PMI | Africa IRS (AIRS) Project

Indoor Residual Spraying (IRS 2) Task Order Four

ETHIOPIA
END OF SPRAY OPERATIONS REPORT
2012

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Prepared by: Abt Associates Inc.

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

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ACRONYMS

AIRS	Africa Indoor Residual Spraying
CB IRS	Community-based IRS
DDT	Dichlorodiphenyltrichloroethane
EC	Environmental Compliance
ECO	Environmental Compliance Officer
EPA	Environmental Protection Agency
FMOH	Federal Ministry of Health
GEMS	Global Environmental Management Support
HEW	Health Extension Worker
HLC	Human Landing Catch
ITN	Insecticide-treated Net
IRS	Indoor Residual Spraying
M&E	Monitoring and Evaluation
MFP	Malaria Focal Person
ORHB	Oromia Regional Health Bureau
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
PSC	Pyrethrum Spray Collection
RTI	Research Triangle Institute International
SBCC	Social Behavioral Change Communication
SOP	Spray Operator
TA	Technical assistance
TOT	Training of Trainers
USAID	United States Agency for International Development

EXECUTIVE SUMMARY

In August 2011, Abt Associates was awarded a three-year Africa-wide Indoor Residual Spraying project (AIRS), IRS 2 Task Order 4, funded by USAID under the President's Malaria Initiative (PMI). The mandate of the project is to limit exposure to malaria and reduce the incidence and prevalence of malaria in up to 17 countries in sub-Saharan Africa through the implementation of indoor residual spraying (IRS) programs. The key objective of the 2012 AIRS program in Ethiopia is to reduce malaria-associated morbidity and mortality by:

- Implementing IRS in 36 districts of the Oromia region;
- Providing technical and logistic support to IRS in 24 PMI-graduated districts in the Oromia region;
- Building capacity of the national malaria program.

The IRS operation in Ethiopia is implemented in two rounds using two different insecticides. During the first round, the spraying was done in 19 districts from June 15 to August 2, 2012 using deltamethrin from the pyrethroid class of insecticides. The second round of IRS, using bendiocarb, an insecticide from the carbamate class in 17 districts was implemented from August 15 to October 7, 2012. In Year One, the project also provided limited IRS support to 24 districts graduated from PMI support in 2011 and conducted post-spray evaluation of the districts.

The project main results achieved during the spray campaigns in 2012 are shown in Table 1:

TABLE 1. MAIN 2012 IRS RESULTS

Target/Result	Overall	Round One	Round Two	Graduated Districts
Number of provinces/districts covered by PMI-supported IRS in 2012	60 districts in the Oromia region (fully supported 26 graduating and 10 new, partially-supported 24 graduated,)	19	17	24
Estimated number of structures targeted for spray as reported in 2012 Work Plan	Total: 1,002,357	490,000		512,357
Total number of structures found in targeted spray districts by Spray Operators	Total: 1,074,212 554,062 (36 districts that were graduating or new) 520,149 (24 graduated districts)	269,057	285,005	520,149[1]

[1] The 24 graduated districts provided the number, which indicates planned to be sprayed, not actually found structures.

Number of structures covered by PMI-supported IRS in 2012	Total: 975,880 547,421 (36 districts that were graduating or new) 428,459 (24 graduated districts)	265,106	282,315	428,459
2012 spray coverage	98.8%	98.8%	99.1%	82.4%
Population protected by PMI-supported IRS in 2012	Total: 2,940,085 1,506,273 (36 districts that were graduating or new including 23,309 pregnant women and 225,875 children under 5) 1,433,812 (24 graduated districts)*	698,898 including 12,571 pregnant women and 105,769 children under 5	807,375 including 10,738 pregnant women and 120,106 children under 5	1,433,812 (further breakdown of data is not available)
Dates of PMI-supported IRS campaign		June 15, 2012–August 2, 2012	August 15, 2012–October 7, 2012	August 15 – October 30 (for all districts, some started later/finished earlier)
Length of campaign		40 days	35 days	39 days (average)
Number of people trained with USG funds to deliver IRS	2,260	1,058	1,202	n/a
Number of seasonal workers trained with USG funds to support IRS (includes all cadres trained)	4,213	2,005	2,208	n/a

*For details refer to AIRS Ethiopia report *Performance and Challenges of 24 Districts Graduated from PMI Support,* January 2013.

- A national-level training was provided on spray pump use and maintenance, comprehensive IRS, pesticide poison management, and entomological monitoring to 93 health staff from the all regions of the country;
- Mortality of susceptible mosquitoes was 100 percent for two consecutive months in the houses sampled for spray quality assessment.

Additional information on the main results is included in the respective sections.

Key lessons learned from the 2012 IRS campaign include:

- Given that all IRS seasonal employees are either government workers or hired by the government, AIRS Ethiopia does not have direct influence on their performance and hence, the IRS campaign requires an enhanced supervision system. To implement the campaign more effectively, AIRS should strive to create mechanisms for better understanding and coordination of efforts between the project and government offices.

- Optimization of transport is important because of the shortage of appropriate rental vehicles prior to the campaign launch and the need for outsourcing multiple rental companies;
- Mass media channels like radio and community outreach through village meetings are expected to be more effective in reaching out with key messages than door-to-door distribution of leaflets that may not be well understood by the community members and mobilizers may not have enough time to diligently explain the content.

1. INTRODUCTION

In August 2011, Abt Associates was awarded a three-year Africa-wide Indoor Residual Spraying project (AIRS), IRS 2 Task Order 4, funded by USAID under the PMI. The mandate of the project is to limit exposure to malaria and reduce the incidence and prevalence of malaria in up to 17 countries in sub-Saharan Africa through the implementation of IRS programs.

1.1 PROJECT OBJECTIVES IN 2012

The major objective of the AIRS Ethiopia project is to contribute to the national and PMI goals of reduction in malaria morbidity and mortality in Ethiopia through the implementation of quality IRS operation in selected districts of the Oromia region.

Specific Objectives:

The 2012 AIRS Ethiopia project had the following specific objectives:

- Spray up to 490,000 structures in 36 districts (up to 353,625 structures in 26 graduating and up to 130,000 structures in 10 new) and provide technical support to IRS operations in 24 graduated districts (up to 512,357 structures) of Oromia in 2012. PMI's IRS will support the total estimate of 1,002,357 structures. The spray campaign consists of two rounds of 19 and 17 districts, respectively.
- Reach a minimum coverage of 85% of the structures found in targeted villages by implementing high quality IRS operations.
- Build capacity at the national, regional state, district, and local levels to manage IRS operations, including planning, spraying, resource allocation, and M&E.
- Support development and implementation of a pilot kebele[2]-based IRS campaign.
- Monitor the impact of IRS operations on selected entomological and health facility indicators.

In addition to implementing the IRS campaign, the project aimed to carry out the following activities:

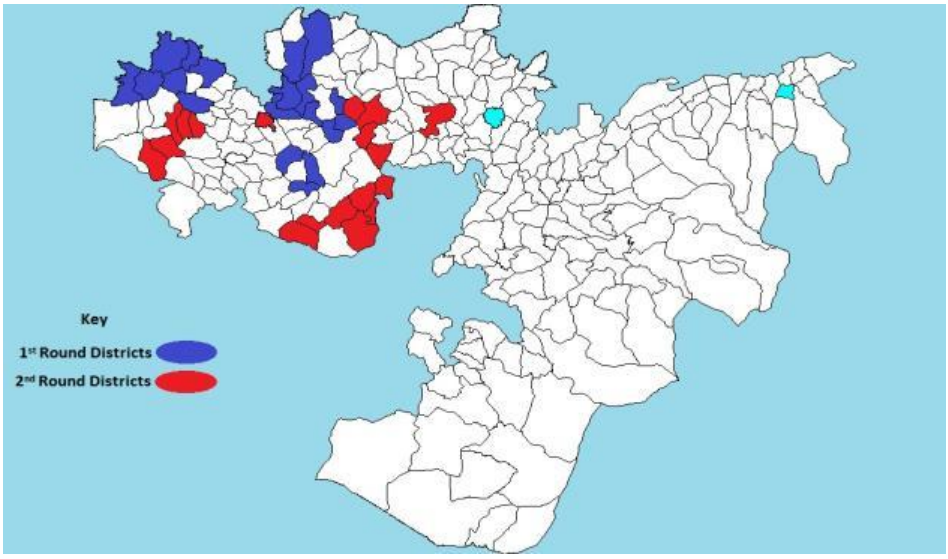
- Organize and conduct national-level comprehensive workshops for FMOH, Regional Health Bureaus, Zonal/District health offices, and Dire-Dawa city council staff to strengthen the capacity of planning, implementation, and M&E of IRS operations.
- Support entomological training to enhance national capacity in conducting insecticide resistance studies, tracking residual life of insecticides, and properly monitoring vector densities, species composition, and behavior;
- Conduct insecticide resistance, wall bioassay, vector density, and behavioral studies to generate adequate data to guide insecticide selection for IRS, monitor if insecticide pressure will force mosquitoes to change or modify their behavior, assess the quality of spraying and determine the residual life of different insecticides in the country context;
- Assist the Federal Ministry of Health (FMOH) with a plan to dispose obsolete insecticides, primarily dichlorodiphenyltrichloroethane (DDT) and malathion.

[2] Kebele is the smallest administrative unit in Ethiopia; it comprises of approximately 1,000 households.

1.2 SPRAY SITES

The AIRS project is carried out in collaboration with the FMOH, the Oromia Regional Health Bureau (ORHB), and other implementing partners in Oromia regional government. The largest region by surface area and population in Ethiopia, Oromia also has the highest malaria prevalence in the country. The 2012 project districts are all located in western and southwestern areas of the region, as shown in Figure 1.

FIGURE1. MAP OF PMI FULLY SUPPORTED DISTRICTS



PMI and the ORHB conducted a series of consultative meetings discussing the incidence of malaria, history of spray, altitude, and other epidemiological factors to make an informed decision about the districts that required full IRS support for 2012. As a result, PMI and ORHB selected 36 districts, 26 of which have already received PMI assistance over the past two years, and 10 new districts. Round One of spraying (June–July) covered 19 districts in three zones and Round Two (August–October) is covering 17 districts in four zones, as shown both in Figure 1 above, and in Table 2.

