BMP	Best Management Practices
BY	Bunkpurugu-Yunyoo
CBS	Community Based Surveillance volunteer
CS	Concentrated Suspension
DA	District Assembly
DHMT	District Health Management Team
EPA	Environmental Protection Agency
GHS	Ghana Health Service
HLC	Human Landing Catch
ICC	Inventory Control Cards
IEC	Information, Education and Communication
IRS	Indoor Residual Spraying
M&E	Monitoring and Evaluation
MOH	Ministry of Health
NMCP	National Malaria Control Program
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
RHD	Regional Health Directorate
RTI	Research Triangle Institute International
SOP	Spray Operator
USAID	United States Agency for International Development
WHO	World Health Organization

Executive Summary

In August 2011, Abt Associates was awarded a three-year Africa-wide IRS project (AIRS), funded by USAID under the President's Malaria Initiative (PMI) and Ghana is one of the countries to receive support to implement Indoor Residual Spraying (IRS). The key objectives of the AIRS project in Ghana are to reduce malaria associated morbidity and mortality in 9 districts located in the Northern region and build upon previous achievements in IRS. The target for the 2012 IRS campaign was to spray at least 90% of structures found in the same 9 districts targeted last year. The IRS campaign consists of one main round of spraying from April 23- July 31 in all 9 districts and then another round of spraying in one half of Bunkpurugu-Yunyoo (BY) district in October - November as part of an operational research study. This End of Spray Report covers spraying that was conducted from April 23 – July 31 and October 29 – November 24, 2012.

A unique characteristic of the 2012 operations was that two insecticides were used in different districts during spray operations: an organophosphate (OP) and a pyrethroid. The OP Actellic Concentrated Suspension (CS) is a long-acting formulation of Pirimiphos Methyl. It is the first time that an OP was introduced for spraying in Ghana and it was used in 3 districts during the spring (April- July) spray round. A pyrethroid was used in the other 6 districts. Spray operations started on April 23, 2012 in the pyrethroid districts and on May 14, 2012 in the organophosphate districts. Spray operations in all districts ended on July 31, 2012. For the shorter spray round in October-November, a pyrethroid was used and spraying began on October 29th.

Table 1: AIRS Ghana at a Glance

Number of districts covered by PMI-supported IRS in 2012	9 districts: (Bunkpurugu/Yunyoo, Chereponi, East Mamprusi, Gushegu, Karaga, Saboba, Savelugu-Nanton, Tolon, West Mamprusi)
Insecticide	Pyrethroid: Bunkpurugu/Yunyoo, Chereponi, Gushegu, Karaga, Saboba Organophosphate: East Mamprusi, Savelugu/Nanton, West Mamprusi Pyrethroids and Organophosphates: Tolon
Number of structures covered by PMI-supported IRS in 2012	Round 1: 355,278 Round 2: 16,354
Number of structures targeted by PMI-supported IRS in 2012	Round 1: 383,142 Round 2: 17,239

2012 spray coverage	Round 1: 93% Round 2: 95%
Population protected by PMI-supported IRS in 2012	Round 1: 941,240 (including 21,774 pregnant women and 188,696 children under 5) Round 2: 41,100 (including 710 pregnant women and 56,778 children under 5)
Dates of PMI-supported IRS campaign	Round 1: April 23–July 31, 2012 Round 2: October 29 – November 24, 2012
Length of campaign	Round 1: 60 days Round 2: 22 days
Number of people trained with USG funds to deliver IRS	Overall: 992

1. Introduction

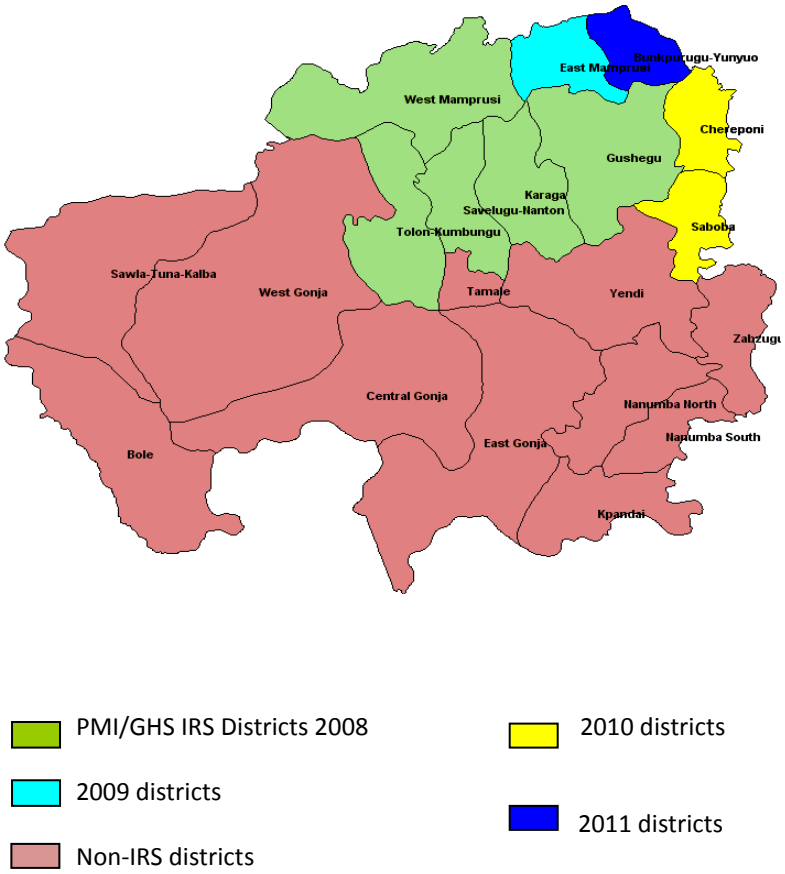
Ghana has been implementing IRS in the northern region with PMI funding since 2008. PMI, in collaboration with NMCP and the Ghana Health Service (GHS), selected and started IRS in 5 districts in 2008 with a commitment to scale up to other districts. By 2011, IRS had scaled up to 9 districts and the same 9 districts were covered in 2012.

The project was designed to meet the overall goal of reducing the malaria burden and malaria associated mortality, especially among pregnant women and children under 5 years. Specific objectives include:

- To implement IRS effectively in the 9 target districts.
- To achieve spray coverage of 90% of eligible structures found by spray operators (SOPs).
- To protect a total population of roughly 900,000 people including pregnant women and children under 5 years of age.
- To ensure human and environmental safety in the use of the selected insecticides during IRS operations.
- The Ghana IRS team will continue to work in partnership with the GHS/ NMCP to plan and implement IRS operations in the targeted districts and to promote uniformity of IRS in those districts supported by GF/AGA and other partners.
- Procure insecticides and equipment for IRS operations through an international competitive tendering process with commodity arrival by April 23, 2012.
- Provide technical support to local staff and community members for implementation of IRS operations. This includes various trainings at different levels.
- Provide technical support for program planning and implementation, data collection, protocol and guideline development, IEC, behavior change communication (BCC), and logistics coordination for IRS.
- Continue to provide financial and technical support for entomological monitoring with the support of Noguchi Memorial Institute for Medical Research (NMIMR).
- Continue to assist the U.S. Centers for Disease Control and Prevention (CDC) and NMIMR to conduct field evaluations of the residual efficacy of selected IRS insecticides in the Northern Region of Ghana.
- Continue to monitor A&P levels among children under five years of age during the rainy and dry season as part of a 3-year PMI operational research study.

The following map illustrates the location of the 9 target districts. IRS districts are colored green, blue and yellow.

Figure 1: Map of the Northern region of Ghana Showing IRS districts



2. Pre-Spray Activities

2.1 District and Insecticide Selection

In 2012, PMI and the NMCP endorsed the continuation of IRS in the 9 districts sprayed in 2011 based on the following factors:

- High malaria prevalence in the beneficiary groups
- Relatively reduced length of peak transmission season
- Vulnerability of the local populations

The choice of insecticide was informed by the following considerations:

- Technical criteria which included:

    - the need to change pesticide class based on insecticide resistance management principles and documented gradual deterioration in susceptibility in the older districts, as reviewed in the November 2011 Noguchi special entomology report.
    - weighing of the cost-effectiveness of a single annual spray round with a long acting pesticide vs. twice annual spraying with a short-acting product.
    - availability of a WHOPES and PMI-approved long acting OP on the market.
- In-country government's preferences -which ensures safety for humans and the environment;
- USAID's procurement rules –which require Abt to conduct a fair and open competition among qualified vendors that offer technically sufficient and cost effective products.

Technical considerations for the insecticide selection were based on data obtained from entomologic monitoring, supplemented by epidemiologic monitoring.

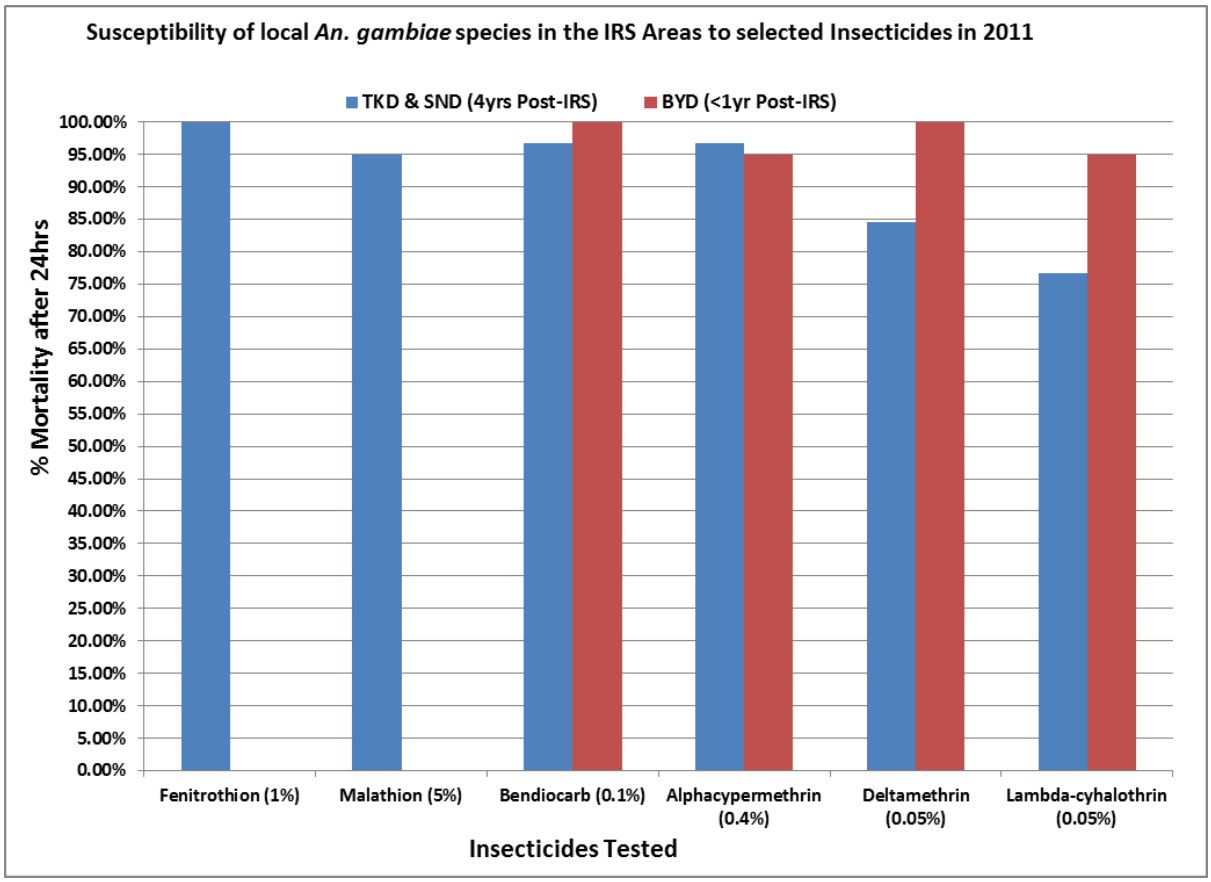
The susceptibility/resistance of local mosquitoes to the following insecticides were tested in 2011:

