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2016 BENIN
END OF SPRAY REPORT

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2016 AIRS BENIN
END OF SPRAY REPORT

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ACRONYMS

ABE	Benin Environmental Agency (*Agence Béninoise pour l'Environnement*)
AIRS	Africa Indoor Residual Spraying
BMP	Best Management Practices
CFV	Constant Flow Valve
CREC	Entomological Research Center of Cotonou *(Centre de Recherche Entomologiquede Cotonou)*
DAGRI	Ministry of Agriculture (to be defined)
DCAM	Community Development and Environment Sanitation (*Développement Communautaire et Assainissement du Milieu*)
DDEGCC-AD	Departmental Directorate of Environment and Climate Change Management **(***Direction Départementale de l'Environnement et de la Gestion des Changements Climatiques*) (Atacora-Donga)
DDEHU	Departmental Directorate for the Environment, Habitat and Urbanism (*Direction Départementale de l'Environnement, de l'Habitat et de l'Urbanisme*)
DDS	Departmental Directorate for Health (*Direction Départementale de la Santé*)
DHAB	National Directorate of Hygiene (*Direction de l'Hygiène et de l'Assainissement de Base*)
DST	Direction des Services Techniques (Mairie de Cotonou)
ECO	Environmental Compliance Officer
EMMP	Environmental Mitigation and Management Plan
EMMR	Environmental Mitigation and Monitoring Report
GPS	Global Positioning System
IEC	Information, Education, and Communication
IRS	Indoor Residual Spraying
LLIN	Long-Lasting Insecticide Net
MAEP	Ministry of Agriculture, Livestock and Fisheries (*Ministère de l'Agriculture, de l'Elevage et de la Pêche*)
M&E	Monitoring and Evaluation
mHealth	Mobile health technology
MOE	Ministry of Environment
MoH	Ministry of Health
MSDS	Material Safety Data Sheet
NGO	Non-Governmental Organization

NMCP	National Malaria Control Program (*Programme National de Lutte contre le Paludisme*)
PID	*Pulvérisation Intra Domiciliaire d'Insecticide*
PMI	President's Malaria Initiative
PPE	Personal Protective Equipment
PSECA	Pre-Spray Environmental Compliance Assessment
SEA	Supplemental Environment Assessment
SHAB	Community Hygiene and Sanitation Service (*Service de l'Hygiène et de l'Assainissement de Base*)
SMS	Short Message Service
SOP	Spray Operator
USAID	United States Agency for International Development
WHO	World Health Organization

EXECUTIVE SUMMARY

This End of Spray Report details the planning, implementation, and outcomes of the 2016 IRS campaign in Benin. AIRS-Benin successfully completed its 20-day IRS campaign and 2 additional days of mop up in Natitingou and Matéri (May 3 - May 25, and May 27-May 28, 2016 for mop-up) well within the scheduled time frame designated by the National Malaria Control Program (NMCP).

Benin is in its sixth year of conducting IRS operations in nine communes of Atacora Department in northern Benin: Natitingou, Boukoumbé, Toukountouna, Cobly, Matéri, Tanguiéta, Kouandé, Kérou, and Péhunko.

As in 2015, the NMCP recommended organophosphates for the 2016 IRS campaign for the nine communes of Atacora, specifically the pirimiphos-methyl capsuled suspension (CS).

AIRS Benin's main tasks for the sixth round were to:

- Provide strategic, technical, management, and operational support for IRS activities in the nine communes of Atacora department.
- Collaborate with the United States President's Malaria Initiative (PMI) and the National Malaria Control Program (NMCP) in the implementation of the milestones of the roadmap for the future of IRS in Benin by entrusting more responsibility to the NMCP in the monitoring of IRS activities in 3 communes: Tanguieta, Materi and Cobly.
- Cover at least 85% of the targeted 270,141 structures with residual insecticide in the nine communes.
- Protect pregnant women and children under 5 years of age against malaria within the nine communes.

The results of the sixth round of IRS in Atacora department were successful, spraying 90.8 % of the eligible structures found by spray operators.

Specific activities led by AIRS – Benin project during the sixth round consisted of the following:

- Procured IRS operational equipment as needed
- Provided financial support for IRS management and operations
- Provided planning, operational, technical, and supervisory support for IRS
- Collected, analyzed, and disseminated information for tracking progress against IRS core
- indicators, and for decision-making purposes
- Enhance and expand the use of mobile health (mHealth) technology in IRS

Contracted directly by PMI/Benin, CREC collected entomological surveillance data to evaluate the quality and effectiveness of the 2016 IRS campaign. CREC noted that the quality of the IRS was high at the baseline test performed on May 13th to 20th, 2016 with 100% mortality rates for mosquitoes coming into contact with sprayed walls.

AIRS Benin implemented the 2016 IRS campaign in close collaboration with PMI/Benin and with several Beninese government partners, most notably NMCP, Ministry of Health (MOH), Ministry of Agriculture, Livestock and Fisheries, Ministry of Environment, Habitat and Urbanization, Beninese Environmental Agency, National Directorate of Agriculture, National Directorate of Hygiene, Department Administrative Authorities of Atacora, and the Department Directorate of Health for Atacora.

The NMCP, our main partner, is involved in all main activities including: development of the operational plan, planning meetings (macro- and microplanning), recruitment of seasonal staff, environmental compliance assessment, and training of seasonal staff.

This report summarizes activities, achievements, lessons learned, and recommendations during this round and informs future IRS programs.

TABLE 1: SUMMARY OF 2016 IRS CAMPAIGN

Number of communes covered by the PMI-supported IRS campaign	**9 communes: Boukoumbé, Cobly, Kérou, Kouandé, Matéri, Natitingou, Péhunco, Tanguiéta, and Toucountouna**
Insecticide	Organophosphate: Pirimiphos-methyl CS
Number of structures sprayed by PMI-supported IRS	269,179
Number of structures found by PMI-supported IRS	296,409
2016 PMI-supported IRS campaign spray coverage	90.8%
Population protected by 2016 IRS campaign - Pregnant women - Children under five	858,113 36,088 167,041
Dates of PMI-supported IRS campaign	May 3 – May 25, 2016
Length of campaign	20 days + 2 additional days for mop up
Number of people trained with US Government funds to deliver IRS	3,104 (female =576) 18,6%

Listed below are some lessons learned from the 2016 IRS campaign.