TABLE 2. NUMBERS OF PMI FULLY SUPPORTED DISTRICTS BY ZONE (N=36)

Zone	East Wollega	West Wollega	Illubabor	Jimma	Kellem	West Shoa	Total
Round One/districts	9	7	3				19
Round Two/districts			1	6	5	5	17

1.3 INSECTICIDES

PMI in collaboration with the FMOH, the ORHB, and other partners conducted a number of insecticide susceptibility studies on the local malaria vector species between 2009 and 2011. Studies conducted by Research Triangle Institute International (RTI) for over two years showed that for DDT vector mortality was lower than 80 percent in 28 of the 29 sites studied; for deltamethrin, in13 of the 25 sites; for lambdacyhalothrin, in seven of the 13 sites; for malathion, in four of the 22 sites, and for bendiocarb,

in two of the 24 sites. The first batch of studies detected a high level of vector resistance to the insecticide DDT. Based on the findings, the FMOH decided to discontinue use of DDT for IRS operations and, instead, decided to use deltamethrin, an insecticide from the pyrethroid class, until more data on insecticide susceptibility and the residual efficacy of alternative insecticides are available. In 2011, government-funded IRS programs exclusively sprayed pyrethroid insecticides, while the PMI-funded IRS program used both pyrethroid and carbamate insecticides to spray the target districts.

However, 2010–2011 studies on insecticide resistance conducted by RTI, the World Health Organization, the FMOH, and other research institutions showed that pyrethroid resistance has spread in many parts of the country. This finding called on the IRS program to reconsider use of pyrethroids. Pending further consultations with partners and experts, the FMOH decided to spray propoxur and bendiocarb from the carbamate class of insecticides in 2012. The FMOH also made a decision to utilize all deltamethrin that has been left in stores from previous rounds by spraying in areas where resistance to the pyrethroid insecticides is not reported.

Therefore, ORHB supplied AIRS Ethiopia with deltamethrin for the Round One (June–July) campaign in the first 19 districts. PMI procured bendiocarb for Round Two spraying (August–October).

2. PRE-SPRAY ACTIVITIES

2.1 MICRO PLANNING

Micro planning was incorporated into the regional comprehensive IRS training. A micro planning meeting was held in May for Round One and in July 2012 for Round Two, with health personnel from selected districts and Oromia zonal health offices. A total of 117 staff participated in Round One and 106 in Round Two meetings. During the meeting, participants developed detailed action plans and a calendar for the Round One spraying. They also agreed on the logistics, transportation requirements, type, and number of spray actors to be involved, and mechanism of capacity building.

2.2 LOGISTICS NEEDS ASSESSMENT AND PROCUREMENT

AIRS Ethiopia project conducted a logistics needs assessment as part of the micro planning meeting with representatives from all targeted districts. The assessment included review of the current stock of equipment, personal protective equipment (PPE), and insecticides. As part of the review, the participants analyzed conditions and availability of soak pits and storage facilities at the district level.

Based on the information from each district, the AIRS Ethiopia team performed a detailed analysis to determine the total number of spray pumps, PPE, and other IRS materials needed for the IRS activities.

Most of the PPE and spray pumps used during the 2011 IRS campaign remained in good condition and were available for use in the 2012 Round One IRS campaign. For Round Two, the project procured large quantities of equipment and spray materials to ensure that SOPs for newly-added districts have all required PPE and supplies. AIRS Ethiopia also noted the quantities of damaged or non-reusable PPE, and developed a list of PPE that AIRS needed to procure.

Overall, procurements were made locally and internationally using an open tender process and collecting bids/quotes on commodities to be purchased. A full list of all PPE and materials procured for the 2012 IRS campaign is found in Table A-1 in the Annex.

The team also established the number and type of vehicles required for each district's IRS operations based on number of structures per district and the topography of the areas. The project conducted a competitive bidding process to acquire vehicles and selected four local companies to supply the transportation.

2.3 HUMAN RESOURCE REQUIREMENTS

AIRS Ethiopia used 2011 sprayed structures to calculate the quantity needs for the seasonal workers. The project stakeholders also agreed that in accordance with previous IRS Ethiopia campaigns, the team and squad leaders, supervisors, and organizers would be recruited from among health professionals working in the selected project districts and zones. On this basis, all districts identified their team and squad leaders including other spray actors based on capacity and their interest to participate in the IRS operation.

2.4 TRAINING

AIRS Ethiopia is committed to building the capacity of national and local staffs to implement, monitor, and evaluate quality spray operations. As part of this commitment, AIRS is striving to develop a cadre of

well-trained spray operators (SOPs) who are technically proficient in insecticide application techniques, can correctly handle spray pumps and can communicate effectively with beneficiaries in the communities and also follow standard environmental procedures. AIRS Ethiopia conducted a five-day, nationwide comprehensive IRS spray operation training for RHB and zonal health staffs in March 2012. In March–May 2012, it held national trainings on spray pumps maintenance, pesticide poison management, and entomological monitoring for health workers from all regions in the country. Selection, invitation, and tutoring of trainees for the trainings were done in collaboration with the FMOH.

Following the national trainings, the project conducted regional comprehensive IRS trainings of trainers (TOTs) for the zonal and district staffs in May 2012. The TOT participants then recruited and conducted a six-day training for spray operators, reserve operators (porters), and squad leaders at the district operational level. The TOT participants also oriented the health extension workers (HEWs), washers, store keeper assistants, and guards on issues related to spray operation, mobilization, and enumeration as well as on environmental compliance (EC). Orientation was provided for drivers at the central level. The project also trained professionals from health facilities in the IRS target districts on pesticide poison management. The AIRS M&E team also trained 22 data entry clerks and deployed 19 of them. The remaining three were kept in reserve in case replacements were needed.

For the Round Two, the project followed a similar approach of cascading trainings to the implementers' level. Table 3 provides a breakdown of trainings, types, and numbers of participants for both rounds.

TABLE 3. SUMMARY OF NATIONAL, REGIONAL AND DISTRICT LEVEL TRAININGS

No	Trainings	Participants	Round One		Round Two		
	National Level		F	M	F	M	Total
1	TOT on spray pump use and maintenance	Vector control expert from regions	1	21			22
2	TOT on comprehensive IRS	Vector control expert from regions	0	32			32
3	Pesticide poison management	Clinicians from regions	7	18			25
4	TOT on entomological monitoring	Entomologists from regions	2	12			14
		Regional Level					
5	TOT on comprehensive IRS	Malaria focal persons, SBCC and EC supervisors	7	110	6	100	223
6	Data entry clerks	Data tech from project zones	6	16	6	11	39
7	Insecticide poison management	Clinicians from district health facilities	29	43	5	18	95
		District Level					
8	SBCC, mobilization, and enumeration	Health extension and other kebele based GOV staff	378	117	418	97	1010
9	Community sensitization and mobilization	Kebele heads	0	231	0	264	495

10	Spray operation and communication	Squad Leaders	4	130	25	156	315
11	Spray operation and communication	Spray operators	0	544	0	711	1255
12	Spray operation and communication	Porters	0	134	0	181	315
13	Washing and EC	Washers	34	0	59	0	93
14	Transport safety	Drivers	0	57	0	78	135
15	Fire safety and operation site security	Guards	0	34	0	39	73
16	EC, stock management and fire safety	Storekeepers	3	16	1	16	36
17	EC, stock management and fire safety	Storekeeper's assistants	1	18	0	17	36
	Total						**4,213**

Note: SBCC=social behavioral change communication, EC=environmental compliance

2.5 ASSISTANCE TO 24 GRADUATED DISTRICTS

The original approach for technical assistance to the 24 graduated districts did not succeed because the districts demanded financial support along with the technical assistance, which was not planned for. However, AIRS project provided the districts with 1,025 pairs of boots and PPE for 1,000 spray operators. In collaboration with the FMOH, AIRS provided training for over 80 health workers from the Oromia region including 24 graduated districts on the use and safety of the two carbamate insecticides that were to be introduced into the program. Before the last spraying cycle ends, the project will visit all 24 districts to assess the environmental compliance and performance in order to determine the assistance needed for next year.

3. MOBILIZATION AND ENUMERATION

For Round One, AIRS Ethiopia conducted social mobilization and enumeration of households and structures for 10 days in the 19 project districts prior to the start of spray operations. Similarly, prior to the Round Two spray, the project spent 10 days to mobilize and count structures in 17 districts.

The main purpose of mobilization was to remind beneficiaries about the positive benefits of IRS in controlling and preventing malaria and malaria-related deaths, and to remind them of their roles and behaviors before, during, and after spray operations.

HEWs, the frontline health workers in each kebele, and other kebele-based government staff, were recruited and trained to be the mobilizers. A total of 36 district malaria focal persons[3] (MFPs), 166 SBCC team leaders and 1,010 mobilizers took part in the mobilization campaigns in both rounds of spraying. AIRS Ethiopia also collaborated with the C-Change project and FMOH structures at all levels to mobilize communities. Door-to-door communication was the main strategy used for community outreach. District MFPs worked in close contact with the SBCC team leaders to inform the population about the spraying schedule. With the support from C-Change, the project developed, printed, and distributed household IRS cards as well as IRS fliers and brochures with key IRS messages (see Table 4).

TABLE 4. COMMUNICATION MATERIALS DISTRIBUTED TO DISTRICTS

Item	Round One	Round Two
Brochure	142,349*	157,651
Poster	3,000	1,000
Household IRS card	191,348	169,251

* Districts also distributed additional brochures remaining from last years' operation.

Prior to Round One spraying, mobilizers (trained HEWs) reached 156,000 households and 437,677 adults (53 percent female and 47 percent male) with IRS education messages. In advance of Round Two, they reached 166,081 households and 365,453 adults (55.5 percent female and 44.5 percent male). As a result, all households reached agreed to follow instructions by SOPs and consented to have their structures sprayed.

Concurrent with the door-to-door mobilization, HEWs also identified eligible structures for the IRS campaign and provided households with IRS cards. HEWs recorded 276,506 unit structures that are eligible for spray. Detailed mobilization and enumeration results by district are shown in Table 5 for Round One and in Table 6 for Round Two.