- Pyrethroid insecticides – alpha-cypermethrin (0.4%), deltamethrin (0.05%), lambda-cyhalothrin (0.05%)
- Carbamate insecticide – Bendiocarb (0.1%)
- Organophosphate insecticide – malathion (5%) and Fenithrothion (1%)

The susceptibility levels of *Anopheles gambiae* s.l. was evaluated on the basis of the WHO criteria of test mortality (WHO 1981; 1998); 98-100% mortality after 24 hours indicates susceptibility, 80-97% mortality suggest marginal susceptibility which needs confirmation and less than 80% mortality for resistance.

The susceptibility assays conducted in 2011 showed that the predominant local vector species (i.e. *An. gambiae*) in BY district exhibited varying levels of susceptibility to the different classes of insecticides. It was found that within the pyrethroid class, the local vector species showed complete susceptibility to deltamethrin but marginal susceptibility (mortality rate of 80-97%) to alpha-cypermethrin and lambda-cyhalothrin, and were completely susceptible to carbamates (bendiocarb). The local *An. gambiae* in Tolon and Savelugu districts were completely susceptible to Fenithrothion but were marginally susceptible to alpha cypermethrin, malathion, and bendiocarb with mortality rates ranging between 84.6% and 96.7% . Some level of resistance was detected for lambda cyhalothrin and deltamethrin (mortality rates of 76.7% and 84.6% respectively) (Figure 2.)

Figure 2: Insecticide Susceptibility of Local Anopheles species in the selected IRS areas of the Northern region of Ghana



Through an extensive consultative process, the following recommendations were reached:

- For the 6 oldest districts, a change of class should occur from a long-acting pyrethroid to the long-acting formulation of Pirimiphos Methyl (Actellic CS), an organophosphate.
- For the study district, (BY district), Alpha-cypermethrin could be used, as per the operations research protocol.
- For the 2 adjacent new districts (Chereponi and Saboba), alpha-cypermethrin could be used to permit economies of scale in IRS operations.

However, due to the inability of the manufacturer to produce adequate quantities of the new formulation of the long-acting organophosphate per the delivery schedule and the availability of adequate pyrethroid stock in Ghana, it was agreed that the use of the long-acting pyrethroid be continued in 6 districts: Bunkpurugu-Yunyoo, Saboba, Karaga, Gushegu, and Chereponi and parts of Tolon Kumbungu , while the remaining three districts and some parts of Tolon district use Actellic CS, as indicated in Table 2 below.

Table 2: List of Selected Districts & Insecticides Used for 2012 Spray Round

District	Insecticide Used
BUNKPURUGU YUNYOO	Alpha-cypermethrin (Fendona)
CHEREPONI	Alpha-cypermethrin (Fendona)
EAST MAMPRUSI	Pirimiphos Methyl (Actellic 300 CS)
GUSHEGU	Alpha-cypermethrin (Fendona)
KARAGA	Alpha-cypermethrin (Fendona)
SABOBA	Alpha-cypermethrin (Fendona)
SAVELUGU/ NANTON	Pirimiphos Methyl (Actellic 300 CS)
TOLON KUMBUNGU	Alpha-cypermethrin (Fendona) & Pirimiphos Methyl (Actellic 300 CS)[1]
WEST MAMPRUSI	Pirimiphos Methyl (Actellic 300 CS)

2.2 Micro-planning

In February 2012, Abt Associates facilitated micro-planning meetings with key partners including the GHS, Regional Health Directorate (RHD), District Health Management Teams (DHMTs), District Assemblies, Environmental Protection Agency (EPA), National Malaria Control Program (NMCP), traditional and community leaders, and the public. These micro-planning meetings served to ensure that their input and involvement were solicited for the 2012 spray operations.

The following issues were highlighted during the micro-planning meetings:

- Provision of office accommodation for district spray operations staff
- Recruitment of spray operators
- Commencement date for spray operations
- The role of stakeholders before, during and after spray operations
- Sanctions for spray operators involved in pilfering insecticide or other IRS commodities

2.3 Environmental Assessment

Ghana's SEA was amended in 2009 and it covers a period of five years (2010-2015). The prepared SEA included the use of pyrethroids and organophosphates in all districts in northern Ghana.

The Ghana AIRS team and officials from the EPA and GHS undertook a joint pre-spray environmental assessment and conducted compliance inspections from March 4 to April 17, 2012 in all nine districts.

Twenty-nine out of the 31 soak pits constructed in 2011 and existing storage facilities appeared to be in good condition but two soak pits needed refurbishment in order to meet the standards in the Best Management Practice (BMP). The concrete floors of these soak pits had cracks in them and

[1] Sixteen (16) communities under Tolon/ Kumbungu sharing boundaries with Savelugu/ Nanton used Pirimiphos Methyl (Actellic 300 CS)

needed cement patches to close them up. The patching was completed before the start of spray operations. In addition, a letter report was written and submitted to PMI which summarized key environmental compliance indicators.

2.4 Logistics Assessment

The Ghana AIRS team conducted logistics assessments in March through visits to the nine IRS targeted districts; met with regional and district stakeholders; conducted a survey on storage facilities, human resource requirements, and operational arrangements; and determined the level of financial resources required for the implementation of 2012 spray operations. The visits offered the team the opportunity to assess the state of facilities and carry out needs assessments in all of the 31 IRS operational sites. Abt Associates based its logistics plan on information gathered through field visits and experience from previous spray rounds (which served as benchmarks for planning the 2012 IRS spray operations).

2.5 Procurement

A total of 40,320 bottles of Actellic 300 CS were procured and the remaining 2011 balance of 47,520 pyrethroid sachets were used. At the end of the first round of spray operations, 3,317 sachets of pyrethroid and 7,234 bottles of Actellic 300 CS were leftover. Ninety-nine sachets of pyrethroid which were not previously accounted for from previous spray rounds were found in the warehouse so they were added to the 3,317 leftover sachets of pyrethroid from round one (3,317 + 99 = 3,416) and used for the second round of spray round.

The spray equipment consignment (Hudson pumps and spare parts) was safely received at the Tamale central warehouse on May 10, 2012. The quantities were verified by physical counts, see Table 3, and the acceptance report was completed and submitted to Abt home office in Bethesda. The Ghana IRS project also received a consignment of IT equipment from Abt home office for the Tamale regional office server room setup and IT support for district IRS operations. The Ghana IRS project procured 3 high capacity and 9 smaller generator sets for the Accra, Tamale, and the nine IRS district offices to be used as power backup systems.

Table 3: List of materials procured internationally and stock quantities

Item	Quantity Before the Campaign	Quantity Procured in 2012	Quantity Used During Campaign	Quantity Damaged	Remaining Stock after the Campaign
Spray Pumps	542	70	612	123	489
Coveralls	1,451	275	1,291	600	1,126
Hard Hats	600	416	570	143	873
Head Gear	1,451	279	788	242	1,488

Item	Quantity Before the Campaign	Quantity Procured in 2012	Quantity Used During Campaign	Quantity Damaged	Remaining Stock after the Campaign
Hand Gloves (pairs)	0	4,923	3,824	347	752
Face Shields	685	275	548	516	444
Nose Masks	41,498	3,200	41,888	-	2,810
Fendona (sachets)	47,520	0	44,203	-	0
Actellic 300 CS (bottles)	0	40,320	33,086	-	7,234

Table 4: List of materials procured locally and stock quantities - Round 1

Item	Quantity Before the Campaign	Quantity Used	Quantity Damaged	Remaining Stock after the Campaign
Neck Covers	1,023	1,023	279	744
Boots (pairs)	998	798	115	883
Fire Extinguishers	42	42	0	42
Rinsing Barrels	216	216	0	216
Jerry Cans	357	357	32	325

Table 5: List of materials procured locally and stock quantities – Round 2

Item	Quantity Before the Campaign	Quantity Used	Quantity Damaged	Remaining Stock after the Campaign
Sae oil (1 liter bottle)	24	24	0	0
Towels	90	87	0	3
Bath buckets	20	10	0	20
Washing basins	10	0	0	10
Cover sheets	110	65	0	110
Water jugs	15	10	0	5

2.6 Human Resources Requirements

Temporary staff was engaged as core district teams to support the district spray operations. They included logistics assistants, IEC assistants, community based volunteers, finance assistants, M&E coordinators and data assistants. In addition, sub-district staff (site managers, field supervisors, and store assistants) was also engaged. For the second round of spray operations in BY, temporary staff were re-engaged. Details of human resources utilized during spraying are presented in Tables 6 and 7 below.

Table 6: Number and type of district level staff used for 2012 spray operations- Round 1

Districts	Spray Operators	Team Leaders	District Spray Ops Coord . (SOCs)	IEC Assist.	IEC Implementers	CBS Volunteers	Data Assist.	Store Assist.	Logistics Assist.	Finance Assist.	M & E Coord.	Site Managers	Field Sup	Waters Fetchers	Washers	Security Off.
BY	48	12	1	1	45	480	1	2	1	1	1	4	4	8	8	8
CHEREPONI	30	8	1	1	36	360	1	1	1	1	1	2	2	4	4	4
EAST MAMPRUSI	48	12	1	1	40	362	1	2	1	1	1	3	3	6	6	6
GUSHEGU	30	9	1	1	45	356	1	1	1	1	1	3	3	6	6	6
KARAGA	25	6	1	1	35	414	1	1	1	1	1	2	2	4	4	4
SABOBA	30	8	1	1	38	568	1	1	1	1	1	3	3	6	6	6
SAVELUGU	44	11	1	1	35	544	1	1	1	1	1	3	3	6	6	6
TOLON	64	16	1	1	45	624	1	4	1	1	1	5	5	10	10	10
WEST MAMPRUSI	56	14	1	2	50	316	1	3	1	1	2	5	5	10	10	10
TOTAL	**375**	**96**	**9**	**10**	**369**	**4,024**	**9**	**16**	**9**	**9**	**10**	**30**	**30**	**60**	**60**	**60**

Please note more seasonal staff are trained than needed. This is to ensure that if a proportion of them dropped out, there would be a sufficient number left. For example, 450 spray operators were trained but only 375 were needed for operations.