- Strong collaboration among AIRS Benin, NMCP, stakeholders and local authorities in the operational communes facilitated IRS operations and promoted sustainability.
- Involvement of health and political authorities in advocacy activities is often jeopardized by their competing responsibilities. It would be interesting to identify other strategies for raising awareness, particularly by approaching organizations that have expertise in this arena like PSI.
- Proper planning and deployment of vehicles are required to avoid transport issues experienced during this campaign.
- To increase coverage in urban areas, experienced mobilizers are necessary to both convince homeowners to accept IRS, and assist them in removing their belongings once they accept.

Plan supervision so as to ensure proper and fair coverage of operational areas, especially remote ones.

1. Introduction

In May 2016, Abt Associates completed its sixth round of indoor residual spraying (IRS) in Benin under the PMI AIRS Project, covering all nine communes in Northern Benin's Atacora Department. AIRS Benin's overall goal was to continue to reduce malaria transmission in Benin via indoor residual spraying (IRS) and thus contribute to the reduction of malaria-associated morbidity and mortality in the Atacora Department. The target number of structures to be sprayed was an estimated 270,141 eligible structures (equal to the number of structures found in 2015). To manage the malaria vector's resistance to insecticide, AIRS Benin continued to use organophosphates (OP), specifically pirimiphos-methyl capsule suspension (CS).

AIRS Benin completed its 2016 IRS campaign from May 3- May 27, 2016, spraying for 20 operational days. The team conducted two additional days of mop-up in Natitingou and Materi in order to increase coverage in those areas; this decision was made collectively by the National Malaria Control Program (NMCP), PMI/Benin, and the PMI AIRS Project.

AIRS Benin implemented the 2016 IRS campaign in close collaboration with PMI/Benin and several government agencies, most notably the Ministry of Health (MOH)/NMCP, the Ministry of Agriculture, Livestock and Fisheries (MAEP), the Ministry of Environment, Habitat and Urbanism, the Benin Environmental Agency (ABE), the National Directorate of Agriculture (DAGRI), the National Directorate of Hygiene (DHAB), and the Departmental Administrative Authorities in Atacora, particularly the Departmental Directorate for Health (DDS). Additionally, the Entomologic Research Center of Cotonou (CREC) continued to be a valuable IRS partner through their direct implementation of entomological monitoring activities funded by PMI.

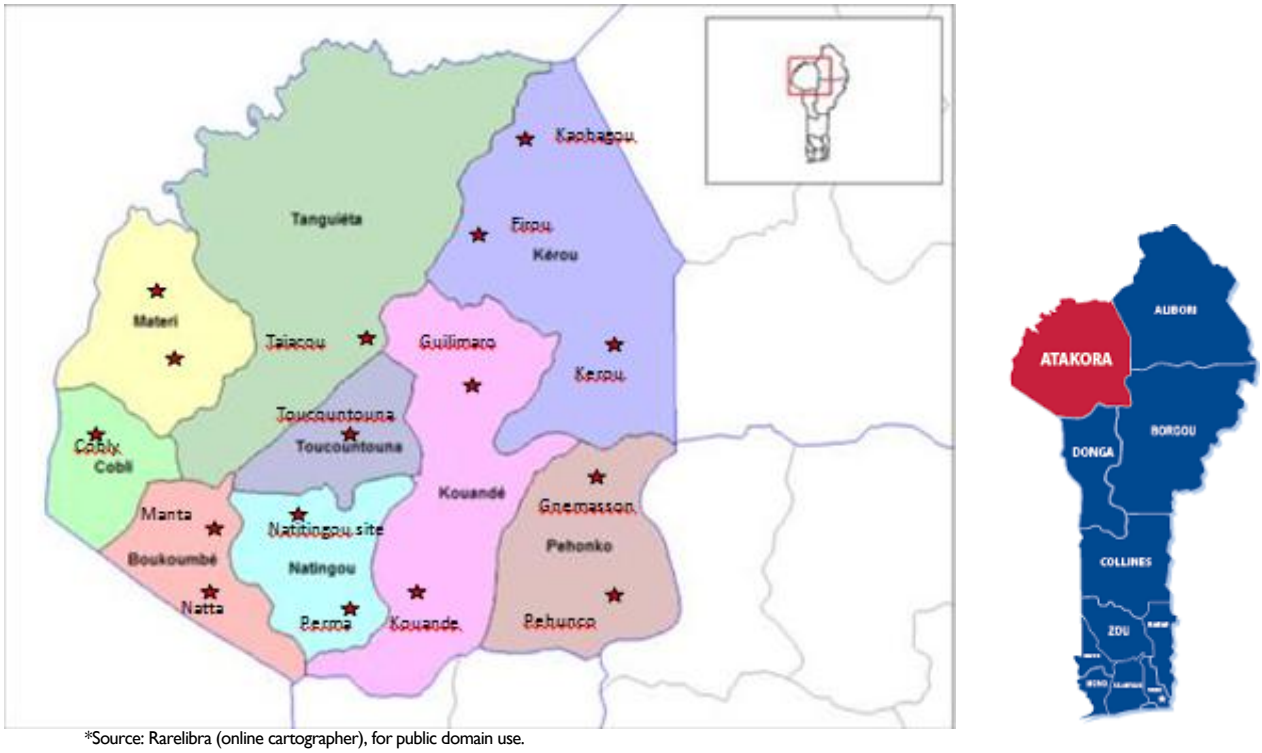
The NMCP, our main partner, was involved all main activities including: development of the operational plan, planning meetings (macro- and microplanning), recruitment of seasonal staff, environmental compliance assessment, and training of seasonal staff,

This report provides a description of the planning, implementation, and monitoring of the IRS campaign operations in 2016. The report also provides the results of the key indicators which AIRS Benin is required to report to PMI, and the preliminary entomological surveillance findings from CREC regarding the 2016 IRS campaign. The report highlights the use of mobile technology to send messages to SOPs, collect IRS data from operation sites, and environmental compliance information on daily basis.