[3] Malaria focal person – a public health officer in charge of malaria component at a district or zonal health office

TABLE 5. ROUND ONE MOBILIZATION AND ENUMERATION RESULTS

District	# of HH mobilized	% of HH mobilized	If not mobilized, most common reason why	# of adults reached with IRS message			# of HHs accepted IRS	% of HHs accepted IRS	# of materials distributed	Total eligible structures found
				Male	Female	Total				
Nejo	10838	99	NP	15729	15729	31458	10838	100	10845	18228
Diga	7032	99	NP	8089	9452	17541	7032	100	7079	10390
Boneya Boshe	4494	100		10047	11015	21062	4494	100	4498	10011
Gubu Sayo	5880	100		8256	6321	14577	5880	100	5888	10191
Wayu	8956	100		9860	13866	23726	8956	100	8990	12895
Sasiga	8989	100		10134	14007	24141	8989	100	8999	15367
Begi	8712	99	NP	13528	14013	27541	8712	100	8780	15173
Guliso	8183	97	NP	9424	11826	21250	8183	100	8437	12359
Wama Hagalo	8723	100		11692	12463	24155	8723	100	8728	17060
Bedele	4966	99	NP	4686	6660	11346	4966	100	4994	7727
Borecha	7900	100		13150	14205	27355	7900	100	7904	21,940
Dhedess	4710	99	NP	4256	5737	9993	4710	100	4745	9225
Kiltu	6503	100		6813	9028	15841	6503	100	6513	13803
Babo Gambel	8170	100		13876	15443	29319	8170	100	8211	16104
Kondala	12092	98	NP	16378	17330	33708	12092	100	12293	15776
Manasibu	11424	99	NP	15633	18044	33677	11424	100	11581	19906
Gida Ayana	12068	95	NP	10272	14154	24426	12068	100	12686	21305
Limu	6597	100		8256	10192	18448	6597	100	6629	11974
Guto Gida	9763	99	NP	13565	14548	28113	9763	100	9851	17072
Total	156000	99		203,644	234,033	437,677	156,00	100	157,651	276,506

Note: HH=household, NP= Nobody Present

TABLE 6. ROUND TWO MOBILIZATION AND ENUMERATION RESULTS

District	# of HH mobilized	% of HH mobilized	If not mobilized most common reason why	# of adults reached with IRS message			# of HHs accepted IRs	% of HHs accepted IRs	# of materials distributed	Total eligible structures found
				Male	Female	Total				
Dendy	6667	91.4%	NP	3705	6676	10381	6667	100%	7296	11912
Bako	7847	88.6%	NP	6884	9717	16601	7847	100%	8854	14109
Shebe	7283	97.7%	NP	8482	9275	17757	7283	100%	7458	12642
Sekoru	9534	100.0%		10881	13448	24329	9534	100%	9534	15227
Danno	8077	98.2%	NP	10368	11717	22085	8077	100%	8229	12737
Ilu Galan	8996	98.6%	NP	10368	13400	23768	8996	100%	9126	15709
Tiro	13917	99.9%	NP	14147	18228	32375	13917	100%	13926	21654
Nonno	8878	99.2%	NP	7910	11432	19342	8878	100%	8953	14390
Kersa	13940	96.8%	NP	9655	15762	25417	13940	100%	14404	23365
Omo	17167	99.7%	NP	22826	17167	39993	17167	100%	17213	29347
Lalo Kile	5719	96.4%	NP	5747	6961	12708	5719	100%	5933	12461
Seyo	9092	100.0%		8933	11687	20620	9092	100%	9096	11871
Hawa	10169	99.1%	NP	12279	14449	26728	10169	100%	10257	19247
Dale	7329	100.0%		4301	7579	11880	7329	100%	7329	10865
Dale Sadi	6603	98.0%	NP	5605	8081	13686	6603	100%	6735	9379
SekaChekorsa	13061	99.9%	NP	10531	13071	23602	13061	100%	13069	18189
Chewaka	11802	100.0%		9825	14356	24181	11802	100%	11,803	16282
Total	166,081	97.9%	NP	162,447	203,006	365,453	166,081	100%	169,215	269,386

4. SPRAY ACTIVITIES

4.1 SPRAY OPERATIONS

In Ethiopia, PMI is implementing the IRS program in close collaboration with the government. In 2012, through AIRS, PMI provided all technical (training, monitoring, entomology, etc.) and logistical (store, soak pit, PPE, equipment supply, insecticide, consumables, transport, etc.) support required for the operation to 36 districts. FMOH through the zonal and district offices provided all the spray personnel (spray operators, team and squad leaders, mobilizers, coordinators, supervisors, store keepers etc.). The numbers of the spray operation teams as shown in Tables 7 and 8 were based on the number of structures found during last year's IRS campaign.

TABLE 7: ROUND ONE DISTRIBUTION OF SPRAY TEAMS BY DISTRICT

Zone	District	# of Spray Teams	# of Squads	# Spray Operators
East Wollega	Gobu Seyo	1	4	16
East Wollega	Wama Hagalo	2	9	36
East Wollega	Boneya Boshe	2	6	24
East Wollega	Wayu Tuka	2	9	34
East Wollega	Guto Gida	2	7	28
East Wollega	Gida Ayana	2	8	32
East Wollega	Limmu	2	6	24
East Wollega	Sasiga	2	6	30
East Wollega	Dega	1	5	20
West Wollega	Guliso	2	7	29
West Wollega	Nejo Rural	2	8	32
West Wollega	Kiltu Kara	1	4	16
West Wollega	Mana Sibu	3	12	48
West Wollega	Kondala	2	9	37
West Wollega	Begi	2	8	32
West Wollega	Babo Gambel	2	8	32
Illubabor	Bedele	1	5	20
Illubabor	Borecha	2	8	32
Illubabor	Dedesa	1	5	22
	Total	34	134	544

TABLE 8: ROUND TWO DISTRIBUTION OF SPRAY TEAMS BY DISTRICT

Zone	District	# of Spray Teams	# of Squads	# Spray Operators
Jimma	Sekoru	2	9	36
Jimma	Omo Nada	4	16	64
Jimma	Tiro Afeta	3	13	50
Jimma	Seka Chekorsa	3	11	44
Jimma	Kersa	0	20	80
Jimma	Shebe Sombo	2	8	31
Kellem Wollega	Lalo Kile	2	8	30
Kellem Wollega	Dale Sadi	2	8	32
Kellem Wollega	Dale Wabara	3	11	44
Kellem Wollega	Hawa Galan	4	14	57
Kellem Wollega	Seyo	2	8	32
West Shoa	Dendy	2	7	28
West Shoa	Danno	2	7	30
West Shoa	Nonno	2	8	33
West Shoa	Ilu Galan	3	12	48
West Shoa	Bako Tibe	2	8	32
Illubabor	Chewaka	2	10	40
Total		40	178	711

Round One of the spray campaign was to have started in all 19 districts on June 15, 2012. However, shortage of long base vehicles from the rental companies and last-minute complications with the rental procedures forced the team to cascade the roll-out of the spraying. As a result, operations began on June 15–18 in 15 districts and on June 26 in the four remaining districts in the three zones (East and West Wollega, and Illubabor). The project completed Round One operations in 40 days.

Round Two rolled out with seven old districts that began spraying on August 15, 2012 and the 10 new districts that started on August 27, 2012. In addition, the project piloted a community-based IRS in one of the old districts, Kersa. The total number of operational days was 35 for the seven old districts, and 33 for the 10 new districts.

For the period of operation, spray teams stayed in camps set up in each district next to the operation sites that included soak pits and possibly a small temporary stores and kitchen stand. On a daily basis, MFPs and team leaders deployed the spray operation squads to the program-supported villages. One squad leader (a malaria technician) had four SOPs and one porter under his/her command. After verifying the daily data, the squad leader completed the spray operator form and

submitted it to the team leader. The team leader cross-checked and compiled the data on the team leader summary form and submitted the report to the MFP. The MFP delivered the form to the district data clerk based at the district health office after thoroughly checking the data for accuracy. The data clerks entered all data on a daily basis and sent the information to the AIRS database manager. This information flow was to have taken place daily but at times there was a 2–3 day delay depending on the distance from an operation site to the district health office and availability of internet to send files to the database manager.

In all project sites, zonal and district MFPs are responsible for supervision of the daily IRS operations in their respective areas. The AIRS Ethiopia team provided the district and zonal health teams with the supervisory checklists to meet and ensure an objective assessment on spray quality, EC, stock management, and so forth. Continuous supervision by zonal and district teams, and project and home office staff observed a number of compliance and performance issues during the visits to the operational sites. Some included:

- Stock tracking and management by some storekeepers (corrected through on-the-spot training of storekeepers);
- SOPs had inconsistent knowledge on handling bulky items inside houses and spraying technique (refreshers were conducted at the camps);
- SOPs did not wash plastic covers everyday (was corrected during the visits);
- SOPs would bring leftover insecticide mix back to the camp (in on-the-job orientation SOPs were encouraged to spray all their insecticides and minimize the chemicals to carry back to the camp).

To address the performance issues the project team focused on the supervision responsibilities and requirements during the Round Two regional training. In addition, AIRS Ethiopia changed the strategy of the project supervision by assigning the Round Two districts to specific project technical experts including the COP. Each of the project supervisors was in charge of monitoring and adjusting as needed spraying performance and environmental compliance in assigned districts. They also closely worked with the government supervisors. The supervision schedule is in Table 9. As a result, the feedback from the supervisors at all levels was very valuable, particularly at the initial stage of the spray operations, to address problems promptly.

TABLE 9. ROUND TWO SUPERVISION SCHEDULE

Supervision/Training by	Districts	August				September					
		Week				Week					
		1	2	3	4	1	2	3	4		
Database Manager	Sokoru									Old district	1
	Omo Nada									Old district	2
	Tiro Afeta									Old district	3
M&E Manager	Seka Chekorsa									Old district	4
	Shebe Sombo									Old district	5
	Chewaka									Old district	6
Operations Manager	Kersa (CB IRS)									Old district	7

ECO	Seyo									New district	8
	Dale Sadi									New district	9
	Dale Wabera									New district	10
	Hawa Galan									New district	11
	Lalo Kile									New district	12
Tech Manager/COP	Bako									New district	13
	Illu Galan									New district	14
	Dano									New district	15
Logistics Manager	Dendi									New district	16
	Nonno									New district	17
Regional Health Bureau	All districts										
Zonal Health Bureau	All districts in zone										
District Health Bureau	All kebeles districts										
Ops manager	All districts										
M&E team	All districts										
ECO	All districts										
COP	All districts										

4.2 COMMUNITY-BASED IRS

AIRS Ethiopia project in collaboration with the ORHB selected Kersa to be the pilot district for community-based IRS (CB IRS). Kersa has been a PMI-supported district for the last three years. It is located in Jimma zone, 335 km from the capital city of Addis Ababa. There are 31 kebeles in the district with 20 of them located in the areas with higher risk for malaria. They were selected for the CB IRS pilot, the results of which are shown in Table 10.

The project did a five-day training to prepare HEWs to serve as squad leaders. Two HEWs participated from each of the 20 kebeles except one. A total of 39 health extension workers were trained to be squad leaders. The HEWs, in collaboration with kebele leaders, selected five literate community members and trained them for six days on spray operation and communication. Four of them worked as SOPs and one acted as porter or SOP replacement in each kebele. Overall, 100 community members were trained as SOPs.