Table 7: Number and type of district level staff - Round 2

Districts	Spray Operators	Team Leaders	District Spray Ops Coord . (SOCs)	IEC Assist.	IEC Implementers	CBS Volunteers	Data Assist.	Store Assist.	Logistics Assist.	Finance Assist.	M & E Coord.	Site Managers	Field Sup	Waters Fetchers	Washers	Security Off.
BYD	48	12	1	1	30	222	2	2	1	1	1	4	4	6	6	8

Due to the short length of the second spray round (20 days), the full complement of spray operators used in round one were proposed to be re-engaged for round two of spray operations. Not all of them were available so 14 spray operators were brought in from East Mamprusi district in order to make up for the needed number of spray operators to finish spray operations in 20 days.

2.7 Trainings

All categories and levels of people recruited for the spray campaign were trained in their various discipline/ area of work to enable them to perform successfully. A refresher training was conducted in BY before the start of the second round of spraying. Tables 8 and 9 list the types of training and Table 10 lists the number of participants at each training.

Table 8: Types of training, duration, venue and brief description of trainings for Round 1*

Type of training	From	To	Venue	Brief Description
TOT for IEC Assistants	2/03/12	3/03/12	Radach, Tamale	Training was focused on IEC and mobilization strategies / enumeration data collection. Participants were to go back to their various districts to facilitate IEC activities
IEC implementers training	12/03/12	15/03/12	All 9 districts	Training on IEC and mobilization strategies/ methods including sensitization techniques, structure identification and data collection
Stock managers	3/3/12	3/3/12	Tamale	Record and stock keeping of all inventories.
TOT for District M&E, SOC's and DHMT/ GHS Staff	2/04/12	6/04/12	Radach, Tamale	Training on Spraying techniques and compliance
TOT for Site managers and Supervisors	9/04/12	13/04/12	Walewale, D/A	Training on Spraying techniques and compliance
Spray Operators training**	16/04/12	21/04/12	All 9 districts	Training on Spraying techniques and compliance
Data management training	19/04/12	21/04/12	Radach, Tamale	Mobilization and Spray data entry
Health Worker/Poison Management training	16/05/12	17/05/12	Radach, Tamale	Managing insecticide poisoning at the health facility.
Applied Entomology Training	27/08/12	1/09/12	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 were given a one day briefing on compliance issues when carrying spray operators, or chemicals. This occurred on April 21 for the fendona districts and on May 13 for the Actellic districts. They did not receive a formal training.

** The pump mechanics were trained along with the SOPs during the SOP training. They did not receive a separate training.

Table 9: Types of refresher trainings, duration, venue and brief description of trainings for Round 2*

Type of training	From	To	Venue	Brief Description
Refresher training for IEC implementers	24/9/12	25/9/12	Bunkpurugu	Training on IEC and mobilization strategies/ methods including sensitization techniques, structure identification and data collection
Refresher TOT for partners, site managers and supervisors	19/10/12	21/10/12	Bunkpurugu	Training on Spraying techniques and compliance
Spray Operators training	22/10/12	27/10/12	Bunkpurugu	Training on Spraying techniques and compliance

*All those who attended the refresher trainings were fully trained during the round 1 spray operations trainings.

Table 10: People trained to deliver IRS

Categories of Persons Trained	Training on IRS Delivery								Other Trainings										TOTAL	
	Training of Trainers		Spray Operations		Data Capture		Logistics Training		Structure Enumeration / IEC TOT		Structure Enumeration / IEC		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
SOC	9	0			9	0													9	0
Disease Control Officers	9	0															6	0	9	0
District Environmental health officers	9	0															2	0	9	0

District information service assistant																	2	0	2	0
Spray operators			659	141															659	141
Data Assistants					8	1													8	1
District M & E Coordinators	9	1			9	1			9	1							3	0	9	1
District Supervisors (Entomology)																	7	0	7	0
Logistics/ store assistants							7	2									6	1	7	2
Medical Assistants/ Prescribers													62	31			2	2	64	33
IEC Assistants									7	3							4	1	7	3
IEC Implementers											356	16							356	16
Field Supervisors (Spray Ops)	29	2																	29	2
Site Managers	30	1																	30	1
Guards															60	0			60	0
TOTAL M/F	95	4	659	141	26	2	7	2	16	4	356	16	62	31	60	0	32	4	1265	200
TOTAL trained	**99**		800		**28**		**9**		**20**		**372**		93		**60**		**36**		**1458**	

3. Information, Education and Communication Activities

To ensure a standardized and adequate delivery of IEC messages, 10 IEC assistants[2] were recruited and trained at the regional level. These IEC assistants were responsible for leading the IEC activities at the district level with technical support from the IEC Coordinator at the regional level. They were directly responsible for all communication activities and served as direct supervisors to the IEC implementers.

3.1 Community Volunteers & IEC Mobilizers

A total of 4,380 community based (CBS) volunteers were recruited to deliver IRS messages throughout the campaign. Every community has 2 CBS volunteers that are responsible for preparing their communities for spraying. The IEC implementers are GHS personnel who have knowledge of their communities and have always proved to be very helpful to the IRS program in the past. Based on their long experience in working with IRS teams at the district level, a total of 372 IEC implementers were recruited and trained for the 2012 spray campaign. The training focused on IEC/BCC, mobilization, structure enumeration.

3.2 Pre –Spray Stakeholder Meetings

Pre-spray stakeholder meetings were held in all the IRS districts and sub-districts. During the second round of spraying in BY district, pre-spray stakeholder meetings were held in only the Bunkpurugu and Yunyoo sub-districts where the spraying was to take place. Participants were drawn from the District Assembly and its decentralized departments. The DHMTs, community leaders, chiefs, assembly people, religious leaders, youth and women leaders were in attendance and stakeholders fully participated in the dissemination of IRS messages across the district.

3.3 Radio Programs

In addition to the one-on-one interaction, radio programs were also organized. Three local radio stations were used to provide information and education on IRS in three operational districts, Tolon/Kumbungu, West Mamprusi and Saboba, and reached listening audiences in other IRS operational districts. In all, a total of 24 radio discussions with call-in sessions and 450 jingle spots were aired in three local languages. There were no radio programs during the second round of spray operations in BYD.

Table 11: IRS Campaign Communication Activities

Activity	Frequency
Radio spots; Jingles (pre, during, and after spray)	450
Radio programs (interactive shows)	24
Video Shows	17

[2] 7 males (4 of which received applied entomology training), 3 females (1 received applied entomology training)

A number of IEC materials were distributed to beneficiary communities and the general public to re-enforce IRS messages. Please see Table 12 for the number and types of IEC materials that were distributed.

Table 12: IEC materials distributed

Item	No. Printed	No. Distributed	Remaining
1. Posters	60,000	42,000	18,000
2. Brochures	30,000	23,000	7,000
3. IRS household cards	100,000	100,000	0
4. T-shirts	372	372	0
5. Caps	372	372	0

3.4 House to House Mobilization and Structure Enumeration Activities

Door-to-door mobilization was the preferred strategy to sensitize households on upcoming spray operations. IEC implementers visited the residence of households and provided direct education/ information on IRS. The sensitization highlighted the roles and responsibility of households before, during and after spray activities and informed them when spraying would occur. During the door-to-door mobilization, implementers enumerated all eligible structures prior to the start of spray operations. The purpose of the enumeration process was to identify each eligible structure and assign a unique IRS serial number printed on an IRS card to each structure. All 372 implementers were trained and enumeration started simultaneously across all 9 districts and lasted approximately 4 to 6 weeks. The enumeration results are presented in Tables 12 and 13.

Table 13: Mobilization/Enumeration Results – Round 1

		# Adults Reached with IRS Messages						Enumeration Data		
District	**# of HHs sensitized**	**Males**	**Females**	**Total**	**# HHs accepting IRS**	**% of HHs accepting IRS[3]**	**# of BCC/IEC Materials Distributed[4]**	**# of Structures Enumerated**	**Total # of Eligible Rooms Found**	**Total Population in Eligible Structures Found**
BUNKPURUGU	11,188	25,743	29,197	54,940	11,188	100.00%	1,321	40,283	43,271	90,897
CHERIPONI	4,879	10,097	12,054	22,151	4,879	100.00%	2,951	22,682	23,099	60,839
EAST MAMPRUSI	12,283	20,287	25,845	46,132	12,283	100.00%	1,069	60,787	62,542	144,599
GUSHEGU	9,092	15,163	17,986	33,149	9,092	100.00%	4,720	40,700	41,346	102,811
KARAGA	6,173	8,967	12,889	21,856	6,173	100.00%	6,293	31,292	31,774	77,204
SABOBA	5,833	10,078	10,837	20,915	5,832	99.98%	3,431	26,615	27,162	70,197
SAVELUGU	10,570	15,507	22,121	37,628	10,554	99.85%	806	52,857	55,609	127,701
TOLON	15,276	31,741	38,225	69,966	15,272	99.97%	1,037	71,505	73,355	168,281
WEST MAMPRUSI	12,102	17,845	21,800	39,645	12,102	100.00%	211	69,357	72,865	165,683
TOTAL	**87,396**	**155,428**	**190,954**	**346,382**	**87,375**	**99.98%**	**21,839**	**416,078**	**431,023**	**1,008,212**

[3] The percentage of households accepting IRS is defined as the number of households who agreed to have their eligible structures sprayed during the time of mobilization/ enumeration divided by the total number of households enumerated.

[4] This refers to the number of materials given directly to households during mobilization in their compounds. It excludes materials pasted at public places like markets schools and mosques. In contrast, table 9 provides an overview of all materials distributed to the district offices.