2. Country Background

Benin is among the 17 countries that receive funding under the PMI / AIRS project. Since 2011, the PMI-funded IRS campaign has been performed in Northern Benin's Atacora Department. Please see Figure 1 to note the location of the Atacora Department and the nine communes where IRS has been performed. Figure 1 also shows the operational sites used to support the 2016 IRS campaign.

FIGURE 1: COMMUNES OF THE ATACORA DEPARTMENT OF BENIN



*Source: Rarelibra (online cartographer), for public domain use.

★ operational site

Table 2 below notes the estimated population of Atacora Department.

TABLE 2: ATACORA DEPARTMENT'S ESTIMATED POPULATION

Communes	Population from 2013 Census preliminary results*	Estimated population (**)			Area (km^2)
		2014	2015	2016	
Boukoumbé	83,147	88,279	90,928	93,611	1,081
Kérou	98,315	104,383	107,515	110,688	3,769
Cobly	68,955	73,211	75,408	77,633	827
Kouandé	112,014	118,928	122,496	126,111	3,237
Matéri ***	111,003	117,855	121,390	124,973	1,719
Natitingou	104,010	110,430	113,743	117,100	1,348
Péhunco	78,173	82,998	85,488	88,011	2,008
Tanguiéta***	73,731	78,282	80,631	83,011	5,466
Toucountouna	39,989	42,457	43,731	45,022	1,068
Total Atacora Department	769,337	816,824	841,329	866,160	20,523

(*) No final figures until now

(**) This estimate is obtained with a 3.04 % growth rate according to the 2013 Census preliminary results

(***) Only the area within Tanguiéta and Matéri Communes, which are not part of the Pendjari Biosphere Reserve, was covered by the IRS campaign in 2016.

2.1 Objectives for 2016 Spray Campaign

As stated in the 2016 AIRS Benin work plan, the three objectives of AIRS Benin for 2016 included:

1. Cover at least 85 percent of eligible structures found in all nine communes of Atacora Department.
2. Develop national and local capacity in organizing, planning, implementing, and evaluating IRS campaigns, with a goal of identifying a plan for sustainability.
3. Implement cost-efficient activities to save funds and ensure ease of management.

Given these objectives, AIRS Benin aimed to cover an estimated 270,141 structures in Atacora during the 2016 IRS campaign and protect as many of the estimated 802,597 people living there as possible.

To achieve these objectives, AIRS worked with several partners specifically NMCP, whose activities Included: 1) Validation of IRS management tools; 2) support with the planning of the IRS campaign 3)training IEC mobilizers and spray operators 4) conducting supervision during the IRS campaign, and 5) help validate data collected during the IRS campaign.

3. Preparation for the 2016 IRS Campaign

3.1 IRS Campaign Planning

Listed below are the activities that were undertaken to plan and organize the 2016 IRS campaign.

TABLE 3: IRS ACTIVITIES PLANNING

Dates	Activities	Participants or Stakeholders	Comments
October 2015-January 2016	Development of 2015 AIRS Benin Work Plan	AIRS Benin and AIRS Home Office	Meeting was held with NMCP to discuss specific points for 2016 spray campaign based on lessons learned in 2015. Guidance was provided by PMI/Benin and PMI/Washington, leading to the final approved work plan on January 29, 2016.
February-May 2016	IRS Campaign Planning	AIRS Benin, NMCP, DDS Atacora, Technical working group (Tasks Force) and other IRS stakeholders	AIRS Benin staff met regularly between February and May to review the organization and planning for the IRS campaign, and made changes as needed.
March 16-18, 2016	IRS Action Plan Development	NMCP, DDS Atacora, USAID/PMI and AIRS Benin	The Action Plan of the nine communes including Tanguieta Health Zone (led by NMCP) were finalized and validated with the NMCP and stakeholders during a workshop that took place in Porto Novo.
April 15, 2016	Sensitization of local authorities on IRS implementation/ Regional Partner Meeting	Five commune coordinators, eight operation sites coordinators, DDS Atacora staff, commune medical doctors health zone coordinators, and nine commune mayors and/or their representatives	Objectives of the meetings were as follows: Discuss roles in the IRS campaign,especially NMCP and DDS representative roles in Tanguieta health zone. Ensure all health centers throughout Atacora Department were prepared to treat any potential health issues arising from the IRS campaign. Gain the endorsment of the nine commune mayors, DDS Atacora, commune medical doctors and health zone coordinators to conduct IRS in the region. Develop the exact schedule of when communities are sprayed, and ensure that all operation facilities were in place to support the IRS operations.

NMCP coordinated and provided main oversight for operations in the Tanguiéta Health Zone, which includes the communes of Tanguiéta, Cobly and Matéri.

3.2 Improvements and new Initiatives for Efficient IRS Operations

Household Preparation

The IRS spray operation's success depends on strong household preparation. During the 2016 spray campaign, IEC mobilizers facilitated spray preparations by informing beneficiaries of the impending spray operations a week before the beginning of the spray campaign and not during the campaign as it was done in 2015. Also, before the spray date, town criers broadcasted information to all household owners of the need to remove their belongings the day of spraying to allow spray operators to quickly carry out their tasks. To track mobilization efforts and identify houses needing re-visits, mobilizers marked houses following AIRS marking guidelines and distributed new IRS card.

Household preparation was emphasized during spray operations and mobilization training. Team leader and spray operator guides were distributed to new spray workers to remind them of all guidelines before spraying (e.g. removing all moveable belongings, ensuring children and animals are kept at least ten meters away from the house during the pesticide mixing and spraying, covering all immovable furniture with a plastic sheet and gathered at the center of the room, etc.). In some areas, especially urban settings like Natitingou, the assistance of mobilizers, operators, team leaders, and coordinators was needed to persuade beneficiaries to accept IRS.