TABLE 10. SPRAY OPERATION PERFORMANCE IN CB IRS

Total # of Eligible Structures Found by SOPs	Total # of Eligible Structures Sprayed	% of Total Structures Sprayed	Population Protected	Pregnant Women Protected	Children Under 5 Protected	% of Population Protected
23,180	22,744	98.1%	70,882	676	9,776	98.5%

The spray operation took 22 working days. To conduct supervision and collect spray operation reports on a daily basis, the supervisors required only one vehicle for each kebele. There was no necessity for deploying vehicles for spray operators and camping. Preliminary cost data, presented in Table 11,

provides comparative information for expenses incurred during implementation of a conventional district-based IRS against the CB IRS.

TABLE 11. COST COMPARISON OF COMMUNITY- AND DISTRICT-BASED IRS

Activity	Community based IRS Year 1	District based IRS Year 1	Community based IRS Year 2	District based IRS Year 2	Difference Year 1	Difference Year 2
IRS logistics	4,719	1,826	0	0	2,893	0
Soak pit	12,070	1,341	0	0	10,729	0
Ops site maintenance	274	133	274	133	141	141
Training	8,964	3,519	8964	3519	5,445	5,445
Spray actors payment	17,358	19,651	17,358	19,651	-2,293	-2,293
Spray actors transport	1,481	24,000	1,481	24,000	-22,519	-22,519
Logistic transport	497	131	497	131	366	366
Total	45,363	50,601	28,574	47,434	-5,238	-18,860

The team conducted preliminary analysis of CB IRS results and identified advantages, challenges and lessons learned:

- CB IRS had about 10% of savings compared to a district-based IRS during the first year of implementation. The savings can go up to 40% during the second year mostly due to decreased number of vehicles required during CB IRS.
- Though IRS acceptance generally high in Ethiopia, CB IRS is more welcomed.
- Quality of spraying is high in CB IRS
    - Wall bioassay tests showed the spray quality was adequate;
    - Better training because more time is given to each trainee, i.e., each five SOPs were trained by two squad chiefs.
- District health staff testified that SOPs showed extra efforts to spray well because they were from the sparying or neighboring village and often knew the tenants. Easy to do mop-up operation in case it is needed.
- Community-based IRS is presumed to be significantly cheaper in the long run.
- Storage of insecticide and IRS equipment at the village level is not easily available.

Sustainability opportunities: CB IRS can be implemented with very limited resources; the community can contribute in case of problems with operational funds.

4.3 LOGISTICS AND STOCK MANAGEMENT

For the 2012 campaigns, the project is renting two central warehouses. The main warehouse is located in Addis Ababa and is rented from a private owner. It is used to store PPE and other IRS materials. Another warehouse is located in Nazareth (also called Adama) and belongs to the ORHB, which is using most of the facility to temporarily store insecticide (deltamethrin) before distributing it to districts. AIRS Ethiopia received its deltamethrin for the first round of spray operations from the ORHB stocks kept in

this store. The Nazareth warehouse also stores a limited AIRS inventory including one incinerator, small amount of spray tanks, helmets, face shields, significant quantity of spare kits, and respirators (masks).

For the long term, the project has negotiated with the ORHB to use a facility on a territory of a regional health center located in the outskirts of Addis. The facility is given to AIRS Ethiopia at no charge for the life of the project with the agreement that AIRS will renovate the space and add a covered shed for the two incinerators that are transferred from RTI but are currently stored in the Addis and Nazareth warehouses. They will be used to dispose project non-DDT spray waste. The renovation and move of all equipment from the two warehouses to the new one was completed in November 2012.

The project also rehabilitated district warehouses in all 36 operation sites, which are managed by the district health offices. The store keepers managing the district stores are employed by the project only for the duration of the spray campaign.

Prior to the campaign, the project dispatched required equipment and materials from the central warehouses to the district ones. For the PPEs and equipment, the project used dispatching slips (notes) that were signed by the receiving stores as proof of delivery. Government vouchers with seal of the district health office were collected as proof of receipt.

Team leaders received insecticide from the district stores. They filled and signed daily insecticide tracking forms, and then issued sachets to the squad leaders with a similar insecticide tracking form. At the end of each spray day, porters or squad leaders would turn in the used and unused sachets to the team leader, who collected and returned them to the store keeper. The store keeper recorded the full sachets on the stock card, updated the balance, and returned the unused sachets to the full stock. Used (empty) sachets were recorded on the daily utilization record form that tracks each store's empty sachets and utilization trend. This reconciliation process enabled the store keepers to ensure an effective daily inventory and to alert AIRS program staff of discrepancies between the stock and the records.

During the operation the store keepers also documented daily minimum and maximum temperature records.

4.4 ENVIRONMENTAL COMPLIANCE

A supplemental environmental assessment was carried out by RTI in August 2011 and approved by USAID in November 2011. Because of this timing, a letter report was not required prior to the spray campaign that began in June 2012.

The project team made significant efforts to ensure that all measures have been undertaken to comply with environmental standards during the spraying rounds (June 2012 and August 2012). AIRS Ethiopia conducted necessary trainings, and refurbished and prepared for use infrastructure such as soak pits and stores for the campaign period. The project procured PPE and materials and organized regular site inspections including an evaluation visit by management expert from Global Environmental Management Support (GEMS) assigned by USAID.

Soak pits/Effluent disposal: To ensure safe disposal of effluent waste, a total of 74 soak pits were inspected and covered with polyethylene plastic sheets during the spray operation period. The liquid waste from the IRS operation was safely and properly disposed.

Stores: There were 26 existing old district stores. The project constructed and/or rehabilitated 10 more district stores for the new districts. Project government counterparts frequently inspected for

stock management and environmental compliance all 36 district stores. All precautions have been made to ensure safe transportation, storage, and distribution of insecticides as well as proper handling of other IRS logistics. The project equipped the stores with fire extinguishers, shelves, pallets, first aid kits, dust bins, emergency kits, and thermometers. Proper booking system, use of bin cards, proper stacking, labeling, updating balance and proper use of PPE, and use of insecticides tracking forms have been practiced.

Pregnancy test: All females involved as spray operators, porters, store keepers, and washers have conducted pregnancy tests and were found fit to be involved in the operation to carry out their assigned duties.

No adverse events or accidents were reported in both spray rounds.

4.5 Environmental Compliance Inspections

In accordance with the 2012 work plan, three inspections have been conducted for each spray round. In addition, for the purpose of preparation/follow-up of soak pits construction, other field work activities were carried out.

The project conducted pre-spray operation inspections to check the preparedness of soak pits and stores for the campaign, ensure that accessibility to the sites is adequate, and observe any additional logistical needs to be addressed prior to the spray campaign.

During the mid-spray inspections, the project Environmental Compliance Officer (ECO) conducted checks to confirm that the spray personnel use PPE properly, residents are safe from insecticide application, and proper technical procedures are followed for preparation of the house and application of the insecticide. He also observed store keepers to ensure proper insecticide tracking, and collection of the IRS generated wastes. Most of the corrections were done on the spot.

After the spray ended, the inspections focused on securing clean, non-contaminated environment around the soak pits and protecting the area from community access. ECO assessed the sites to ensure that all PPE and other IRS logistics were properly washed, collected, and stored with proper booking system for the next period of operation.

The ECO who led the above-mentioned inspections submitted detailed reports to the country office after each inspection. The AIRS EC Manager has also conducted the environmental compliance audit. Discussion and follow up measures have been taken on his findings and recommendations. The GEMS consultant has also evaluated the EC status of the project and recommendations of the consultant are being taken into consideration.

Overall, the inspections revealed the environmental compliance requirements are satisfactorily met, with few exceptions that will be improved in the future. During the evaluations, certain issues/points came up that are not clearly manifested in the Best Management Practices Manual including drinking and eating between spray hours, and not using the left over spray solution for next day. Therefore, there is a need

to reconsider, approve, and include these points in the Best Management Practices Manual.

Use of PPE: Adequate supply of PPE has been provided for spray actors involved in handling of pesticides: spray operators, porters, store keepers, washers, and other workers handling pesticides. Use of PPE has been satisfactory except for the chronic problem encountered due to use of improper size of boots.

Solid Waste Collection and Disposal: Non-DDT-contaminated IRS-generated solid wastes such as empty sachets, used masks and contaminated boxes have been collected and stored in district stores from where they will be transported for final disposal through incineration at a central location.

Capacity Building/Training:

- A presentation on EC was given at the National TOT, conducted in Nazareth for participants including other regions of the country;
- Training on Environmental Compliance was given in two TOTs conducted for the two spray rounds.

Lessons Learned:

- Use of polyethylene sheets to cover cracked concrete and temporary soak pit floors is a cost-effective and quick solution to minimize the soil contamination;
- Outsourcing construction of soak pits with proper guidance and close supervision where it is possible is more efficient;
- Involvement of District Health Office and District technical staff in construction of soak pits is a good practice to increase district ownership among the health officers.

5. POST-SPRAY ACTIVITIES

5.1 CLOSING OF IRS OPERATIONS

AIRS Ethiopia has decided to merge an end-of-spray meeting with the stakeholders for Round One and Two campaigns for the following reasons:

- Overlap of Round One and Two activities. All key experts from the central National Malaria and Vector Control Program and district and zonal health offices are fully engaged in both rounds of spraying along with the AIRS team. Therefore, the back-to-back schedule for both rounds of spraying did not allow time for proper preparation and execution of an end-of-spray meeting;
- Saving time and resources. Holding a single end-of-spray meeting will save time and be cost effective.

The-end-of spray meeting covering both rounds was held in October 29-30, 2012 in Jimma town. Key outcomes of the end-of-spray conference were:

1. Agreement that the 2012 spray operation was successful with 99 percent of the structures covered;
2. The project and health offices at the district, zonal, and regional level should continue to work very closely with the AIRS team;
3. The project would strive to provide all logistics required for the operation and health offices staff need to perform their duties as per the required standard for spray quality, environmental compliance, and stock management;
4. Misbehavior and non-performance of drivers from rental companies should be reported by MFPs and AIRS will take action immediately to replace cars;
5. AIRS has used all means to minimize delay in processing of payments to spray actors but the improvement of the system is still required for future operations;
6. The CB IRS is perceived better than the district-based IRS arrangement for acceptance and quality.

Although the overall end-of-spray meeting was held in October, the AIRS team did hold a three-day internal evaluation meeting of the Round One operation, to do the following:

- Identify weaknesses and strengths of the Round One campaign;
- Discuss ways of resolving the weaknesses and transferring the strengths and best practices of Round One to Round Two.

Moreover, the team trained each other so that all team members can do a comprehensive supervision when out in the field. All team members did training on M&E, EC, spray quality, stock management and tracking, and so forth. Each component leader also provided a checklist for each area of supervision.