Table 14: Mobilization/Enumeration Results – Round 2

		# Adults Reached with IRS Messages						Enumeration Data		
District	**# of HHs sensitized**	**Males**	**Females**	**Total**	**# HHs accepting IRS**	**% of HHs accepting IRS[5]**	**# of BCC/IEC Materials Distributed**	**# of Structures Enumerated**	**Total # of Eligible Rooms Found**	**Total Population in Eligible Structures Found**
BUNKPURUGU	5,356	7,955	9,217	17,172	5,3471	99.83%	1,857	20,540	20,618	44,431

4. Implementation of IRS Activities

For the first round, spray operations started on April 23, 2012 in the six pyrethroid districts and on May 14, 2012 in the three organophosphate districts due to the delayed shipment of the Actellic. Though operations started on different dates in these districts, they all ended on July 31, 2012. There were 2 conflicts which affected spray operations, one in Bunkprugu-Yunyoo district, and the other in Gushegu. The conflict in BY lasted roughly 7 days and during this time, all spray operations were ceased for safety reasons. In Gushegu there was also factional violence that led to an imposed curfew in Kpatinga community, located in Gushegu district. Unfortunately, these interruptions placed more pressure on the Ghana AIRS team to finish spraying by the end of July. In addition, storms in Chereponi destroyed some eligible structures and interrupted spray operations.

The second round of spraying in BY district started on October 29th and ended on November 24, 2012. Unlike the first round of spraying, there were no interruptions in round two. The duration of spray operations varied from 57 to 73 days across the various districts for the first round and 22 days for the second round. Table 14 shows the duration of spray operations for each of the nine districts.

Table 15: Length of Spray Operations for the 9 districts

District	Number of Days of Spray Operations – Round 1	Number of Days of Spray Operations – Round 2
Bunkpurugu/Yunyoo	57	22
Chereponi	60	N/A
East Mamprusi	59	N/A
Gushegu	57	N/A
Karaga	57	N/A
Saboba	67	N/A
Savelugu-Nanton	57	N/A
Tolon Kumbungu	73	N/A
West Mamprusi	61	N/A

4.1 Monitoring & Supervision

Supervision of IRS activities occurred at four different levels. Team leaders provided direct and constant supervision to the spray operators daily. The second level of supervision was done by field supervisors stationed at each operational site. Thirdly, the district management team conducted spot checks on data, spray quality, and use of PPE and insecticides. The fourth level of monitoring and supervision was done by the Tamale office staff. Monitoring teams sampled spray operator cards for physical verification at the community level to ensure the quality of data collection and spraying.

4.2 Environmental inspection

The Environmental Compliance Officer and the operations team visited all 31 sites across the 9 districts to give technical assistance to district teams and also conduct a mid-spray environmental compliance inspection of IRS activities. No adverse events were reported during or after spray operations. It was however noted that some of the spray pumps were leaking around the nozzle area. Most of the pumps have been used for about five years and can no longer be repaired. The AIRS team will take this in to consideration when planning and ordering international spray equipment for the next round.

A checklist drawn from PMI/ IRS Best Management Practice manual was used to ensure district adherence to 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 PPEs, proper handling of insecticide, mixing procedures including the triple rinse process for empty Actellic CS bottles in the three organophosphate districts.

4.3 Data Reporting/ Entry of Spray Operator Cards

Spray data was collected and entered into the database on a daily basis. Team leaders checked and verified data cards and signed off on them. Further checks were done by the field supervisors, district M&E coordinators, and data assistants before the data was entered into the database. Totals on the spray operator's card were entered first (for quick reporting) before entering household by household data. Weekly reports were sent to PMI.

4.4 Logistics and Stock Management

All local and international commodities procured for 2012 Ghana AIRS operations were transported to the AIRS regional warehouse in Tamale for subsequent distribution to the 9 IRS districts prior to the start of spray operations. Insecticides received in 2012 AIRS operations were transported by road in a sealed containerized truck escorted by the Logistics & Procurement Coordinator from the port of entry to the final destination in Tamale.

All inward and outward supplies were recorded on stock cards. Requisition and delivery books were used for all transactions in the regional office and all of the 31 IRS operational sites by the Logistics Team. This was to keep track and monitor movement of all materials and ensure effective usage. All insecticides from district stores to the field were coded and recorded on daily insecticides tracking sheets by district team leaders. At the end of every day's operations, team leaders accounted for all used/unused insecticides sachets and bottles and the district store keepers ensured proper safe keeping in the district stores to avoid pilferage. At the end of the campaign, all used/unused insecticides sachets and bottles sent to the 9 IRS districts were accounted for and returned to the central warehouse. Used insecticide sachets and bottles have been packed in special polythene bags awaiting incineration.

The Ghana AIRS team embarked on a routine inventory & stock control exercise in all the district stores during spray operations to monitor the trend of IRS material usage and also provided technical assistance to the district logistics team on stock and inventory control management.

5. Post-Spray Activities

5.1 Post spray evaluation meetings

Post spray evaluation meetings were held at the district and regional level. The main objectives of the end of spray evaluation meetings were to:

1. Present the performance of 2012 spray operations to key stakeholders.
2. Solicit views and opinions of stakeholders on IRS processes, activities, strategies, results, challenges and the way forward.
3. Mark the end of 2012 spray operations.

End of spray evaluation meetings were held in all 9 districts with a final one at the regional level, which was attended by the NMCP, PMI team, and the Regional and District Health Directorate. Others stakeholders who participated in meetings included chiefs, representation from District Assemblies, and other partner organizations working in the area of health.

Table 16: Number of end of spray evaluation meetings held- Round 1

District	# Meetings held	Participants
Bunkpurugu/Yunyoo	2	158
Chereponi	1	75
East Mamprusi	1	118
Gushegu	3	100
Karaga	1	107

Saboba	1	91
Savelugu-Nanton	1	162
Tolon Kumbungu	1	124
West Mamprusi	2	157
Regional (Tamale)	1	93

Table 17: Number of end of spray evaluation meetings held- Round 2

District	# Meetings held	Participants
Bunkpurugu/Yunyoo	2	162

The following issues were discussed at the end of spray evaluation meetings:

- The support and contributions of stakeholders to IRS implementation.
- The overall achievement of IRS (spray coverage), challenges and way forward.
- The views and opinions of stakeholders on the overall operational process.
- The need for monitoring of epidemiologic and entomologic data.
- The importance of monitoring and learning from AGA's experience in the Upper West.
- The scoping study will assess options for shifting IRS to other areas in the country.

5.2 Post spray environmental compliance assessment

All storage facilities and soak pits at the 31 operational sites have been cleaned and are kept locked with danger signs still embossed on the fence and walls of the facilities. The facilities are still guarded 24 hours a day.

5.3 Waste disposal

The three main forms of solid waste generated during the 2012 IRS campaign were: empty sachets of Fendona (pyrethroids), empty triple rinsed bottles of Actellic CS (organophosphate) and well washed damaged hand gloves and boots. All empty sachets of Fendona were well packaged into special bags and have been successfully incinerated at the Kumasi Centre for Collaborative Research (KCCR) from December 16th – 22th. The empty triple rinsed Actellic bottles were recycled at Cyclus Elmina from November 8th –20th. Well washed used gloves and punctured boots have been packaged and are awaiting proper disposal. All solid waste materials were disposed of in accordance with the PMI/ IRS Best Management Practices manual.

6. Entomology

Entomological monitoring for IRS programs is essential since it provides information on vector susceptibility, resistance, and the quality of spraying. Over the past three years, key operational decisions, such as the timing of spray activities, as well as the selection of insecticides, have been made based on the outcomes of such entomological studies. In recognition of this, the AIRS project, together with Noguchi Memorial Institute for Medical Research, provided technical assistance in entomological monitoring of the PMI sponsored IRS program in Northern Ghana. The entomological monitoring activities undertaken within the period focused on:

- Testing the quality of the spraying and understanding the residual effect of the chosen insecticide on different wall surfaces found in the targeted area.
- Understanding the effect of IRS on vector density, biting behavior, and the infectivity rate of the local vectors in the area where spraying took place.
- Assessing the local vector susceptibility to various WHO-approved insecticides.
- Building human capacity in the area of entomological field monitoring and management of an IRS program.

Quality Assurance of Spraying and Residual Life Test

Spray Quality Assessments

This was done using the WHO cone wall bioassays method, to assess the quality of spray by the different teams within the selected districts, and provide important feedback on the quality of work done by the different spray teams.

The selected communities in these districts were:

- Boatarigu, Nyelinkpe, Majefouk and Tobont *(Bunkpurugu Yunyoo district)*
- Nambaglaa, Tarikpaa and Yizegu *(Savelugu-Nanton district)*
- Nyankpala *(Tolon–Kumbungu district)*

The results from the spray quality assessment ranged between 98.3% and 100% mortalities of the exposed vectors. On the other hand, the control mortalities recorded were between 0.0% - 20.0%. No significant variation was observed in the percentage mortalities among the three different types of walls tested, wood, cement and mud. The quality of spraying was deduced from the percentage mortalities of exposed mosquitoes on the different types of sprayed surfaces.

Several chiefs, community leaders and community members were invited to observe the wall bioassay tests. This served as an opportunity to educate community members on general misconceptions and perceptions on the IRS program. The test results produced, assured the community members that the spray teams were adept in spray techniques and correctly deposited the right amounts of insecticides on the wall surfaces.

Figure 3: Spray Quality assessment on the different wall surface types that were sprayed with Alphacypermethrin in the Bunkpurugu-Yunyoo and Tolon-Kumbungu districts.

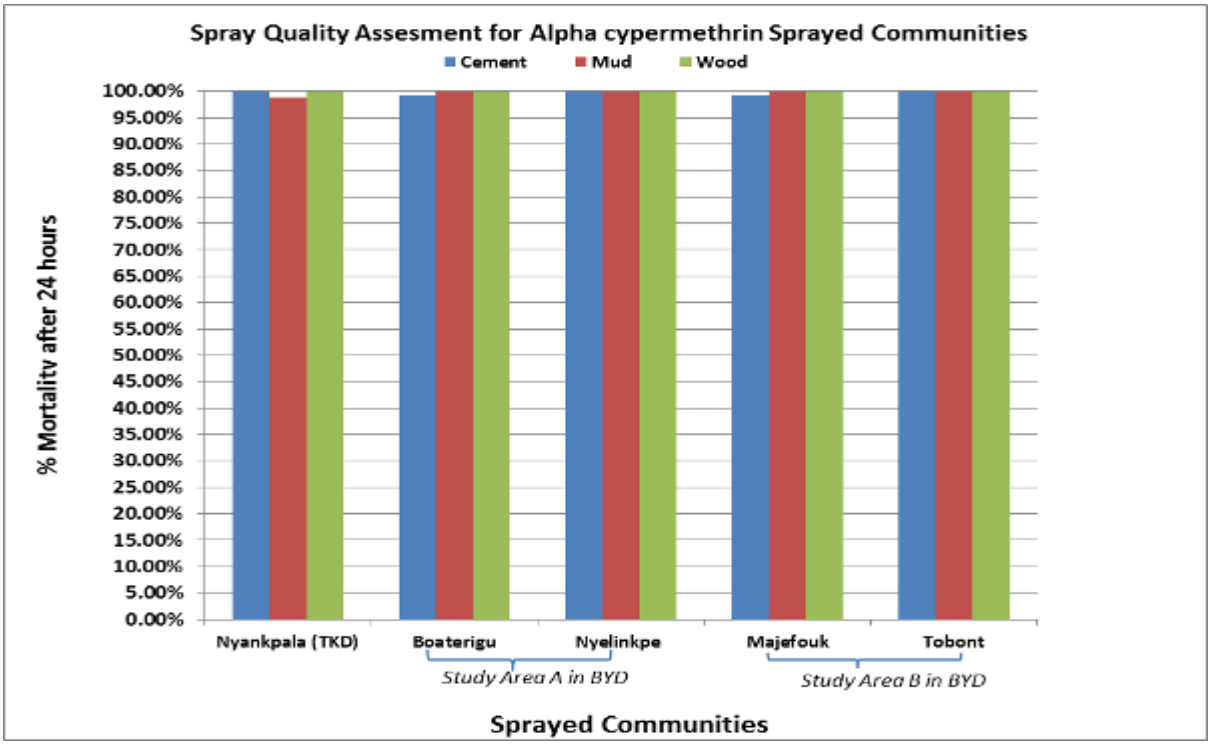


Figure 4: Spray Quality assessment on the different wall surface types that were sprayed with Pirimiphos methyl in the Savelugu-Nanton district.