Generally, beneficiaries waited for spray operators' arrival in the village before starting to remove their belongings; in rural areas people were keener to remove their items as compared to urban settings. Sometimes spray operators forgot to remove wall hangings, therefore actions were taken to remind spray teams to do so. In such circumstances, AIRS Benin's supervision checklist was very helpful to take quick corrective actions, and to enforce spray teams' best practices.

Directly Observed Spraying

This year AIRS Benin implemented the *directly observed spraying (DOS)* approach to spray supervision. The DOS tool was used during the spray campaign by team leaders to ensure that their SOP teams used high quality spraying techniques. Each spray day, team leaders observed the spraying technique of at least one SOP under his/her responsibility inside the structure and recorded their findings. This allowed for in-situ corrective action of practices when necessary.

Daily health team leader checklist

The daily health team leader checklist was used to track SOP health status at the beginning of each spray day. The tool was filled out daily by team leaders to ensure that SOPs were in good health to perform spraying.

Daily Performance Tracking

The AIRS-Benin team explained the importance of the daily performance tracking tool to site supervisors, spray operators, and team leaders during the ToT and training of spray operators. This tool was improved by adding two indicators to summarize the main observations of directly observed spraying. At the end of each spray day, team leaders completed the sheet with nine indicators, to gauge the overall performance. The indicators recorded included: number of spray operators who worked, number of structures found, number of structures sprayed, number of insecticide bottles used, insecticide stock balance, average number of structures sprayed per unit of insecticide, average number of structures sprayed per spray operator, number of SOP supervisions completed and number of red flags / issues recorded.

Structure marking

In order to keep track of the structures visited by the spray operators, AIRS Benin taught SOPs to mark each structure with chalk according to the spraying status as follows:

- P : structure sprayed (Pulvérisé)
- NP: unsprayed structure (Non- Pulvérisé)
- X: structure to be sprayed during mop up

FIGURE 2: STRUCTURE MARKING

Marking structures with chalk was extremely helpful for mop-up operations as it was easy to erase the previous marking according to the new spraying status of the house.

Operation site coordination

Given its large area, three site coordinators were hired to manage and supervise spray operations in Kounadé. This position had similar tasks as the commune coordinator but a smaller geographical area to manage and supervise. AIRS Benin maintained five site coordinators in the Natitingou Health Zone as in 2015.

Expanded mHealth Use

In 2016, AIRS Benin used mobile health (mHealth) initiatives throughout all nine communes of Atacora to improve spray operations. The team implemented the following:

- *Performance Management Tracker (PMT):* A dashboard was developed to allow the M & E team to display the following on the same screen in figures and graphics: spray progression, SOP performance and insecticide use on a daily basis for each operational site (commune). The dashboard has the ability to analyze data for different variables.

- *Mobile-based supervisory forms (new in 2016):* Mobile-based supervisory forms were used by government and project supervisors. User-friendly reports summarizing daily observations were automatically transmitted to supervisors for prompt decision-making. This was the first year that AIRS Benin used the Dimagi CommCare platform for this initiative.
- *Automated Data Collection Verification (DCV (new in 2016)):* For the first time, AIRS Benin used a digitized Data Collection Verification (DCV) tool to identify data inconsistencies in real time. Anomalies found were compiled during the evening meetings for the preparation of feedback messages for corrective actions by spray teams. The DCV was housed in the same CommCare platform as the supervisory forms.
- *Daily SOP job aids:* AIRS Benin sent out daily messages to spray operators, supervisors, and team leaders in the nine communes of Atacora department. These messages reminded key seasonal staff of issues found during supervision throughout the campaign. Local supervisors and site coordinators analyzed the observed anomalies to provide guidance for corrective measures during the morning debriefing / mobilization. Supervisions of following days included a follow up on the compliance with the instructions provided.

3.3 Insecticide Selection

Following entomological surveillance from 2014 and 2015, CREC reported high susceptibility of malaria vectors to pirimiphos-methyl (insecticide of organophosphate class). This insecticide was therefore selected once again for the 2016 IRS campaign. NMCP complied with CREC's recommendation during the workshop on the future of IRS in October 2015 and approved blanket spraying in Atacora Department with pirimiphos methyl CS for the 2016 IRS campaign.

3.4 Logistics Planning and Procurement

3.4.1 PPE and Insecticide Procurement for the 2016 IRS Campaign

In February 2016, AIRS Benin reviewed its IRS equipment inventory list at the central warehouse in Natitingou. Most of the PPE and spray pumps used during the 2015 IRS campaign were in an acceptable condition and were available for use during the 2016 IRS campaign. AIRS Benin noted the quantities of damaged or non-reusable PPE and developed a list of PPE to procure locally and internationally. A full list of PPE procured for the 2016 IRS campaign is included in Table 21 (Annex A).

The inventory count revealed that 12,815 bottles of pirimiphos-methyl CS were in stock and usable for the 2016 IRS campaign. AIRS Benin noted that it needed a total of 54,028 bottles of insecticide. The project procured an additional 41,220 bottles of pirimiphos-methyl CS to cover the nine communes in Atacora. The organophosphate shipment arrived in Benin on March 25, 2016.

AIRS Benin also received quality control test results via CEMAS laboratories (see Annex B) for the batches of organophosphates shipped to Benin, which reported that all batches were of good quality and ready for use during this campaign.

3.4.2 Planning the Logistics and Transportation for the 2016 IRS Campaign

In March 2016, AIRS Benin worked with the NMCP and DDS Atacora to plan the logistics and transportation to implement the 2016 IRS campaign. Several field visits were conducted with NMCP and DDS Atacora staff to meet local authorities, to identify transportation routes, and note areas with difficult roads. These field visits led to detailed transportation plans that allowed AIRS Benin to note the length of time it would take to send re-supply trucks from the central warehouse in Natitingou to the operation sites, and to note how long it would take spray operators to reach various communities.

3.4.3 Distribution of PPE to Operation Sites

AIRS Benin started distributing PPE and insecticide to all operation sites, two weeks before the IRS campaign began (April 18-23).

Table 4 summarizes the distribution of key PPE items to each of the operation sites.