At the end of the evaluation meeting, members of the technical team were assigned to 2–3 specific districts to provide overall supervision and on-the-spot trainings, and take corrective actions for any problems encountered.

5.2 Demobilization and Logistics

All spray equipment, including spray pumps, PPE, plastic sheets, tents, and mattresses, were properly cleaned and returned to district stores. Proper inventory of all IRS-related materials was done in November for all the 36 districts in the Round One and Round Two spray operation. The inventory results showed that all non-consumable IRS equipment and materials were returned back from operation sites; no loss or damage was reported. All items were also found to be properly cleaned and stored. It is important to note that the government is the owner of all IRS items and all items are recorded and documented by the district health offices. The store keepers are responsible for dispatching and collection of the items back after the operation. The government has a system for making staff pay for items lost or damaged under their responsibility.

5.3 Incineration and Final Disposal of Non-DDT Waste

AIRS Ethiopia has inherited large quantities of insecticide waste and two small mobile incinerators that can be used to dispose non-DDT-contaminated waste. In 2012, AIRS worked with the regional environmental protection authority (EPA) and health office to secure a permit and a site for incineration. The total waste has been accumulated in 60 PMI supported districts from 2009 to 2012 IRS operations including the AIRS Ethiopia spray campaigns of 2012. As a result, the project performed the following activities:

- Identified appropriate installation sites for the incinerators;
- Obtained approval and permit to undertake incineration in the selected sites;
- Received approval and design work on incinerator shelter construction/rehabilitation from the Oromia RHB;
- Completed rehabilitation of incinerator shelters;
- Trained four operators and other AIRS and RHB staff on machine operation in November 2012;
- Arranged an expert to calibrate (cure) one incinerator that had not been functioning and tested in 2011;
- Started incineration of non-DDT waste at the end of November.

5.4 Disposal of DDT and DDT Waste

PMI has asked the project to explore disposal options in-country and/or outside of Ethiopia for DDT and DDT waste that has been accumulated in past spray campaigns. The project contracted out URS, an international engineering firm to conduct an assessment of two local cement kilns in order to provide recommendations on the possibility of modifying the kilns for DDT disposal and the potential cost associated with it. The AIRS Environmental Compliance Manager has also visited the facilities to get a better understanding and collect on-the-ground information about location, current conditions, and willingness of the kiln management to cooperate. He gathered information on kilns' compliance with the international environmental policies and discussed the technical, political, and managerial aspects of the proposed project with the kiln managers and government officials. URS developed a report that was submitted to PMI for final review and commentary.

6. ENTOMOLOGY

The 2012 work plan of the AIRS Ethiopia includes a number of entomological monitoring activities that are anticipated to be implemented in collaboration with the ORHB, the FMOH, and Jimma and Addis Ababa Universities. Most of the entomological monitoring activities have being carried out by the AIRS entomology team. The major activities accomplished from January to August 2012 include efficacy and residual life of different insecticides on sprayed walls, monitoring vector behavior and density, insecticide susceptibility tests, and other relevant entomological studies.

6.1 INSECTARY

PMI/AIRS Ethiopia supports a well-functioning insectary in Nazareth. The insectary is owned by the Oromia RHB. Earlier, PMI rehabilitated and equipped the insectary. Under the AIRS project, PMI provides regular support for procurement and care of lab animals for mosquito feeding, maintenance of insectary equipment, and payment of temporary staff. The insectary is a reliable source of susceptible mosquitoes for all entomological monitoring activities undertaken by the AIRS team. The insectary also serves as a learning center for a number of local and international trainings on entomology.

6.2 THE RESIDUAL LIFE OF POTENTIAL ALTERNATIVE INSECTICIDES

Cone/wall bioassay tests have been undertaken to assess the residual life of a number of potential alternative insecticides, which include long-lasting (CS) formulation of pirimiphos methyl, deltamethrin, and propoxur. RTI started the studies in 2011 and AIRS has completed the research. The results of the study conducted on 15 sprayed houses in Adama area showed that the residual life of two insecticides (pirimiphos methyl and deltamethrin) was more than six months. Mortality rate of laboratory-reared susceptible *An. arabiensis* was 100 percent after six months of spray (see Tables 12 and 13).

TABLE 12. WALL BIOASSAY RESULTS OF TESTING DELTAMETHRIN 2.5% WDP

House No.	Percent Mortality						
	After 24 hrs.	After 1 month	After 2 months	After 3 months	After 4 months	After 5 months	After 6 months Feb
1	100	100	100	100	100	100	100
2	100	100	100	100	100	100	100
3	100	100	100	100	100	100	100
4	100	100	100	100	100	100	100
5	100	100	100	100	100	100	100
average	100	100	100	100	100	100	100
control	4.0	8.0	4.0	6.0	2.0	2.6	14.7

TABLE 13. WALL BIOASSAY RESULTS OF TESTING PIRIMIPHOS METHYL 30% SUSPENSION

House No.	Percent Mortality						
	After 24 hrs month (October 2011)	After one months (November 2011)	After 2 months (December 2011)	After 3 months (January 2012)	After 4 months (February 2012)	After 5 Months (March 2012)	After 6 Months (April 2012)
1 (Experimental hut)	100	100	100	94.85	100	100	100
2(Experimental hut)	100	100	100	92.2	100	100	100
3	100	100	100	100	100	100	100
4	100	100	100	92.2	95.6	95.3	100
5	100	100	100	74.2	95.6	92.3	100
average	100	100	100	90.6	98.1	97.7	100
control	6.0	6.0	4.0	14.6	6.7	5.3	4.0

6.3 STUDY ON THE IMPACT OF PH ON RESIDUAL LIFE OF CARBAMATES

Many pesticides, particularly commonly used organophosphate and carbamate insecticides, are known to undergo a chemical reaction in the presence of alkaline water that reduces their effectiveness. The pesticide is hydrolyzed and rendered ineffective when it is mixed with water with a pH greater than 7. The more alkaline the water, the more rapidly the pesticide breaks down.

AIRS Ethiopia is conducting cone bioassay tests to determine the residual efficacy of carbamates (propoxur and bendiocarb) at different pH levels of spray water and types of wall surface. For this study, the project constructed a total of 12 experimental huts in two different locations in Adulala-Hate-Aroreti kebele, Adama district, East Shoa zone, Oromia region. The study is designed to last from April through October 2012. Data collection started on April 27, 2012. The first set of vector mortality data was gathered 24 hours after spraying with the insecticides. Testing will be repeated monthly for six months.

The study so far showed that:

- Adjusting the pH level of spray water had no effect on efficacy and residual life of these insecticides;
- Bendiocarb and propoxur sprayed on dung-coated walls performed better than when sprayed on mud walls; the reason is not yet known;
- pH of the two plaster materials (mud and dung) did not differ;
- Propoxur showed longer residual life than bendiocarb.

6.4 DETERMINATION OF QUALITY OF SPRAYING AND PERSISTENCE

This activity was performed 1–3 days after the spraying began in Gobu-Seyo district, East Wollega zone. Susceptible and wild species of *An. gambiae s.l* were exposed to deltamethrin 2.5 percent water dispersible powder sprayed walls in 10 houses. The overall mortality rate of wild mosquitoes exposed to deltamethrin-sprayed walls 1–3 days after the spray was 25.8 percent. In a bioassay test with susceptible mosquitoes, mortality was 100 percent. One month after spray, mortality of wild mosquitoes was 8 percent and mortality of susceptible was 100 percent. Two months after spray, mortality of susceptible

An. gambiae s.l was 98.6 percent; there was no point in continuing the test with wild mosquitoes as it had been confirmed that wild mosquitoes are highly resistant to deltamethrin. The results indicated that the spray quality was adequate but the vector in the operation area was resistant to deltamethrin as shown in Table 14.

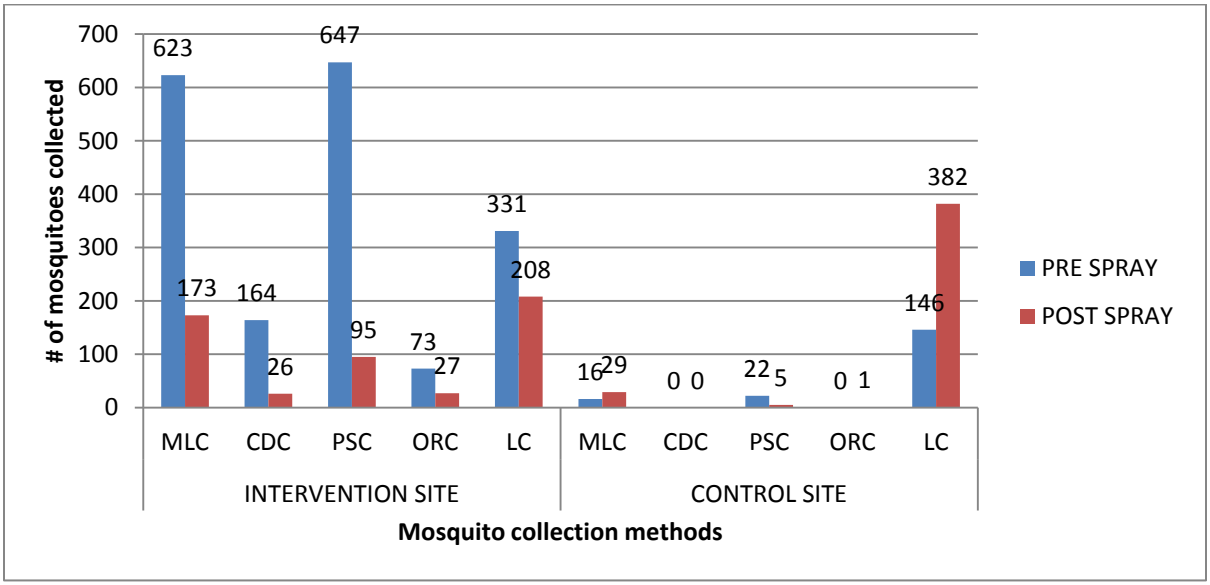
TABLE 14. BIOASSAY RESULTS OF SPRAYED SURFACES EXPOSED TO DELTAMETHRIN

Mosquito Type	Exposure	# of Mosquitoes Exposed	# of Mosquitoes Killed after 24hr	% Mortality	Corrected Mortality (%)
Susceptible (lab reared) mosquitoes	Test mosquitoes	405	405	100	100
	Control mosquitoes	135	13	9.6	9.6
Wild (field collected) mosquitoes	Test mosquitoes	450	116	25.8	25.8
	Control mosquitoes	150	0	0	0

6.5 MONITORING VECTOR DENSITY AND BEHAVIOR

Two sites were selected for vector density and behavior monitoring where pre- and post-spray data collection was conducted. The sites are Gambela Tere kebele in Gobu-Seyo district, an intervention site, and Bako Tibe, Kebele 01, a control/unsprayed site. A pre-spray assessment was conducted before the spraying began and the studies were repeated one month after spray. Figure 2 demonstrates significant reduction in vector density observed in the post-spray collection in the intervention village, while not much difference was recorded in the control village.