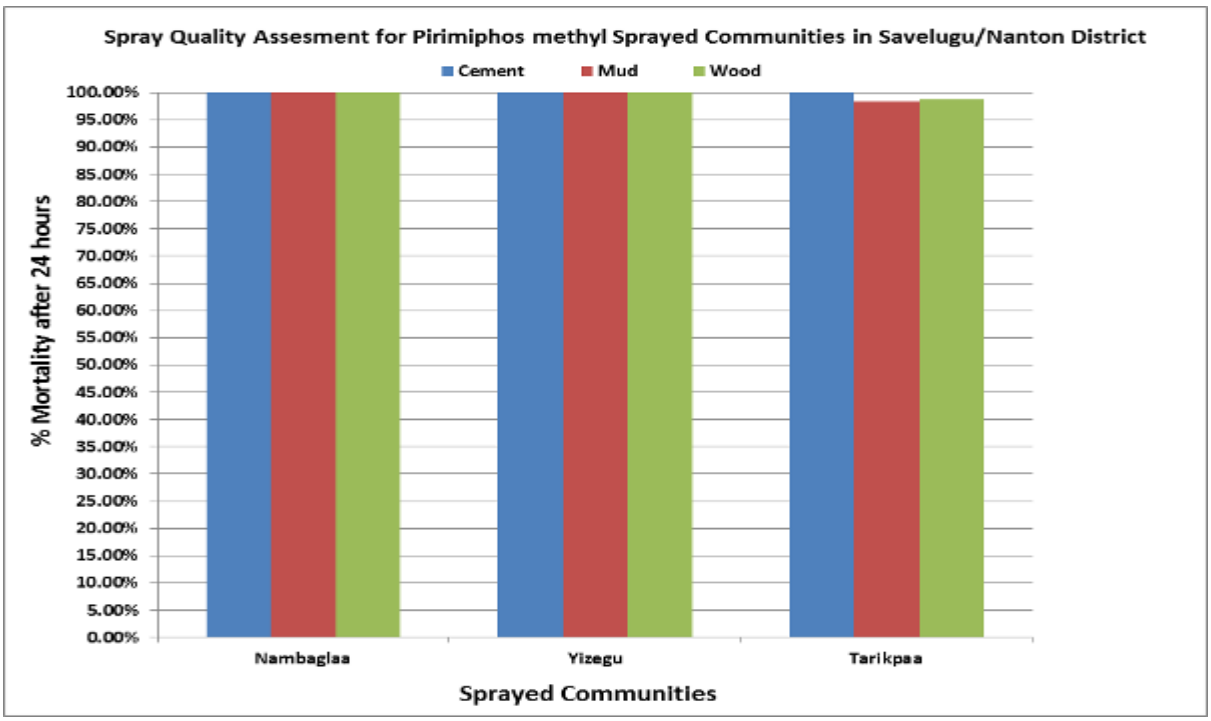
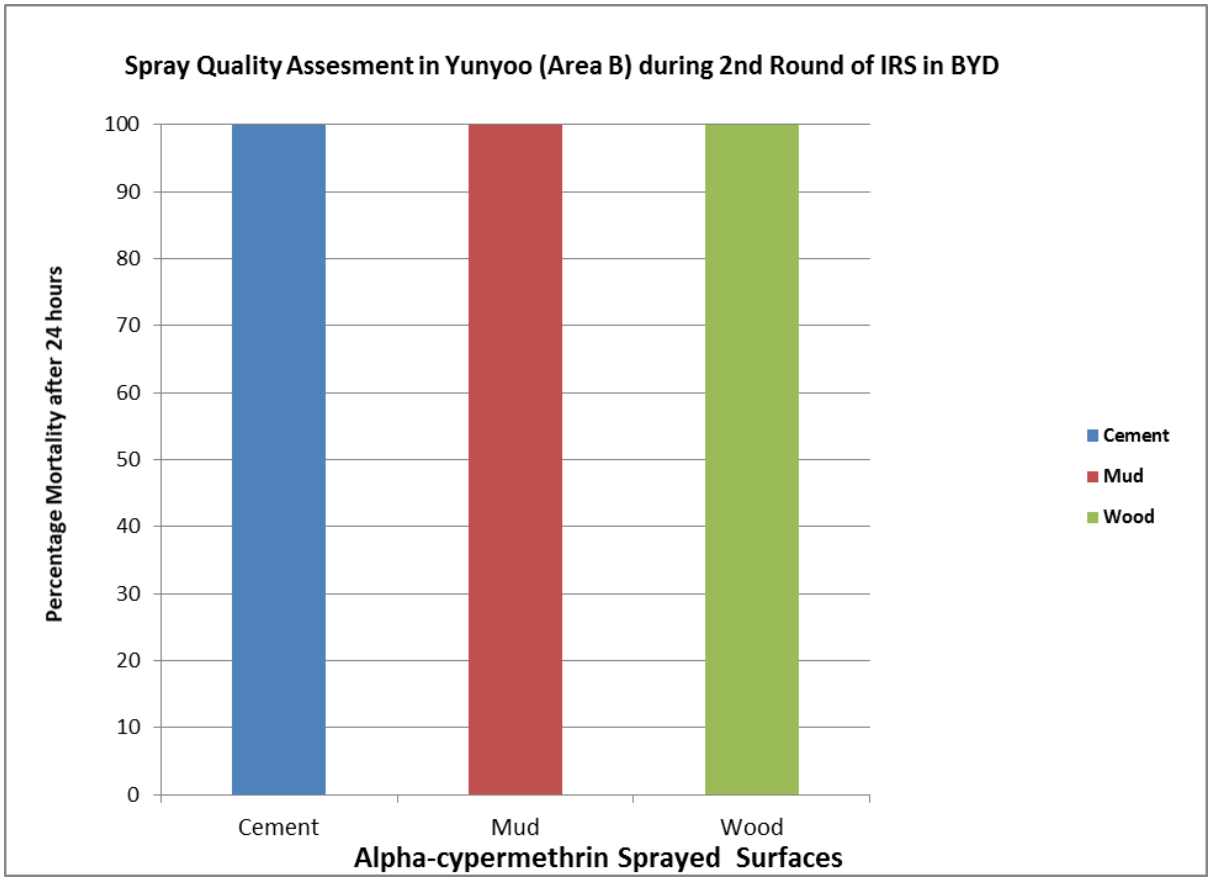


Figure 5: Spray quality assessment of Alpha-cypermethrin (Fendona) on different wall surfaces in Yunyoo during the second round of IRS operations in Bunkpurugu-Yunyoo District



Residual Efficacy Assessments

The residual efficacy of the sprayed insecticides are been monitored bimonthly, through the WHO cone wall bioassays. The percentage mortalities of exposed mosquitoes on the different types of sprayed surfaces (i.e. cement, mud and wood) gave an indication of the performance of the sprayed insecticide.

The results from the wall bioassays carried out two months after spraying the wall surfaces still show higher mortalities, a possible indication that the sprayed insecticide is still efficacious two months after the structures were sprayed. Results of the bioassays are presented in the Figures 6 & 7 below.

Figure 6: Decay rate of Pirimiphos methyl on different wall surfaces, 2 months after spraying