TABLE 4: DISTRIBUTION OF KEY PPE TO OPERATION SITES

Operation Sites	Overalls	Boots	Helmets	Pumps	
				X Pert	Goizper
Natitingou*	170	83	83		61
Perma**	142	79	67		52
Toucountouna	130	73	66		51
Nata	154	83	78	59	
Manta	140	79	70	55	
Taiacou	135	105	68	53	
Matéri	245	125	125	93	
Dassari	177	92	93	66	
Cobly	219	112	110		84
Kouandé	171	102	87		67
Guilimaro	163	86	86	63	
Ouassa Pehunco	296	144	142	106	
Gnemasson	92	48	47	37	
Firou	101	52	52	41	
Kérou	277	140	140	104	
Kaobagou	27	16	13	14	
Total	**2,639**	**1,419**	**1,327**	**691**	**315**

* The Central Warehouse in Natitingou also served as an operation site during the campaign for the communities near Natitingou.

** Even though Birni is within Kouandé Commune, its equipment was put in the Perma operation site store room, which is closer to Birni (about 15km by road).

3.5 Human Resources

3.5.1 Recruitment of IRS Campaign Seasonal Staff

IRS campaign supervisors and hygiene staff were selected by DDS Atacora.

Spray operators, team leaders, pump technicians, and washers were recruited in each intervention area by the local health department using criteria provided by AIRS Benin, in collaboration with the NMCP. Spray operator criteria included: literacy, ability to carry a spray pump for at least 6 hours per day, and good health condition for work as certified by a medical check. Additionally, all spray operators were required to be an individual known in their communities, and to have had working experience in community health activities. During recruitment, gender balance was considered and great effort was made to recruit more women. Priority was given to spray operators who had performed well during the 2015 IRS campaign.

3.5.2 Number of Seasonal Staff Hired

AIRS Benin hired 2,835 seasonal staff to implement the 2016 IRS campaign, which included 2,292 men (80.8%) and 543 women (19.2%). Table 5 provides a breakdown of the number of seasonal staff hired per category.

TABLE 5: SEASONAL STAFF HIRED FOR THE 2016 IRS CAMPAIGN PER CATEGORY

Seasonal Staff	Total Seasonal Staff Hired	Male	Female	Proportion of Women
Service technicians	66	58	8	12.1%
Washers	65	0	65	100.0%
Storekeepers	17	15	2	11.8%
Data clerks	41	21	20	48.8%
Commune coordinators	13	11	2	15.4%
Team leaders	162	134	28	17.3%
Spray operators	966	840	126	13.0%
Finance Assistant	3	2	1	33.3%
Supervisors (Community Agents)	83	62	21	25.3%
IEC Mobilizers	1,387	1,117	270	19.5%
Logistic Assistant	2	2	0	0.0%
Guards	30	30	0	0.0%
Total number and Proportion of women hired for the IRS campaign	**2,835**	**2,292**	**543**	**19.2%**

IRS Benin worked to increase the overall participation of women in the IRS campaign. In 2016, 543 women were hired (19.2%) compared to 459 hired in 2015 (15.4%). This increase in number is a result of the advocacy to break social stereotypes about women's abilities to contribute to IRS and to create more welcoming and inclusive sites for women.

3.6 TRAINING

AIRS Benin organized twelve trainings for all the IRS campaign's seasonal staff to ensure that everyone was aware of their roles during the IRS campaign. Additionally, the training sessions covered the precautionary measures to be taken when working with insecticides and provided guidance in case of an inadvertent accident or inappropriate use of insecticide. All trainings emphasized the contribution of the staff's work in preventing malaria transmission, and recalled the harassment prohibition policy.

Training sessions were conducted by AIRS Benin staff, and government counterparts, including staff from NMCP, DDS, DHAB, and Departmental Directorate for the Environment Habitat and Urbanism (DDEHU). Staff from CREC and local firefighter units also helped in leading some training sessions.

AIRS Benin completed a five-day workshop to develop the IRS campaign plans for the NMCP and to build their capacity. This was especially important for them to lead the spray campaign in Tanguieta Health Zone. The workshop, which included all IRS components, was geared towards the IRS focal points identified by the MOH from NMCP national and departmental staff (DDS Atacora-Donga and Tanguiéta Health Zone).

TOT was completed two weeks before the IRS campaign for all commune coordinators and hygiene staff (assigned as IRS supervisors) to enable them to lead the training of spray operators at each operation site. In total, 3,104 people – of whom 2,493 (80.3%) were men and 611 were women (19.7%) – attended trainings. Government and health center staff attended several trainings and acted as partners in supporting the IRS campaign on issues including understanding intoxication treatment, IEC messaging, etc.

IEC mobilizers were trained in each sub-commune for pre campaign mobilization. Only spray operators and team leaders who received a high score on the post-training test were hired. Table 6 also shows the number of people trained by institution and category.

TABLE 6: NUMBER OF PEOPLE TRAINED BY INSTITUTION AND CATEGORY

Categories of Institutions/ Individual Trained	Number of People Trained for 2016 IRS Campaign	
	M	F
DDS	1	
NMCP regional	1	
DDEHU	1	
Government commune coordinators	3	
Commune chief doctors/other doctors	5	4
Chiefs of health post/midwife	44	25
Hygiene staff	15	6
Commune coordinators (not government)	5	3
Others Hygiene agents	69	18
Spray operators	994	163
Data clerks	19	18
Storekeepers	15	2
Logistics assistants	2	
Service technicians	61	8
IEC agents	1125	299

Categories of Institutions/ Individual Trained	Number of People Trained for 2016 IRS Campaign	
	M	F
Washers		65
Drivers	117	
Guards	16	
TOTAL M/F	**2493**	**611**
TOTAL/ trainings		**3 104**

3.6.1 Brief Description of Training Activities

Training of Trainers (ToT)

During this training, hygiene staff, commune and operation site coordinators were trained on spray methods, filling data collection forms, and providing IEC to IRS beneficiaries on how to prepare their structures before and after the IRS operation. The participants were also trained on gender integration and sexual harassment awareness.