FIGURE 2. PRE- AND POST-SPRAY RESULTS OF VECTOR MOSQUITO DENSITY



MLC = man landing catch; PSC = pyrethrum spray catch; ORC = outdoor resting collection; LC = Larval collection.
PSC = 20 Houses; ORC = 6 collectors x 2 hours; LC = 6 Collectors x 100 dips

6.5.1 LARVAL COLLECTION

Larvae collected from breeding habitats decreased from 331 to 208 per 600 dips post spray in the intervention village; this increased from 146 pre spray to 382 post spray in the control village.

6.5.2 PYRETHRUM SPRAY COLLECTION

Indoor resting mosquitoes collected from 20 houses using the Pyrethrum Spray Collection (PSC) method decreased from 647 pre spray to 95 post spray in the intervention village; this number also decreased from 22 to five in the control village. All mosquitoes from PSC catches were classified for their abdominal stages (unfed, fed, half gravid, and gravid). The ratio of gravid and half gravid to fed mosquitoes during pre-spray indoor resting collection in the intervention village was 162 to 438, indicating the vector's preference to rest outdoors (exophilic).

In other words, more fed mosquitoes were collected than half gravid and gravid combined. Other factors could have been involved but the reason could also be due to exophilic behavior as the expectation is to have more half or full gravid mosquitoes than fed mosquitoes collected indoors if the vector is endophilic. The vector seems to prefer resting outdoors pre- or post-spray. Spray seems not to have an effect on the vector resting behavior. The same ratio was 13 to 78 post spray in the intervention village indicating the same exophilic tendencies after spray. This could also be affected by weather and other human activities. Detailed analysis of these data will be included in a separate entomological report.

6.5.3 HUMAN LANDING CATCHES

A human landing collection (also called man landing catch) was undertaken before and one month after the spray. Two collectors (one sitting indoor and the other outdoor) spent the whole night (6pm to 6am) exchanging places every hour. Tables 15 and 16 demonstrate the results. In the intervention village, the team collected 623 mosquitoes before vs. 163 one month after the spray. The result in the control site was 16 vs. 29. During pre-spray collection, the indoor vs. outdoor ratio was 219 to 404 in the intervention site and 6 to 10 in control sites. During post-spray monitoring, the ratio was 52 to 111 and 12 vs. 17 in the intervention and control site respectively. A total of 289 (indoors) vs. 542 (outdoors) were caught attempting to bite humans in both intervention and control sites during both pre- and post-spray collections.

Overall human landing catch collection results showed that vector biting was consistently lower indoors than outdoors, indicating a tendency of exophagic habits. To further elaborate on these findings, the data indicates that the vector has both options but it prefers biting people sitting outdoors than those sitting indoors. However, because people spend more time indoor than outdoor, a mosquito has to go inside to bite, which means people can still be protected by IRS and bed nets; both will remain to be effective.

TABLE 15. TOTAL *AN. GAMBIAE S.L.* COLLECTED IN JUNE 2012; PRE-SPRAY

Sites	MLC			CDC		PSC	ORC	LC
	IN	OUT	TOTAL	IN				
Intervention site	73	89	162	88		647	73	331
	134	269	403	67				
	4	16	20	2				
	8	30	38	7				
Total	**219**	**404**	**623**	**164**				
Control site	3	5	8	0		22	0	146

	1	1	2	0				
	2	3	5	0				
	0	1	1	0				
Total	**6**	**10**	**16**	**0**				

MLC = man landing catch; PSC = pyrethrum spray catch; ORC = outdoor resting collection; LC = Larval collection.
PSC = 20 Houses; ORC = 6 collectors x 2 hours; LC = 6 Collectors x 100 dips

TABLE 16. TOTAL *AN. GAMBIAE S.L.* COLLECTED IN JULY 2012; POST-SPRAY

Sites	MLC			CDC		PSC	ORC	LC
	IN	**OUT**	**TOTAL**	**IN**				
Intervention site	13	26	39	11		95	27	208
	29	51	80	14				
	5	21	26	0				
	5	13	28	1				
Total	**52**	**111**	**173**	**26**				
Control site	4	7	11	0		5	1	382
	2	3	5	0				
	4	2	6	0				
	2	5	7	0				
Total	**12**	**17**	**29**	**0**				

MLC = man landing catch; PSC = pyrethrum spray catch; ORC = outdoor resting collection; LC = Larval collection.
PSC = 20 Houses; ORC = 6 collectors x 2 hours; LC = 6 Collectors x 100 dips

6.5.4 CDC LIGHT TRAPS

CDC light traps collection was undertaken in two houses for two nights in each. Density was higher pre spray (164) than post spray (26) in the intervention village. No mosquito was found from the indoor CDC light traps pre and post spray in the control village as shown in Table 12.

6.5.5 PARITY RATE

Ovary dissection was performed on all unfed female mosquitoes captured during the pre- and post-spray human landing collections to determine the rate of parity. Pre spray, 513 out of 615 (83.4 percent) dissected vectors were parous in the intervention village and 15 out of 16 (93.8 percent) in the control. Post spray, this figure was 133 out of 175 (76 percent) in the intervention village and 18 out of 29 (62.1 percent) in the control village. The proportion of parous vectors was lower after spray in the intervention village. The same was true for the control village after one month. This probably indicates that the insecticide had little effect because of the high level vector resistance to deltamethrin but it is hard to make any conclusion from these two data sets.

6.5.6 INSECTICIDE SUSCEPTIBILITY

More than 20 insecticide susceptibility tests were undertaken between June and August 2012; vector resistance to deltamethrin was detected in a number of sites and the vector was susceptible to bendiocarb, propoxur, and fenitrothion in the tested areas.

The susceptibility level of *Anopheles gambiae* complex, the major vector of malaria in Ethiopia, to 0.05 percent deltamethrin, 0.1 percent bendiocarb, 1.0 percent fenitrothion, and 0.1 percent propoxur was tested in five selected sites in the Oromia project districts in July 2012. The tests were conducted on 2–3-day-old female mosquitoes reared from larvae. The test results showed 8–61 percent susceptibility of *An. gambiae* to deltamethrin, indicating a high level of resistance of the vector to this insecticide. The susceptibility to bendiocarb in Asendabo and Bako sites was 95–100 percent. Susceptibility of the vector to fenitrothion was 98 percent in one site and 100 percent for propoxur in three sites (Table 17).

Similar studies by RTI and other partners between 2010 and 2011 also showed that the vector is susceptible to bendiocarb, propoxur, and fenitrothion. The selection of bendiocarb for IRS in the PMI project districts and the FMOH's decision to use both types of carbamates in all areas sprayed by the national IRS program were based on these data. The data on deltamethrin resistance were mixed. Deltamethrin killed more than 80 percent of the vector in 15 of the 28 sampled sites; mortality was less than 80 percent in 13 localities. The FOMH decided to spray deltamethrin in all areas where the resistance level was low and/or in the areas where data on deltamethrin resistance was not available.

Other reasons for the FMOH's decision of spraying deltamethrin in June-July 2012 included: (i) The FMOH was getting reports of case increase in May and a large number of districts needed spray with a long-lasting insecticide in June; the only insecticide available in stores at the time was deltamethrin. (ii) The FMOH decided to spray all deltamethrin accumulated in stores, which otherwise expire in 2013. FMOH believed that this would avoid keeping another obsolete chemical in district and regional stores. Due to these reasons, AIRS had to comply with the FMOH's decision to spray deltamethrin in districts where the vector was known to be susceptible to deltamethrin or there were no data regarding resistance to deltamethrin. Out of 36, 19 districts met the criteria of either reported susceptibility to deltamethrin or no report of resistance.

TABLE 17. RESULTS OF SUSCEPTIBILITY TESTS BY AIRS, 2012

Insecticide	Area	% Mortality
Bendiocarb	Nazareth Lab Colony	100
	AAU Lab Colony	100
	Gobu Sayo project district (wild)	100
	Ilu Gelan project district (wild)	97.3
	Asendabo project district (wild)	95
Deltamethrin	Gutin project district (wild)	42
	Njeo project district (wild)	61
	Omo Nada	8
Propoxur	Gutin project district (wild)	100
	Dale Sedi	100
	Omo Nada	100
Fenitrothion	Dale Sedi	98

7. MONITORING AND EVALUATION

7.1 APPROACH AND KEY OBJECTIVES

The overarching M&E approach of AIRS Ethiopia was to use the local lessons learned in combination with successful aspects of M&E systems to:

- Emphasize accuracy of both the data collection and the data entry process through comprehensive trainings and supervision at all levels;
- Facilitate data use in both field and office settings through participatory project design and implementation;
- 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.

7.2 REPORTING INDICATORS AND DATA MANAGEMENT

AIRS Ethiopia used various quality assurance methods and tools to ensure high-quality IRS program implementation. During regional and zonal TOTs, the M&E team emphasized definitions of key IRS terms, reporting indicators and protocols, and proper data collection methods and tools. They also trained field staff and supervisors on supervisory roles and responsibilities and data security. The M&E team was fully engaged in supervising field work during both mobilization and spray operation. While observing data collection and entry processes in the field, the team identified gaps and were able to suggest timely corrective actions on the spot. M&E team members were engaged in frequent internal data quality assessments during the spray campaign.

7.3 SPRAY RESULTS

Using 2011 data for structures found by SOPs in each district, AIRS Ethiopia planned to complete the Round One spray operation within 30 working days. However, due to an 18.5 percent difference in the number of structures found by SOPs between 2011 and this year, Round One took 40 spray days overall, with one district completing spraying in less than 30 days, four districts needing up to 10 extra working days to finish, and 14 of the 19 districts completed spraying within the 30-day period. The average duration of the Round One spray operation was 31 working days. Table 18 provides total number and breakdown of structures sprayed vs. found by the district and demonstrates populations protected by IRS in Round One.

In Round Two, the project completed spraying in seven old districts in 35 days and in 10 newly added districts in 33 days. Table 19 demonstrated total and breakdown spray data for this round.