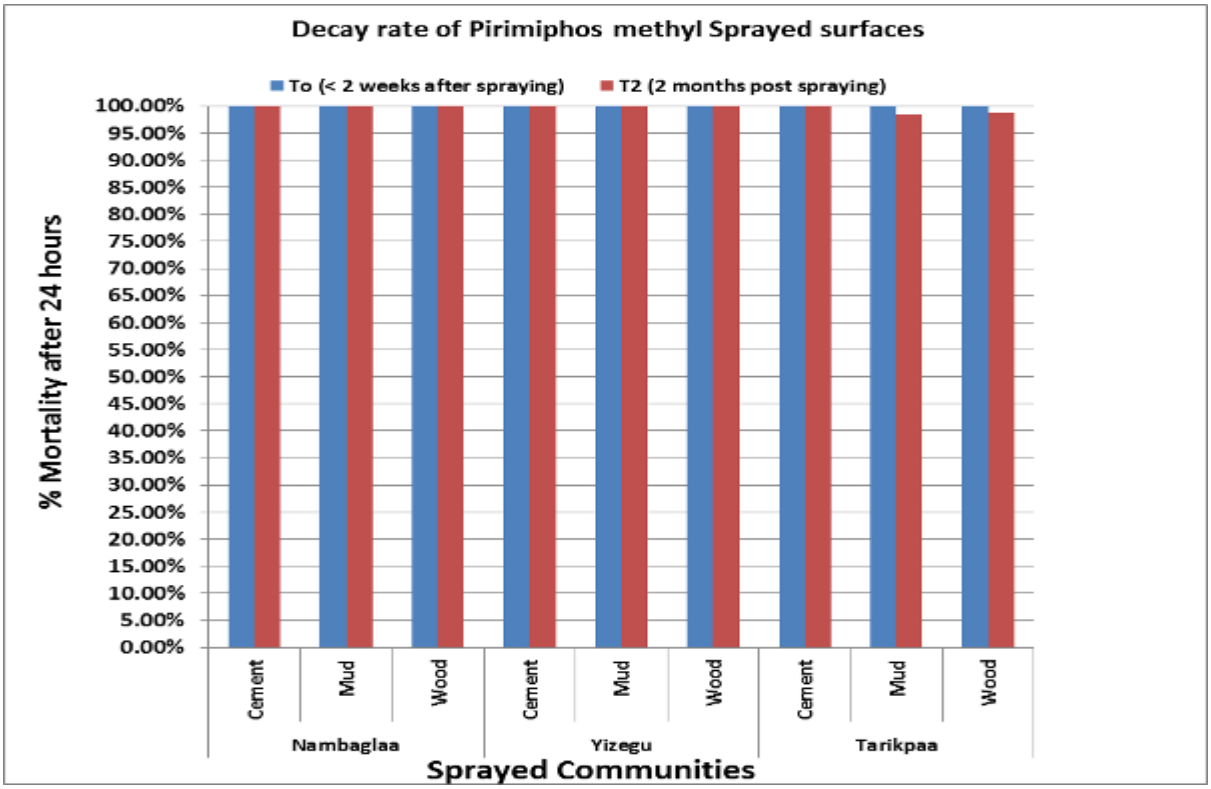
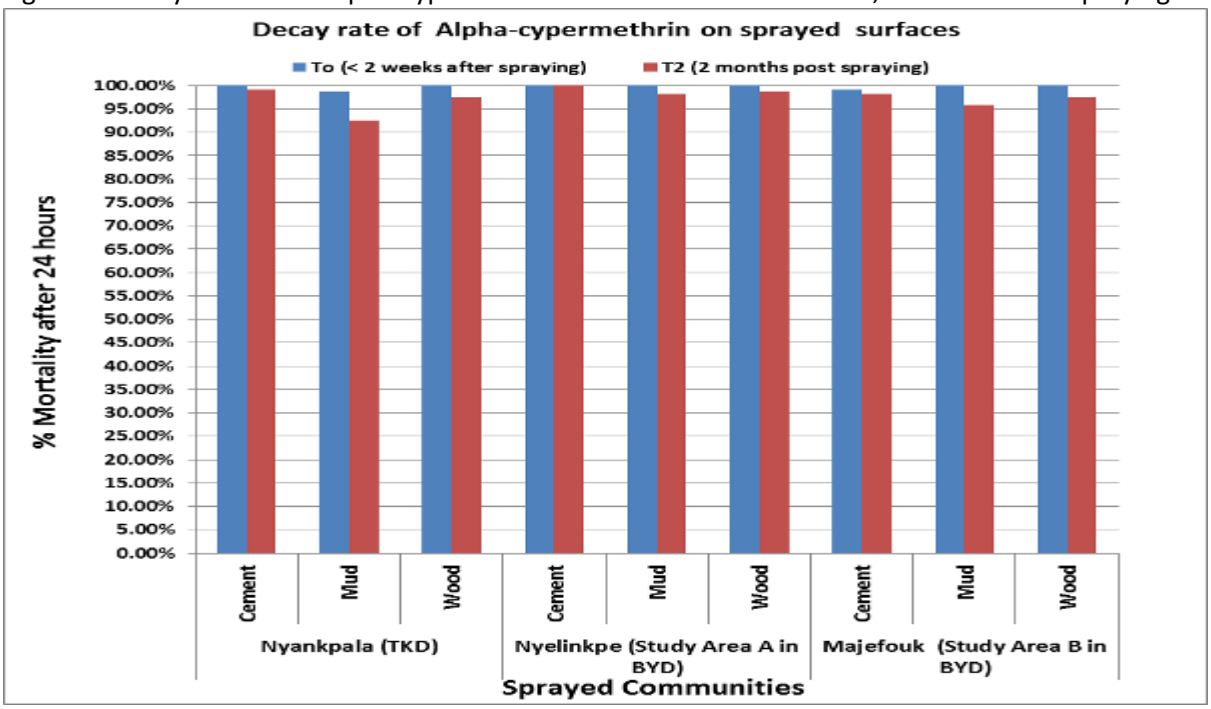


Figure 7: Decay rate of the Alpha-cypermethrin on different wall surfaces, 2 months after spraying

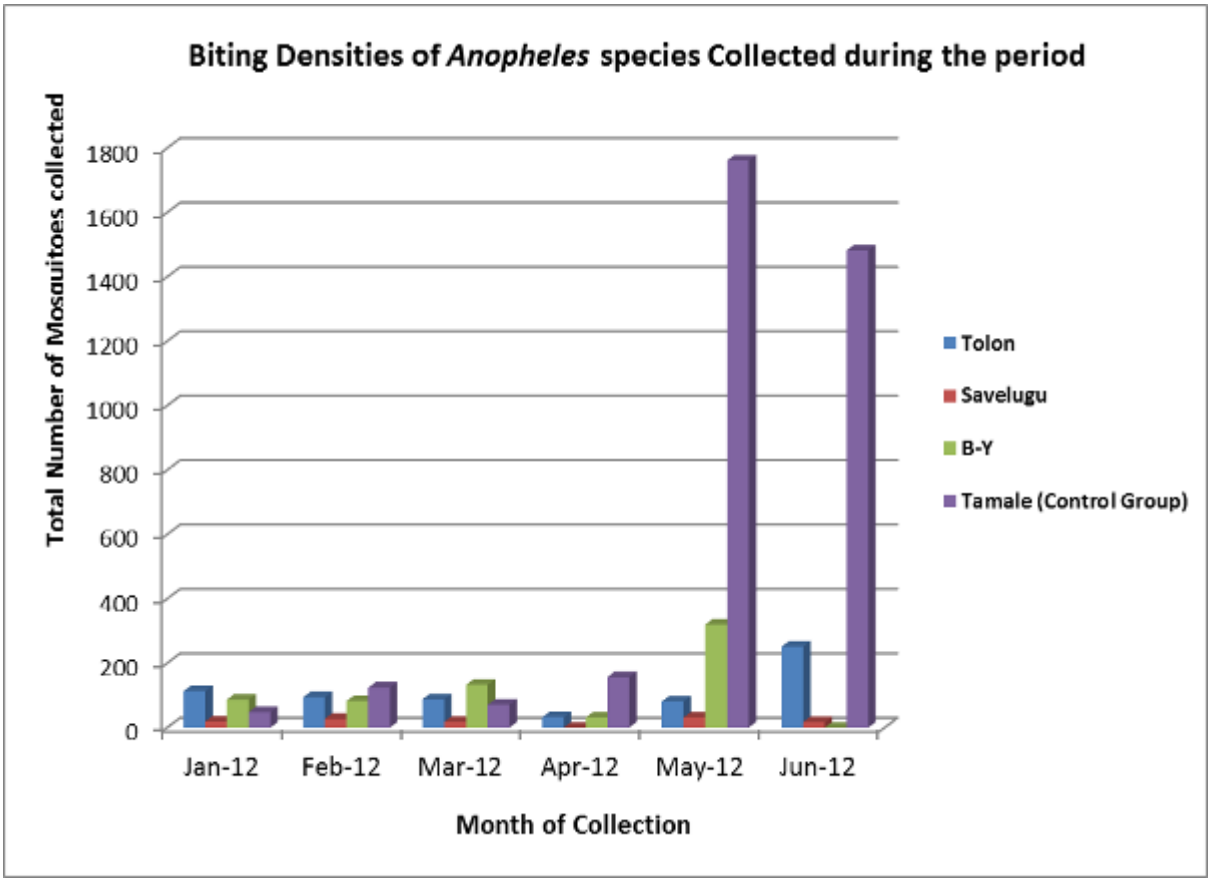


Vector Density and Behavior

As part of the entomological monitoring activities, monthly surveys were also conducted in three of the nine districts sprayed (Savelugu-Nanton, Tolon-Kumbungu and Bunkpurugu-Yunyoo districts) with one unsprayed district (Tamale metropolis) serving as the control. Results from the surveys conducted by AIRS, GHS and NMIMR joint team in the first two quarters of the year, showed a clear effect of IRS on the transmission indicators monitored. Some of the results are presented below:

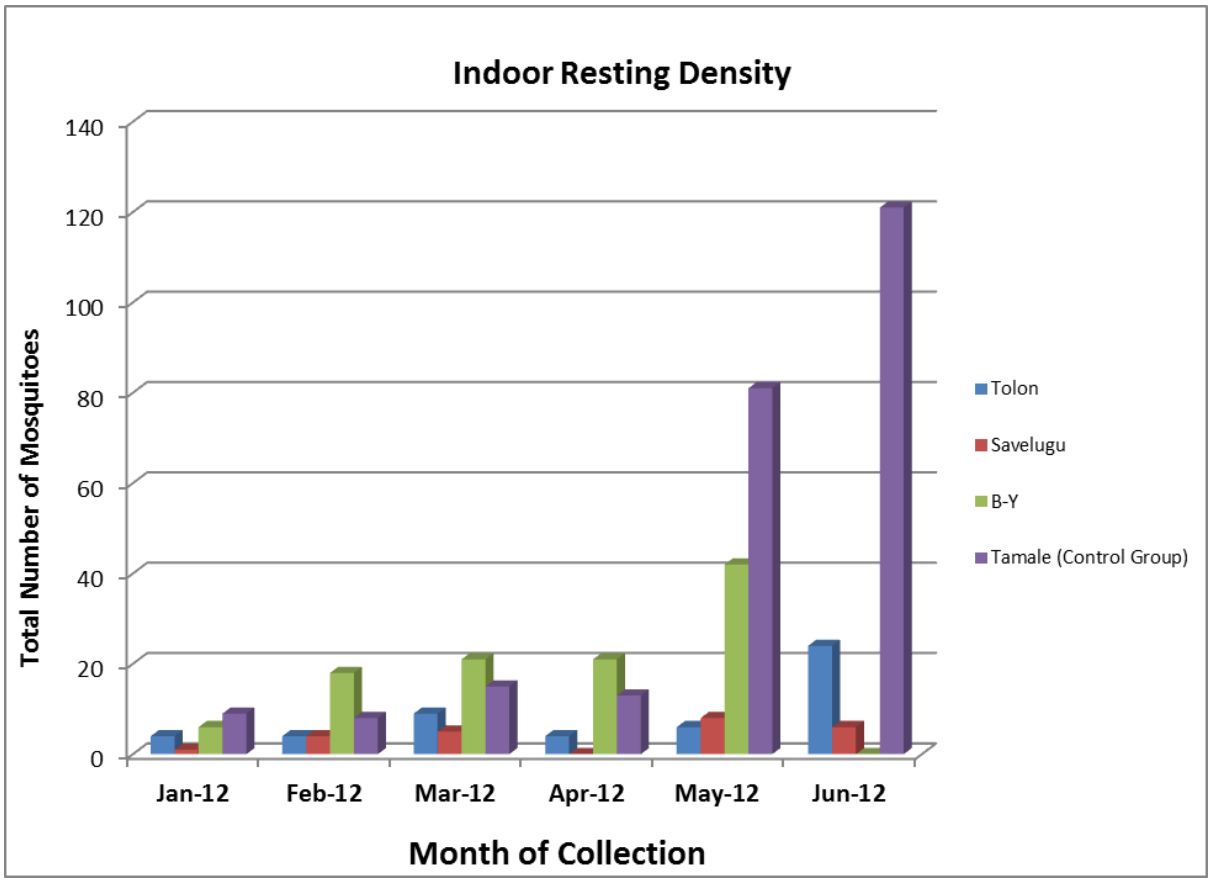
- *Anopheles* species collected within the period included *An. Gambia s.l, An. funestus, An. rufipes, An. nili* and *An. pharoensis. An. gambiae* however remained the predominant vector species in all the study areas.
- A total of 5,067 female *Anopheles* mosquitoes were collected by landing catches from all study sites. Of this number, the unsprayed study sites/ communitites in Tamale (control district) contributed 71.9% of the total number of mosquitoes collected (see Figure 9 below).