The hygiene staff and commune coordinators, in turn, trained spray operators in the 16 sub communes the week before the IRS campaign (the 17th site is considered part of Natitingou and not part of a sub-commune).

Spray Operator Training

All spray operators traveled to their assigned training venues, where they received five-day training on all aspects of IRS. Special emphasis was placed on the project's gender approach and sexual harassment during these trainings to allow participants to better understand these concepts and shed light on women perceptions about IRS-relaed jobs. The trainings included a day and half in the classroom regarding spray techniques, gaining familiarity with PPE and protocol for conducting spray operations, three and a half days for practicing the spray technique using water on the walls in training sites and the use of CFVs.

In addition, the training focused on the new quality insurance approaches in Benin: mhealth system, spray quality verification and daily health checklist. For all spray operator training sessions, a pre-test and post-test was administered. Spray operators who scored the highest on the post-test were selected to become the team leaders for each spray team. Spray operators also learned procedures for mixing the insecticide and cleaning their bottles, as well as precautions for spraying with organophosphate insecticides. SOPs of the nine communes of Atacora were trained to read SMS reminders and react accordingly.

Team Leader Training

This one-day training emphasized the role of team leaders during the spray campaign. A draft of the AIRS-developed Team Leader Training curriculum was used though the curriculum was still not final at the time of the training. New team leader tools (e.g. DOS form and daily health checks) were reviewed and practical exercises done.

Data Capture Training

Data clerks were trained on IRS data entry forms and the database used for uploading all IRS campaign data in a one-day training. Data clerks also practiced entering data at the AIRS Benin data entry center in Natitingou.

Logistics Training

During two days (April 15 and 16, 2016), logistics assistants and storekeepers were trained on commodities management, the value of completing and updating stock cards, the appropriate protocol for storing PPE and insecticide, and filling out the performance tracking sheet. Additional training was provided for storekeepers on how to store the full and empty insecticide bottles. The storekeepers were also trained on how to send the daily IRS data to the CommCare platform. This training focused on the SMS network system and the five key IRS variables to be captured.

Spray Pump Maintenance Training

Pump technicians learned to maintain and repair the different components of spray equipment. The three days of training (April 26 to 28) also covered progressive rinsing and calibration of the spray pumps to be able to assist SOPs at the end of each IRS campaign day.

Washer Training

On May 02, 2016, washers were trained on personal and environmental precaution measures when handling contaminated PPE.

FIGURE 3: TRAINING OF WASHERS IN NATITINGOU ON MAY 2, 2016

Fire Security Training

The Natitingou fire brigade trained IRS campaign drivers, storekeepers, and guards on fire risks and first aid on May 02, 2016. One hundred and forty eight seasonal workers who attended this training learned to distinguish different types of fire extinguishers, how to effectively use them, and how to move injured persons from vehicles in case of fire or traffic accident.

FIGURE 4: NATITINGOU FIRE BRIGADE LEADS TRAINING ON FIRST RESPONSE TECHNIQUES IN CASE OF ACCIDENT

Transport Security Training

Drivers participated in transport security training. Drivers and seasonal logistics staff learned appropriate methods to secure and safely handle insecticides. Participants also learned how to manage an insecticide spill and to prevent traffic accidents.

Training on management of side effects caused from exposure to insecticides

Medical and health personnel from the nine communes of Atacora Department were trained on how to manage potential side effects from contact with insecticides, particularly those pertaining to organophosphates class. The course focused on the mechanism of inhibition of acetyl cholinesterase, physiological implications of this inhibition, clinical diagnosis of side effects, and case management of poisoning, including symptoms and antidotal treatment. The training was led by the Head of Toxicology Department of the Medical School of Cotonou.

4. Advocacy/IEC Activities

Before and during the IRS campaign, IEC activities focused on IRS roles in malaria prevention. With participants, AIRS Benin and NMCP shared vector control strategies and benefits for the prevention of malaria, especially through IRS. Different stakeholders at the community level were involved in IEC activities, namely local leaders, town criers, community health workers, and religious and women association leaders. Many other channels of mass communication were used: local radios, town criers, flyers, and door to door communication.

Local radios aired various malaria prevention messages and spots. All communication activities and key messages were discussed and planned with the NMCP IEC focal point and were reviewed and approved by the Departmental Service of Public Health.

In March 2016, AIRS Benin reviewed IEC materials from the previous year's IRS campaigns and adjusted IRS training manuals. The IEC materials included leaflets distributed to inhabitants living in the targeted structures. Messages from local radios and town criers included information on IRS and insecticide used in this campaign (organophosphates).

Several training sessions were held before launching the IEC activities including:

- Guidance to local radio managers
- Training of trainers
- Training of IEC professionals

4.1 Description of Advocacy / IEC Activities

Advocacy Activities and Community Mobilization

The week before the IRS campaign, staff from the DDS (Departmental NMCP staff) and AIRS Benin had a workshop with local leaders, religious authorities, health zone coordinators and IRS site coordinators. The workshop was led by the prefect who presided over the launch together with the departmental health director. Workshop participants went over the IRS campaign schedule and reinforced the benefits of IRS for malaria prevention. In turn, commune administrators and AIRS Benin staff ensured that beneficiaries were informed and ready for the IRS campaign. Additionally, several meetings were held with community leaders, particularly the heads of villages and public criers to provide details on the organization of the IRS campaign and the benefits of this intervention in malaria prevention.

In total, 1174 community leaders, particularly chiefs of village and public criers, participated in IEC activities.

Mobilization

Door-to-door mobilization and IRS card distribution were carried out the week before IRS campaign. In 2016, mass mobilization was combined with IRS operations in each site. This mass mobilization was led by site coordinators under the supervision of IEC focal point. They met the head of villages and town criers one or two days before the passage of operators in their localities. Town criers reminded beneficiaries of best practices, especially house preparation during IRS operations.