TABLE 18. ROUND ONE SPRAY PERFORMANCE BY DISTRICT

Zone	District	Total # of Eligible Structures Found by SOPs	Total # of Eligible Structures Sprayed	% of Total Structures Sprayed	# of Eligible Sleeping/ living Structures Found by SOPs	# of Eligible Sleeping/ living Structures Sprayed	% of Sleeping/ Living Structures Sprayed	Total Population	Population Protected	Pregnant Women Protected	Children <5 protected	% of Population Protected	Eligible Rooms	
													Found	Sprayed
East Wollega	Diga	10790	10716	99.31%	6197	6180	99.73%	29403	29267	459	4205	99.54%	12899	12134
	Sasiga	14024	13942	99.42%	7860	7750	98.60%	41129	40723	814	6493	99.01%	15760	15748
	Gida Ayana	17757	17087	96.23%	8823	8563	97.05%	46266	45195	914	5593	97.69%	21820	21795
	Boneya Boshe	9942	9867	99.25%	3443	3373	97.97%	21977	21698	259	2735	98.73%	11963	11843
	Wama Hagalo	16286	16204	99.50%	5807	5749	99.00%	34231	33723	604	5666	98.52%	15917	15747
	Guto Gida	12122	11209	92.47%	7058	6740	95.49%	35735	34552	609	4939	96.69%	11509	11483
	Gobu Sayo	9721	9369	96.38%	4130	3910	94.67%	21987	21095	231	2773	95.94%	6917	6897
	Limu	10907	10782	98.85%	5053	4953	98.02%	24710	24364	735	3336	98.60%	10941	10891
	Wayu Tuka	14074	13904	98.79%	7494	7403	98.79%	36445	35993	359	4378	98.76%	15708	15661
	Sub Total	**115623**	**113080**	**97.80%**	**55865**	**54621**	**97.77%**	**29188**	**286610**	**4984**	**40118**	**98.19%**	**123434**	**12219**
West Wollega	Manasibu	24373	24294	99.68%	10617	10585	99.70%	64312	64114	1086	10365	99.69%	43105	42979
	Kondala	16312	16268	99.73%	11666	11627	99.67%	59429	59238	1749	12598	99.68%	21359	20759
	Begi	15789	15789	100.00%	6438	6437	99.98%	47966	47966	833	9161	100.00%	18604	18584
	Guliso	12088	11661	96.47%	7653	7333	95.82%	38231	36856	265	3886	96.40%	21894	21752
	Kiltu Kara	11270	11264	99.95%	5106	5106	100.00%	27003	26996	171	2634	99.97%	17660	17657
	Nejo Rural	17906	17328	96.77%	9331	9046	96.95%	50331	49086	370	5297	97.53%	32127	31371
	Babo Gambel	16330	16310	99.88%	6720	6705	99.78%	39634	39560	555	5566	99.81%	17649	17580
	Sub Total	**114068**	**112914**	**98.99%**	**57531**	**56839**	**98.80%**	**32690**	**323816**	**5029**	**49507**	**99.05%**	**295832**	**29288**
Ilubabor	Borecha	20498	20486	99.94%	7842	7842	100.00%	37548	37536	1387	6367	99.97%	18400	18400
	Dhedessa	10120	10011	98.92%	5434	5386	99.12%	27126	26865	624	5912	99.04%	9418	9204
	Bedele	8748	8615	98.48%	5518	5404	97.93%	24409	24071	547	3865	98.62%	10605	10598
	Sub Total	**39366**	**39112**	**99.35%**	**18794**	**18632**	**99.14%**	**89083**	**88472**	**2558**	**16144**	**99.31%**	**38423**	**38202**
Total	**19**	**269,057**	**265,106**	**98.53%**	**132,190**	**130,092**	**98.41%**	**70,787**	**698,898**	**12,571**	**105,769**	**98.73%**	**457,689**	**45,328**

TABLE 19. ROUND TWO SPRAY PERFORMANCE BY DISTRICT

Zone	District	Total # of Eligible Structures Found bySOPs	Total # of Eligible Structures Sprayed	% of Total Structures Sprayed	# of Eligible Sleeping/ living Structures Found by SOPs	# of Eligible Sleeping/ living Structures Sprayed	% of Sleeping/ Living Structures Sprayed	Total Population	Total Population Protected	Pregnant women protected	Children < 5 protected	% of Population Protected	Eligible Rooms	
													Found	Sprayed
Jimma	Sekoru	16166	16158	100.0%	9724	9716	99.9%	43199	43167	369	6546	99.9%	**23678**	**23595**
	Omo Nada	25188	25125	99.7%	15217	15171	99.7%	79550	79287	1019	12816	99.7%	44297	44139
	Tiro Afeta	21774	21476	98.6%	16356	16111	98.5%	66906	65937	790	10267	98.6%	30203	29621
	Kersa	23180	22744	98.1%	14412	14103	97.9%	71947	70882	676	9776	98.5%	42495	41640
	Seka Chekorsa	18580	18461	99.4%	11088	10968	98.9%	54316	54066	699	7783	99.5%	33503	33307
	Shebe Sombo	13004	12951	99.6%	7240	7193	99.4%	35094	34901	432	4896	99.5%	20546	20320
	Sub Total	**117892**	**116915**	**99.2%**	**74037**	**73262**	**99.0%**	**351012**	**348240**	**3985**	**52084**	**99.3%**	**194722**	**192622**
Kelem Wollega	Lalo Kile	12765	12523	98.1%	5283	5170	97.9%	30240	29611	308	4022	97.9%	20565	20205
	Dale Sadi	11939	11935	100.0%	5234	5231	99.9%	29478	29440	293	4277	99.9%	22538	22380
	Dale Wabara	15751	15747	100.0%	6869	6869	100.0%	35835	35820	201	4115	100.0%	23337	23063
	Hawa Galan	21162	20911	98.8%	11954	11838	99.0%	63468	62956	1423	11933	99.2%	29834	29496
	Seyo	13353	13341	99.9%	7577	7566	99.9%	41326	41279	515	5448	99.9%	25328	28287
	Sub Total	**74970**	**74457**	**99.4%**	**36917**	**36674**	**99.3%**	**200347**	**199106**	**2740**	**29795**	**99.4%**	**121602**	**123431**
West Showa	Dendy	11021	10624	96.4%	6339	6048	95.4%	32705	31529	297	3792	96.4%	14020	13628
	Danno	13941	13513	96.9%	7532	7160	95.1%	40057	38502	432	5502	96.1%	17445	16903
	Nonno	13479	13350	99.0%	7751	7645	98.6%	40328	39880	583	5719	98.9%	15833	15689
	Ilu Galan	17836	17815	99.9%	8380	8363	99.8%	43491	43403	553	6161	99.8%	26248	26214
	Bako Tibe	14317	14103	98.5%	8209	8016	97.6%	40441	39567	242	4759	97.8%	20855	20646
	Sub total	**70594**	**69405**	**98.1%**	**38211**	**37232**	**97.4%**	**197022**	**192881**	**2107**	**25933**	**97.8%**	**94401**	**93080**
Ilubabor	Chewaka	21549	21538	99.9%	12291	12280	99.9%	67196	67148	1905	12294	99.9%	23174	22920
	Sub Total	**21549**	**21538**	**99.9%**	**12291**	**12280**	**99.9%**	**67196**	**67148**	**1905**	**12294**	**99.9%**	**23174**	**22920**
Total	**17**	**285,005**	**282,315**	**99.1%**	**161,456**	**159,448**	**98.9%**	**815577**	**807,375**	**10737**	**120106**	**99.1%**	**433899**	**432053**

Based on past SOP performance, the team calculated an average of 14 structures to be sprayed per day per SOP. The average surface area of a structure was approximately 100m^2 and one sachet of insecticide per 8-liter pump was estimated to cover approximately two structures. In Round One, the actual average SOP output was 16 structures per day and one sachet of insecticide was used to cover 2.25 structures. In Round Two, average SOP daily output was 14 structures and one sachet of insecticide was used to spray 1.95 unit structures. On average, SOPs used seven sachets per day. Detailed insecticide use data are included in Tables A-2 and A-3 of the Annex.

During the spray campaign, information was also collected on mosquito net availability and use as shown in Table 20.

TABLE 20. USE OF NETS IN SPRAY AREAS

ROUND ONE				
Zone	**District**	**Insecticide-Treated Nets**		
		Total ITNs Found	**Pregnant Women Sleeping under ITNs**	**Children <5 Sleeping under ITNs**
East Wollega	Diga	3117	180	1665
	Sasiga	2780	449	1693
	Gida Ayana	5912	493	3141
	Boneya Boshe	3865	176	1913
	Wama Hagalo	4870	357	3204
	Guto Gida	9119	419	4236
	Gobu Sayo	3979	146	1821
	Limu	2521	245	1103
	Wayu Tuka	9755	298	3858
	Sub total	38819	2708	21726
West Wollega	Manasibu	17123	1051	8640
	Kondala	18057	1417	9091
	Begi	9825	677	7136
	Guliso	5058	63	1037
	Kiltu Kara	3069	106	1539
	Nejo Rural	10774	235	3592
	Babo Gambel	8809	126	881
	Sub total	72715	3675	31916
Illubabor	Borecha	8719	831	3927
	Dhedessa	2667	254	2262
	Bedele	7893	480	3413
	Sub total	12010	1484	10015
Total19 Districts		**123544**	**7867**	**63657**

ROUND TWO				
Jimma	Sekoru	10338	254	5387
	Omo Nada	22511	779	10427
	Tiro Afeta	13948	471	7220
	Kersa	18299	465	7255
	Seka Chekorsa	19841	663	7265
	Shebe Sombo	10584	346	4090
	Sub total	**95521**	**2978**	**41644**
Kelem Wollega	Lalo Kile	8010	261	3655
	Dale Sadi	3772	126	2224
	Dale Wabara	2018	40	531
	Hawa Galan	4213	332	3050
	Seyo	13022	458	5048
	Sub total	**31035**	**1217**	**14508**
West Shoa	Dendy	6336	160	2614
	Danno	11864	279	4870
	Nonno	8140	454	4554
	Ilu Galan	7892	375	4656
	Bako Tibe	3338	32	741
	Sub total	**37570**	**1300**	**17435**
Ilubabora	Chewaka	8842	1027	7327
	Sub Total	**8842**	**1027**	**7327**
Total 17 districts		**172968**	**6522**	**80914**
GRAND TOTAL		***296,512***	***14,389***	***144,571***

7.4 M&E Data Entry, Storage, and Security

An Access IRS database developed for PMI was fully implemented by Abt Associates under AIRS Ethiopia. In consultation with regional and zonal officials, the project recruited data clerks who met a range of criteria including computer literacy and, specifically, competency in database programs. A three day training was given to a total of 22 data entry clerks during Round One. Training emphasized hands-on practice on entering data from field forms, ensuring consistency and completeness, generating reports, and archiving and securing data.