Figure 8: Biting densities of *Anopheles* species collected during the period



- The effect of the spraying on vector density was also shown in the reduction in the number of indoor resting mosquitoes (endophilic species) in sentinel communities in the IRS districts compared to the unsprayed sentinel communities in the Tamale metropolis (the control district). Of the 430 female *Anopheles* species collected by the Pyrethrum spray collections the (control district) contributed 57.4% (see Figure 10).

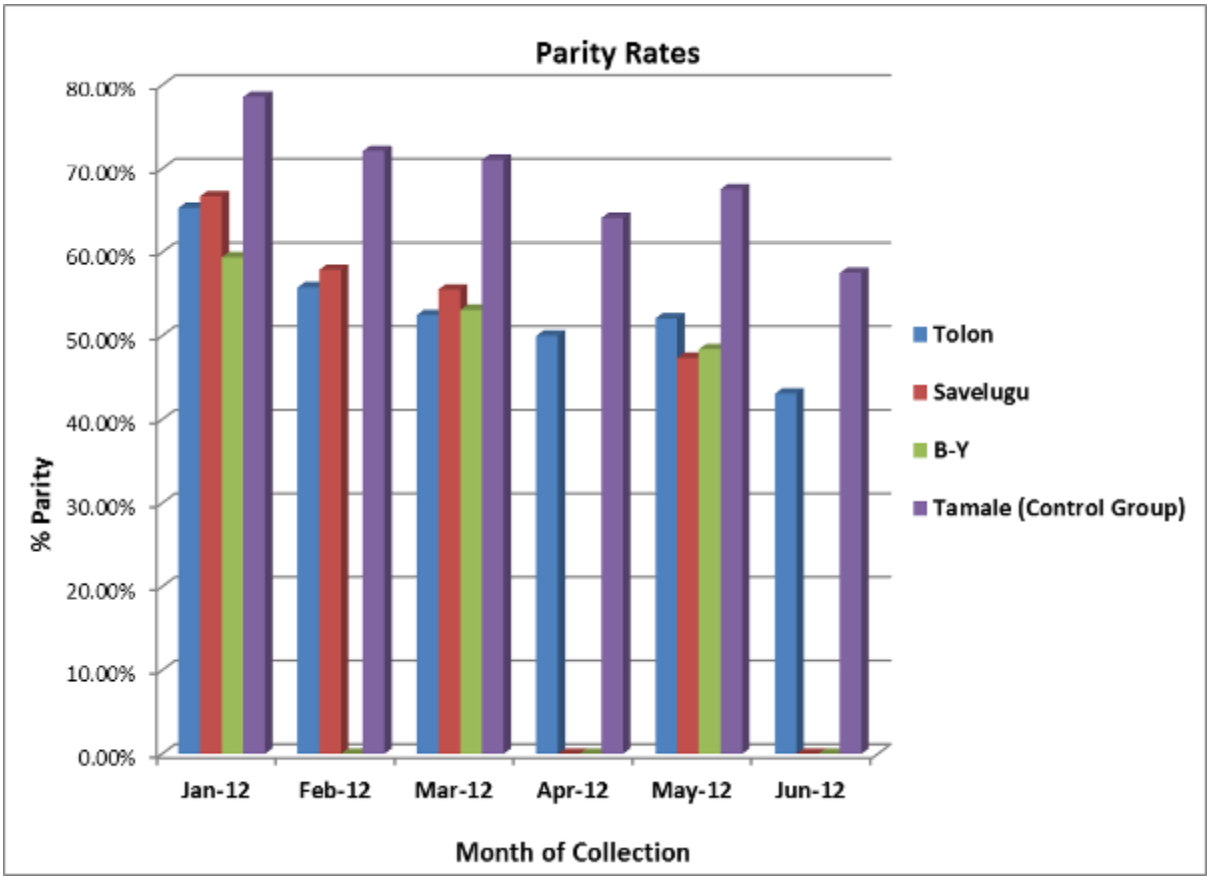
Figure 9: Total Number of Indoor resting mosquitoes collected by the Pyrethrum Spray Collection Method



Parity Rates

The impact was also observed in a significant decline in parity rates of mosquitoes in the IRS operational areas compared to Tamale, the control area. This trend indicates that more parous (older) mosquitoes were being killed in the IRS areas and the population being replaced by new nulliparous mosquitoes (Figure 10).

Figure 10: Parity Rates



Entomology Training

As part of capacity building efforts, an applied entomology training workshop was organized in Tamale. The training was aimed at building capacity of staff of Ghana Health Services, District Assemblies and AIRS project district staff. In all, 36 people were trained in applied entomological techniques to enable them to better educate IRS targeted communities and assist in entomological monitoring operations in the coming years. Some of the topics covered during this training were:

- Introduction to biology and diversity of malaria vectors
- Malaria transmission and species identification
- Insecticide susceptibility and bioassay test
- Insectary management and basic entomological laboratory and field techniques, and entomological approach to malaria control

It is expected that the graduates from the training, together with the existing field technicians who had been previously trained to support the field activities in entomology, will form the core group in the IRS districts to undertake the field part of the monitoring activities. This is an effort to the building of regional capacity to be able to independently undertake entomological monitoring functions for the IRS program.

7. Monitoring and Evaluation

7.1 Key Objectives and Approach

The key objectives of the M&E system and approach is to ensure accurate and timely data entry to enable AIRS staff to adapt implementation as needed and monitor spray progress and coverage. With these objectives in mind, the following were emphasized during the M&E process:

- Ensure accuracy of both the data collection and the data entry process through comprehensive trainings 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

During the 2012 spray campaign, AIRS officially enumerated structures during the house-house mobilization process and with the intention of using this figure as the dominator to calculate spray progress during the IRS campaign. Unfortunately, the database installation was delayed so this data was not able to be entered before the spray campaign began and thus was not used for this purpose. Instead, spray progress was calculated as has been done in the past by using the previous year's structure data, in this case 2011 structures found by SOPs. Spray coverage was calculated using the number of structure sprayed over the number of structures found by SOPs.

7.2 Data collection and Data Management

Data was collected using standardized data collections forms designed to capture all core PMI indicators. All data collection was preceded by training on data capturing. Mobilization/enumeration data was collected by IEC implementers during house-to-house mobilization and spray data was collected by spray operators during spray operations.

Table 18: Ghana IRS 2012 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
Daily Spray Operator Form	Used by Spray Operators during spray operations to capture structures and rooms found and sprayed, population protected, and mosquito net availability and use
Daily Team Leader Form	Used by spray operator's team leader during spray operations to summarize information on the Spray Operators card.
Mobilization/Eligible Structure	Used by IEC implementers during pre-spray mobilization/

Identification Form (MO 1)	sensitization activities to identify and enumerate eligible structures and capture population reached with IRS messages

Note: In BY district during the second round of spraying, the team leader daily summary data collection form was not used for the following reasons:

- Information captured in the team leaders form, is already on the spray operators form, team leaders just recopy what the spray operator has written and sometimes they make mistakes.
- Information on this form was not used for data entry or any kind of analysis.

Team leaders were asked not to use this form so that they would have more time to do mathematical verification and check for other data collection accuracy/errors. Supervision of the data collection process was carried out at various levels through field visits. Table 18 documents the personnel responsible for supervision during data collection.

Table 19: Levels of data collection supervision

Data	Supervised by
Mobilization/Enumeration 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, M & E Manager, Operations Manager

7.2.1 Data Entry

AIRS employed 9 data assistants to enter data collected in the 9 targeted districts. The project procured 9 laptops and installed the AIRS Ghana database on each of them. Data was entered simultaneously at each of the nine districts. Data entry was at two levels: first by "Totals" (for quick reporting and feedback), then by "Details" for verification purposes.

7.2.2 Data Storage

Data forms are stored in three ring binders. Mobilization data were filed by zone within the binders. Spray data were filed by date in the binders. Each binder contained particular sub-district information.

At the end of every day, all 9 databases are backed up electronically.

7.2.3 Data cleaning and verification

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

- Ensuring that all data cards are entered correctly
- Making necessary corrections to ensure that the totals and details data entry were in agreement.
- Checking and removing duplicate records
- Identifying and entering missing records

After data cleaning at the district level, all 9 data assistants were assembled at the regional level for "cross verification." Ten percent of all data cards from each district were randomly selected and verified for accuracy.

7.2.4 Data quality and Control (QA/QC)

QA/QC Issue	Method/Tools for Quality Assurance
Spray and Mobilization/Enumeration Data Integrity	▪ Used standardized data collection forms. ▪ Comprehensive training on data capture. ▪ Multiple levels of supervision. ➢ Spray operators are supervised by their team leaders, who monitor data capturing and verify collected data. ➢ Supervisors monitor team leaders and verify spray operator and team leader spray data collection forms. ➢ District M & E coordinator monitors and verifies data capture by spray operators, team leaders and supervisors. ➢ District IEC assistant and District M & E Coordinator jointly verifies and spot checks data collection by IEC implementers ▪ Structure spot checks to cross-check Daily Spray and Mobilization/Enumeration report. ▪ Database designed with locks and logic checks
Spray Data Entry and Management	▪ Data entry training for all data assistants ▪ Prompt field data entry and transfer; data cards arrive at data entry sites daily and data entry is also done on a daily bases ▪ Data verification via double-data entry ➢ Initial data entry of daily totals per IEC implementer/Spray Operator ➢ Follow-up entry of individual household data ▪ Data scan for irregularities by database manager and IRS supervisory staff ▪ In all 9 districts, 10% of all spray data cards were verified for accuracy
Data Security	▪ Data collection forms are printed on durable sheets ▪ Data collection forms were filed systematically and stored in binders ▪ Database is designed with password protected access to restrict unauthorized entry ▪ Database are backed up daily to an electronic file storage system

7.3 Results

7.3.1 Spray Results

After data cleaning and verification, the following tables provide the summaries of the 2012 spray operations data.