1,387 IEC agents participated in the 2016 IRS campaign. All received two-day training in April that focused on messaging and effective communication techniques, structure marking and the filling of

mobilization data collection cards and the IRS card. 81 trainers participated in the IEC TOT. IEC mobilizers mobilized all Atacora villages in the three days prior to the start of the spray campaign. This year, household awareness was not done during the campaign but rather three days before the campaign which proved to be a better strategy despite the fact that mobilization was still not perfect this year Household members who were home when IEC agents came to their house were provided leaflets related to the IRS campaign. Leaflets informed them of what to do before, during and after the spraying, and what to do with their IRS card. They were also sensitized on malaria preventive measures.

Town Criers

AIRS Benin worked with 1,174 town criers and heads of villages to announce the IRS schedule, house preparation and best practices before and after the spraying.

Radio Broadcasts

Six community radio stations in Atacora were contracted to cover the IRS campaign. Activities included the broadcast of messages in French and in local languages covering the following contents:

- Dissemination of IRS operations schedules in each location
- Talk shows, roundtables and radio plays
- Regular spots on malaria preventive measures
- Best practices during IRS operations, etc.

Additionally, AIRS Benin staff, commune and department officials participated in call-in shows and on-air presentations on IRS. Local radio stations also covered the IRS campaign launch and closing ceremonies.

Their contract covered the period from April 16 to July 9, 2016. Six weeks after the IRS campaign, radios continue to sensitize communities on malaria prevention aspects.

4.2 Results of IEC Activities

Nearly all household owners (99,55 %) sensitized by the IEC mobilizers accepted IRS in this year's campaign. The main reason presented by the few refusal cases was the "bad smell" of the insecticide experienced in the previous campaigns (2014 and 2015). Other IEC sensitization failings included the absence of household owners during IEC visits, schedule conflicts with cultural ceremonies, etc.

TABLE 7: OVERVIEW OF MOBILIZATION RESULTS[2]

Commune	Total Households (eligible structures)	Total Households Mobilized	Proportion of Households Mobilized	Population Sensitized			Total Households Accepting IRS	Proportion of Households Accepting IRS	Number of Leaflets Distributed
				Men Sensitized	Women Sensitized	Total Population Sensitized			
Boukoumbé	13,611	13,492	99.13%	26,931	29,980	56,911	13,432	99.56%	13,190
Cobly	10,278	10,263	99.85%	20,085	23,159	43,244	10,261	99.98%	10,213
Kérou	8,328	8,247	99.03%	21,310	23,159	44,469	8,152	98.85%	8,483
Kouandé	10,528	10,507	99.80%	26,883	30,174	57,057	10,485	99.79%	10,965
Matéri	13,689	13,635	99.61%	41,657	43,604	85,261	13,628	99.95%	15,265
Natitingou	12,843	12,747	99.25%	23,294	26,617	49,911	12,574	98.64%	12,521
Péhunco	7,639	7,626	99.83%	24,408	26,546	50,954	7,596	99.61%	7,673
Tanguiéta	7,158	7,156	99.97%	14,309	15,984	30,293	7,146	99.86%	7,083
Toucountouna	4,365	4,355	99.77%	7,175	8,763	15,938	4,355	100.00%	4,311
Total	**88,439**	**88,028**	**99.54%**	**206,052**	**227,986**	**434,038**	**87,629**	**99.55%**	**89,704**

[2]AIRS Benin entered mobilization data only by total line per mobilization form; mobilization data was not double-entered. Households consist of multiple structures.

TABLE 8: IEC ACTIVITIES CONDUCTED BY RADIO STATIONS (APRIL 16 TO JUNE 25, 2016)

Activities	Number of Broadcasts
Disseminating short radio spots and messages (French and national languages)	2324
IRS schedule announcements/invitations for local leaders to attend IRS planning meetings (French and national languages)	542
Debates and discussion shows	53
IRS campaign information covered in local news stories	32
Animation radio games	17
Reports	6

4.2.1 Rapid Assessments of IEC Activities

This year the team in charge of IEC activities was not able to conduct a survey to measure the exposure of populations to different communication channels. However, given the number of refusal cases in large cities like Natitingou, meetings were initiated with heads of villages and chiefs of commune who helped alleviate this problem.

5. Implementation of IRS Campaign Activities

5.1 Spray Campaign Launching Ceremony

The 2016 IRS launch ceremony took place in Boukoumbé on May 6th. During this event, speeches were given by various officials, including the PMI/Benin Resident Advisor who highlighted the continued partnership between the United States Government and the Government of Benin to prevent and control malaria. The Director of the health department of Atacora-Donga stressed the full commitment of his team to learn and participate in the campaign notably in the health zone of Tanguiéta. The General Secretary of the Minister of Health who represented the Minister gave a speech noting the engagement of local authorities and government to contribute in the success of the IRS operation. He emphasized the efforts of the Beninese Government in addressing malaria burden in the country.

Other attendees of the launch ceremony included staff from the NMCP; DDS staff members, mayors from various communes, staff from commune health centers, and various community and religious leaders.

The official launch of the spray campaign was done in two houses in these areas. Two heads of households accepted the operation and their structures were sprayed by the SOP in the presence of these authorities.

5.2 Short-term Technical Assistance

Two STTAs occurred during 2016 spray campaign. The first was by the M&E Manager from AIRS Madagascar and the second, by the Technical Program Manager from the Home office (Bethesda, MD - USA).

The mission carried out by the M&E Manager from Madagascar took place from April 27 to May12, 2016 and aimed to:

- Assist AIRS-Benin team in the implementation of monitoring and evaluation system as the country has a new M&E manager
- Support the AIRS-Benin team in the smooth running of the mHealth system using CommCare platform of Dimagi
- Support AIRS-Benin M&E team in the analysis of IRS data
- Participate in the supervisions of the IRS operations

The STTA of the PMI AIRS Benin Technical Program Manager took place from May 8-16, 2016. The purpose of this SSTA was to support the country team in the implementation and supervision of spray campaign.

These two STTAs provided valuables insights for the smooth operation of the IRS campaign. Recommendations provided during the debriefing sessions allowed AIRS Benin team to improve the quality of the IRS campaign.