During mobilization/enumeration and spraying, each district was assigned a data entry clerk who was supervised by the district MFP as well as the AIRS M&E and Database Manager. Regular supervision emphasized the skills data entry clerks learned through their training and provided correction and feedback.

To ensure the secure storage of all data collected by the Ethiopia AIRS program, all paper forms submitted were filed by date and location binders in a secure location at the district health offices. In addition to paper-based documentation system, electronic data were secured by back-up protocols to the central server using sync technology.

There was continuous and vigorous data quality assessment and field supervision during mobilization and spray supervision. Data quality assessments were carried out by M&E staff, operations, and environmental and technical personnel.

8. Challenges and Lessons Learned

1. In some cases mobilization data reports were delayed in reaching data entry clerks due to poor access by road to villages/kebeles. Rain aggravated this problem. The project resolved the problem in many of the districts by encouraging the districts health officers to use the motor bicycles for data collection and supervision. The project covered the cost of fuel.
2. Lack of internet availability prevented timely reporting of mobilization and spray data from some districts. This was resolved by providing transportation facility or allowance for data entry clerks to travel to the nearest towns with internet access.
3. The distance from operational sites or soak pits to some target villages was far. This, coupled with poor access by road, affected daily output as spray teams had to walk long distances to and from operation sites.
4. Size and comfort of boots was an issue for some SOPs. The fact that boots are procured internationally, before the SOPs are recruited, makes buying the correct sizes difficult.
5. Changes in the definition of unit structures from last year (the requirement of recording all other structures by type) created confusion among the mobilization team and spray team. Last year, only living structures were counted and recoded in the SO form. This year other structures like latrines, kitchens, animal sheds were also counted and recorded. In some instances the mobilizers also counted some ineligible structures like small latrines without a roof as structures. As a result, some mobilization reports overstated the number of eligible unit structures in some areas. This problem was quickly corrected during supervision by the AIRS team and district supervisors.
6. Poor capacity of and commitment of mobilizers and inadequate supervision by mobilization supervisors also contributed to discrepancies between mobilizer found and SOP found data. AIRS discovered that mobilization/enumeration data of 2012 was less reliable than actual spray data; SOP found unit structures exceeded enumeration data in some districts and was less in other few districts.
7. Due to the poor communication system and non-availability of microfinance institutions in some districts, there was delay in paying seasonal workers in the field. In one district, SOPs stopped working for 1–2 days in protest. Problem was quickly corrected by dispatching AIRS finance staff to effect payments on site.
8. Undertaking a Round One spray operation in 19 districts while simultaneously preparing Round Two in another 17 districts overburdened the AIRS team.
9. There was shortage of long base vehicles during the first few days of the operation; districts did not start operations at full capacity for the first few days.
10. Except for the core team of AIRS experts, the workers involved in the spray operation are employees of the district and zonal health offices. The AIRS team pays the per diem to the health office staff for their contribution to the spray operation. Although AIRS can deny paying the per diem or request that a non-performing worker be replaced, there is little the project can do to penalize these workers when their performance is substandard. In some instances AIRS rejected the involvement or demanded the removal of poorly performing district staff from the spray operation. Health mangers at the zonal offices were very cooperative and understanding.

11. The project sprayed deltamethrin produced and packaged locally; the packaging of deltamethrin was poor, creating some spillage at the store and operation sites.
12. Sync technology applied for data management was not as effective as expected because of the poor connections and technical difficulties.

9. RECOMMENDATIONS

1. Taking the problem of accessibility and distance from operation sites to the villages into consideration, some districts require more than the two soak pits that are the current practice; increasing the number of soak pits to four per district would ease the problem, reduce the cost of transport, and increase SOP output.
2. Wearing boots is a very common practice in all the project sites and the average cost is about $4. Providing this amount to the SOPs would allow them to buy their own boots that fit correctly.
3. The time and resources spent in mobilization and enumeration was not worth the investment. Leaflet distribution as part of the door-to-door mobilization should be replaced by more effective communication methods such as community meetings and radio spots where possible including new districts. Households living in malaria risk areas in Ethiopia have been familiar with IRS campaign for decades and acceptance is not a problem. During mobilization, 100 percent of the households declared that they would be happy to have their houses sprayed. Pre-spray enumeration of unit structures can be dropped except for new districts; SOP-collected data on unit structures were more reliable than mobilizer-collected data.
4. The mechanism for paying seasonal workers should be revisited. The AIRS team will work to improve the system of the project-based direct payment to the workers and use it only as a last resort. Other options for more efficient reimbursement should be discussed in coordination with government partners and financial institutions.
5. AIRS and zonal and district health offices should work more closely. This would help resolve problems observed such as assigning the right people for the various spray operation tasks; for instance, store keepers could easily be trained to perform proper stock management and insecticide tracking as well as managing spray coordination and supervision. Similarly, accountability on issues such as EC and stock management has also to be shared between the project and the government health offices.
6. The FMOH should be encouraged to enhance the standards for insecticide procurement. Chemicals procured should have proper packaging, compliant with international environmental and health safety standards and appropriate for long-term storage and transportation.
7. The quality of trainings given to district and zonal staff need to be improved by reducing the number of participants per session and increasing the number of days.

ANNEX

TABLE A-1. INTERNATIONAL AND LOCAL PROCUREMENT INVENTORY

Items	Quantities Received			Items	Quantities Received	
	Round One	Round Two	Non-PMI Supported		Round One	Round Two
International Procurement				***Local Procurement (continued)***		
Spray pumps		500		Thermometer	17	10
Face shields		27	2500	Big wash basin		70
Head gear/ Helmet		660	2508	2L Jug		201
Rubber gloves-short (box of 12)		459	500	Polythene sheet 3M	55	38
Spare parts kit		55		Tool Kit bag		70
N95 Respirator / mask			3000	Screwdriver		126
Tip T-Jet nozzle		1150		Plier		126
CF valve 1.5 Bar		550		First aid kit	26	56
Universal Hard hat adapter		34		Foam mattress		480
Boots (pair)		881	2500	Canvas tent		60
Local Procurement				Plastic bucket		511
Boots (pair)			40	Shovel		
Overalls		1317	1683	Warning sign-store		10
Apron		46		Fire extinguisher	26	20
Warning sign-soak pit			38	Poster	3,000	1,000
Plastic Funnel	274	472		Flyer	142,349	157,651
2000 liter water tanker		20		M&E forms	64,369	49,367
Foam Matters		480		Spray card	30000	10000
Bathing soap- bar (box)	480	293		Inventory book	38	34
Chalk-100s (box)	326	290		Inventory card	1500	1500
6V Battery	8			Electrical Generator (portable)	8	
6V Battery charger	2			Plastic sheet		371
Nylon rope (roll 5 m long)			18	Duffel bag		126
Nylon rope (roll 20 m long)			40	Latex glove (box of 50 pcs)		17
Canvas tent		60		Graduating cylinder	94	108

TABLE A-2. ROUND ONE INSECTICIDE USE

District	# of Structures Sprayed	Total Sachets Rec'd	Total Sachets Used	Total Sachets Lost/ Damaged	Total Sachets Leftover	Average # Structures Sprayed/ Sachet	Average # Sachets per SOP per Day	Average # Unit Structures per SOP per Day
ROUND ONE								
Diga	10716	6176	6153	5	18	1.75	10.3	18
Sasiga	13942	5777	4538	16	1223	3.11	4.3	13
Gida Ayana	17087	8460	8021	0	439	2.16	7.0	15
Boneya Boshe	9867	5200	4159	0	1041	2.40	6.4	15
Wama Hagalo	16204	8558	8283	3	272	1.99	6.8	14
Guto Gida	11209	6779	4555	0	2224	2.49	6.5	16
Gobu Sayo	9369	6817	4848	0	1969	1.95	8.2	16
Limu	10782	5519	5079	0	440	2.10	6.4	14
Wayu Tuka	13904	7849	6261	3	1585	2.23	6.1	14
Manasibu	24294	10715	10356	6	353	2.35	6.5	15
Kondala	16268	8528	5347	0	3181	3.04	4.5	14
Begi	15789	9424	7948	0	1476	1.99	7.5	15
Guliso	11661	6589	4799	0	1790	2.43	4.7	20
Kiltu Kara	11264	5568	5256	0	312	2.14	8.9	19
Nejo Rural	17328	8845	8023	0	822	2.16	7.2	15
Babo Gambel	16310	7477	6989	0	488	2.39	6.4	15
Borecha	20486	8692	8351	0	341	2.45	6.5	15
Dhedessa	10011	4749	3717	0	1032	2.69	5.1	14
Bedele	8615	5208	5159	0	49	1.74	8.9	15
Total 19 districts	**265106**	**136930**	**117842**	**33**	**19055**	**2.29**	**6.8**	**16**

TABLE A-3. ROUND TWO INSECTICIDE USE

District	# of Structures Sprayed	Total Sachets Rec'd	Total Sachets Used	Total Sachets Lost/ Damaged	Total Sachets Leftover	Average # Structures Sprayed/ Sachet	Average # Sachets per SOP per Day	Average # Unit Structures per SOP per Day
ROUND TWO								
Sekoru	16158	8254	7895	0	359	2.05	6.9	14
Omo Nada	25125	16292	15929	0	363	1.58	7.5	13
Tiro Afeta	21476	12121	12076	0	45	1.78	7.8	15
Kersa	22744	15572	15005	0	567	1.52	5.4	13
Seka Chekorsa	18461	10590	10584	0	6	1.74	7.8	14
Shebe sombo	12951	7056	5533	0	1523	2.34	5.9	14
Lalo Kile	12523	7185	4656	0	2529	2.69	5.0	12
Dale Sadi	11935	7800	5773	0	2027	2.07	6.0	13
Dale Wabara	15747	10115	7324	0	2791	2.15	6.4	14
Hawa Galan	20911	13198	7815	0	5383	2.68	4.7	13
Seyo	13341	9284	6434	3	2850	2.07	6.1	13
Dendy	10624	7557	6931	0	626	1.53	8.3	13
Danno	13513	6845	6715	0	130	2.01	7.5	14
Nonno	13350	7561	4912	0	2649	2.72	5.1	14
Ilu Galan	17815	10847	9117	0	1730	1.95	6.5	13
Bako Tibe	14103	7427	6926	0	501	2.04	7.0	14
Chewaka	21538	11774	10828	0	946	1.99	8.5	17
Total 17 districts	**282315**	**169478**	**144453**	**3**	**25025**	**1.96**	**6.0**	**14**
Grand Total R1&2	**547,421**	**306,408**	**262,295**	**36**	**44,080**	**2.09**	**6.8**	**15**