Table 20: Summary of IRS Spray Results- Round 1

District	Structures Found	Structures Sprayed	Spray Coverage	Pop. Protected	Pregnant Women Protected	Children <5 Protected	Pop. Not Protected	% of Population Protected
BUNK-PURUGU	37,598	36,484	97.0%	88,165	1,655	16,953	2,159	97.6%
CHERIPONI	20,618	19,039	92.3%	54,835	1,466	13,711	3,077	94.7%
EAST MAMPRUSI	49,628	45,593	91.9%	127,816	3,049	25,029	6,266	95.3%
GUSHEGU	35,461	31,957	90.1%	89,267	2,554	19,361	6,096	93.6%
KARAGA	30,147	28,464	94.4%	76,320	2,157	17,622	2,754	96.5%
SABOBA	22,327	20,175	90.4%	62,286	1,386	13,284	4,038	93.9%
SAVELUGU	43,520	39,014	89.6%	102,646	2,359	19,316	8,349	92.5%
TOLON	81,904	75,307	91.9%	187,799	4,754	33,499	9,787	95.0%
WEST MAMPRUSI	61,939	59,245	95.7%	152,106	3,324	28,878	4,444	97.2%
Total	**383,142**	**355,278**	**92.7%**	**941,240**	**22,704**	**187,653**	**46,970**	**95.2%**

Table 21: Summary of IRS Spray Results- Round 2

District	Structures Found	Structures Sprayed	Spray Coverage	Pop. Protected	Pregnant Women Protected	Children <5 Protected	Pop. Not Protected	% of Population Protected
BUNK-PURUGU	17,239	16,354	94.87%	41,100	710	6,778	1,436	96.62%

Table 22: Number of Mosquito Nets – Round 1[6]

	Mosquito Nets		
	Total Mosquito Nets Found	Nets Used by Pregnant Women	Nets Used by Child < 5
BUNKPURUGU	17,637	694	10,590
CHERIPONI	9,551	717	6,593
EAST MAMPRUSI	13,386	1,441	8,771
GUSHEGU	17,116	1,411	11,515
KARAGA	11,306	909	6,865
SABOBA	11,178	795	8,693
SAVELUGU	14,567	1,125	10,126
TOLON	26,612	2,369	17,597
WEST MAMPRUSI	20,944	1,405	12,041
TOTAL	**142,297**	**10,866**	**92,791**

[6] Total number of mosquito nets available in a house/compound at the time of spraying.

Table 23: Number of Mosquito Nets- Round 2

	Mosquito Nets		
	Total Mosquito Nets Found	Nets Used by Pregnant Women	Nets Used by Child < 5
BUNKPURUGU	16,043	651	6,004

7.3.2 Other indicators

Table 24: Other Spray indicators – Round 1

	District									
Indicator	Bunkpurugu	Cheriponi	East Mamprusi	Gushegu	Karaga	Saboba	Savelugu	Tolon	West Mamprusi	**Total/Average for all 9 Districts**
Total Sachets/ Bottles Received	8,800	4,099	9,624	7,400	6,064	4,549	9,480	17,220	12,480	**79,716**
Total Sachets/ Bottles used	7,636	4,075	9,453	6,946	6,064	4,542	9,222	17,019	12,331	**77,288**
Total Sachets/ Bottles damages/ lost	0	0	0	0	0	0	0	0	0	**0**
Total Sachets/ Bottles leftover	1,164	24	171	454	0	7	258	201	149	**2,428**
Ave. # structures sprayed/ Sachet (Bottle)	5	5	5	5	5	5	5	5	5	**5**
Avg # sachets per SO per day	3	3	3	4	5	3	4	4	4	**4**
Avg # SOP worked/ day	40	25	47	33	22	21	42	62	51	**343**

Avg # structures sprayed by SOP/ day	16	14	18	19	24	16	18	18	20	**18**

Table 25: Other Spray indicators- Round 2

Indicator	
Total sachets received	3,416
Total sachets used	3,416
Total sachets damaged/ lost	0
Total sachets leftover	0
Ave. # structures sprayed/ Sachet	4.78
Avg # sachets per SO per day	4
Avg # SOP worked/ day	38
Avg # structures sprayed by SOP/ day	19

8. Capacity Building of the Ministry of Health

In order to promote sustainability, AIRS Ghana worked with government partners and other key stakeholders throughout the planning and implementation of IRS. The AIRS Ghana team worked with the GHS, District Assembly EPA, and Environmental Health teams at the Regional, District and Community level to conduct pre-spray activities, such as environmental inspections, planning, training, and IEC activities, as well as monitoring and supervising spray activities.

For instance, GHS and DA staff was part of the training of trainers. This training equipped them with the knowledge and skills of IRS operating techniques. Together with the AIRS district team, they were key facilitators at the training of spray operators at the district level. GHS personnel and other stakeholders were 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. The entomological unit of AIRS Ghana, with technical assistance from Noguchi, organized a training for selected GHS staff and other partners and stakeholders in applied entomology to equip them with technical skills, knowledge and tools for disseminating IRS messages effectively.

During spray operations, the SOCs worked closely with district level stakeholders, such as the DHMTs, to facilitate IEC activities and obtain community acceptance of IRS. AIRS Ghana regularly communicates and meets with other IRS stakeholders, such as AGA, and entomology partners, such as Noguchi, to discuss lessons learned and further the IRS agenda in Ghana. Collaboration with government partners and other stakeholders is essential to the success of the AIRS program. AIRS Ghana depends on these partners to meet our goal of achieving a 90% spray coverage and continues to build their capacity with each spray round.

9. Challenges, Lessons learned and Recommendations

The following challenges, lessons learned, and recommendations were identified during the 2012 spray campaign:

9.1 Challenges

1. Delay in the delivery of Actellic 300 CS forced the Ghana AIRS team to push back the start of spray operations in 3 districts and presented undue pressure on the entire operational team to finish on or before 31st July, 2012.

2. Ethnic conflicts in some districts (Bunkpurugu- Yunyoo and Gushegu) affected spray operations. Spray operations were ceased for several weeks due to security reasons.

3. Some households lost their IRS cards. This made data capture difficult and slowed down data entry.

4. The early onset of the rains disrupted spraying activities and affected the daily performance of SOPs.

5. Spray operators had to walk several kilometers to communities that could not be accessed by vehicles as a result of poor road networks especially in the Karaga district.

6. Some households demanded ITNs as a condition for accepting IRS.

7. Farming activities during the spray operations period prevented some household members from being available to prepare their homes for the spray campaign.

8. Rain storms disaster in Chereponi destroyed some eligible structures and interrupted spray operations.

9. There was reluctance in some households to place their household items outside during spraying, especially in the peri-urban areas.

10. The mobilization/enumeration period coincided with the national immunization campaign and national voters' registration exercise, and the same implementers doing the mobilization were involved in these national activities. This impeded the smooth roll out, implementation and monitoring of the mobilization/enumeration activities.

11. Spray Operators found 1,119 fewer eligible structures during Round 2 in BY than in Round 1 because of the following reasons:

    - Many households turned structures within compounds that were used for sleeping during Round 1 into food storage sheds during the time period of the second round of the spray campaign which corresponds with harvest season. Since guidelines in Ghana do not consider food stores as eligible for spraying, there were fewer eligible structures during Round 2 compared to Round 1.

    - Collapsed structures: Most people in the Bunkpurugu and Yunyoo sub-districts do not have very permanent structures and therefore during the rainy season there are a significant number of structures found by SOPs that have recently collapsed.

    - Nomadic farmers who come from urbanized areas like Tamale go to BY for farming. Once the farming is over, they leave and close the structures until the next farming season. Since these structures are not inhabited during the second round of the IRS campaign, they are not considered eligible for spraying.

9.2 Lessons Learned and Recommendations

1. Late start affects spray performance and coverage. An early start of spray operations with increased number of spray operators is recommended for 2013 and beyond.
2. IEC/ BCC activities should be intensified. More women and women 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.
3. IEC activities must begin on time so as to reach the intended target audience.
4. 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.
5. Intensify the use of radio programs to inform and educate people on IRS activities.
6. The use of video documentary on malaria vector behavior gives a better understanding of the science behind IRS and hence erases misconceptions. It is recommended that video shows become an integral part of community IEC activities.
7. A new type of insecticide Actellic CS, was introduced during the 2012 spray round. The strong smell of the insecticide was identified as a possible reason why household members might not

accept IRS. Fortunately, due to the intensification of IEC messages by the Ghana AIRS team, this challenge was changed in to a strength. The Ghana AIRS team did not see a high level of refusal rates and the acceptance of Actellic CS was more than expected in the three districts that used it.

Annex A. Other Indicators

Table A-5: Output/Process Indicators		
Quality Management Indicators		
	Data Collection Method/Comments	
A. Information, Education and Communication		
a. Number of IRS educational brochures distributed	Receipts of radio spots aired	65,000
b. Number of radio spots aired		450
B. IRS Training/Supervision Effectiveness		
a. Supervisory Ratio – number of team leaders and spray operators reporting to each supervisor	Daily spray operator and team leader form	Team supervisory ratio – 1 team leader to 4 spray operators
		Field supervisor : spray team ratio - Average of 1 supervisor : 3 teams.
C. Stock Management/Record Keeping		
a. Complete tracking of number of sachets in stock, number of empty sachets returned, and number of sachets disposed of	Stock cards, stock verification reports, Spray Operator Daily Report forms, and end of spray waste disposal report and comparing relevant data to the IRS database tracking system.	100%
b. Number of insecticide sachets lost		0
D. Entomological Indicators		
a. Vector species identification	The entomological monitoring reports will collect data on the applicable indicators. Data will	*Anopheles gambiae and Anophele Funestus*
b. Vector density – change on vector distribution and seasonality		Anopheles gambiae prdeominant species

c. Vector behavior – indoor vs. outdoor biting and resting	be gathered by the IRS Nigeria in coordination with University of Jos.	*See final entomology report*
d. Percentage of vectors susceptible to insecticide and mechanism of resistance		*See final entomology report*
e. Insecticide decay rates on spray surfaces		% Mortalities ranged between 92.5% - 100%
E. Environmental Indicators		
a. Environmental compliance officer oriented and trained	Data was collected during environmental trainings, supervisions and inspections.	Yes
b. Number of supervisors, spray team leaders, and spray operators trained in environmental compliance and sensitivity		800
c. Number of national and sub-national environmental and/or health officers trained in environmental compliance		18
d. Percent of storehouses inspected and approved before spray operations		100%
e. Percentage of operation centers with adequate PPE before spray operations		100%
g. SEAs completed		Yes