5.3 Spray Operations

The 2016 IRS campaign was implemented from May 03 to 25, 2016. Due to the low coverage in the communes of Natitingou and Matéri, two more days were added in the attempt to increase their coverage rates. Each week, spray teams were deployed Monday through Saturday during the campaign while Sundays were reserved for a weekly review meeting with site coordinators and to repair spray equipment. The 966 spray operators were divided into 162 spray teams. Each was composed of five to six spray operators and supervised by a team leader. The number of spray teams per commune was determined by the estimated number of targeted eligible structures found in each commune using 2015 IRS campaign data as reference.

TABLE 9: DISTRIBUTION OF SPRAY TEAMS BY COMMUNE

Communes	No. of spray teams	No. of eligible structures found by spray operators in 2015
Matéri	25	41,474
Natitingou	18	29,385
Kouandé	26	44,275
Boukoumbé	17	29,090
Péhunco	22	37,137
Kérou	25	40,328
Tanguiéta	8	13,490
Cobly	13	22,044
Toucountouna	8	12,918
Total	**162**	**270,141**

5.4 IRS Spray Campaign Supervision

5.4.1 IRS Campaign Supervision by AIRS Benin Staff

AIRS Benin staff, including the Chief of Party, Operations Manager, ECO, Logistics Coordinator, and M&E Manager moved to Natitingou during the IRS campaign. Every day, following the supervision plan, AIRS Benin technical staff, and counterparts from NMCP and USAID/PMI Benin traveled to the field to provide supportive supervision to seasonal staff to ensure that the IRS campaign activities were performed appropriately. Supervision activities included, but were not limited to:

- Observe spray operator performance: house preparation, spraying practices, house marking, filling forms and compliance to other instructions;
- Evaluate the support provided to SOPs by team leaders and the proper filling of forms and checklists;
- Evaluate the performance of storekeepers in the management of commodities and products;
- Assess the compliance to instructions regarding the handling of insecticide and other contaminated equipment, including PPE
- Address concerns raised by the beneficiaries, seasonal staff, and other individuals involved in IRS operations;

- Check the performance of each spray operator team using the daily performance tracking sheet;
- Ensure that IRS operations in sites managed by the NMCP, namely Tanguiéta, Cobly and Matéri, are performed appropriately

The AIRS Benin team and NMCP followed field activities and daily spray progress closely using daily updates that the commune and operation site coordinators sent via SMS platform to the AIRS Benin technical staff. These messages noted the estimated number of structures sprayed each day (based on the coordinator's review of the spray cards turned in daily) and any issues that arose in the field. This reporting allowed the AIRS Benin team to track its progress against the IRS schedule, and to identify any campaign issues that needed quick resolution from the team.

In addition to the daily SMS report generated by CommCare platform, the 17 storekeepers sent indicators from the Performance Tracking Sheet by SMS to the platform located in Natitingou. Every day around 7 p.m. a debriefing and coordination meeting was organized by the AIRS Benin team and IRS campaign supervisors from the national, departmental NMCP and DDS staff. The meetings provided a forum for AIRS Benin and their government counterparts to update each other on IRS campaign progress, discuss various issues/adjustments that needed to be addressed and resolved the following day, and determine what new daily reminders would be sent out in the nine communes.

5.4.2 IRS Campaign Supervision by Beninese Government Staff

Approximately 50 government staff from national, departmental, commune and environmental ministry provided supervision of spray operations in the field during the 2016 IRS campaign. Since 2015, NMCP led the spray campaign in the three communes of Tanguiéta Health Zone including operations, IEC activities, logistic management, and M&E activities. This was an increase in NMCP's involvement in the IRS campaign, since they had only led spray activities in one commune in 2014. Finally, the daily debriefing meetings were chaired alternately by the NMCP and AIRS Benin during the 2016 IRS campaign. Table 10 provides a breakdown of the supervision activities performed by government staff during the 2016 IRS campaign.

TABLE 10: BREAKDOWN OF SUPERVISION BY BENINESE GOVERNMENT AGENCIES

Government Level	Office	Number of People	Supervised Activities
National	NMCP	6	IEC and mobilization activities, environmental compliance (pre-spray, and post-spray inspection), spray operations, M&E and data collection, IRS trainings
	DHAB	1	Spray Operations, IEC ativities.
	DAGRI	1	Environmental compliance (pre-spray and inspection)
	ABE	1	Environmental compliance (pre-spray inspection)
Departmental	NMCP-Atacora	2	IEC and mobilization, environmental compliance, spray operations, M&E, trainings
	DDEGCC	2	Environmental compliance (pre-spray, mid-spray, and post-spray inspection), spray operations
	DDS	1	Spray operations, IEC mass mobilization, M&E, IRS trainings
	Public Health Service	1	IEC and mobilization, spray operation, M&E, IRS trainings
	Community Hygiene and Sanitation Coordination (SHAB)	2	IEC and mobilization, environmental compliance (pre-spray, mid-spray, and post-spray inspection), spray operation, IRS trainings

Government Level	Office	Number of People	Supervised Activities
Commune	Health Zone Coordinator	3	IRS training, mass mobilization, spray operations, M&E
	Commune Chief Doctors	9	IRS training ,mass mobiliztion, environmental compliance, spray operations, M&E
	Hygiene staff from Commune Health Centers	21	Spray operations, quality of the spraying, environmental compliance by spray operators and washers, IEC during campaign, data control.

5.5 Stock Management During the IRS Campaign

AIRS Benin used inventory control cards (ICC) to keep track of each item in the central warehouse and operation sites. Storekeepers updated the ICC daily regarding the movement of stock from each store room. Storekeepers were also required to conduct daily routine physical stock counts to ensure that the actual stock in store rooms matched the ICC record.

At the beginning of each IRS campaign day, insecticide bottles were issued only to team leaders, who documented the number of bottles that they received. Thereafter, the storekeeper immediately entered the amount provided to the team leaders on the ICC to ensure accurate stock balances. At the end of each IRS campaign day, spray operators turned in their stock of bottles (used and unused) to the team leader, who collated these and submitted them to a storekeeper. The storekeeper recorded the full bottles on the ICC as a positive adjustment, updated the stock balance, and registered the used bottles on a daily utilization record form. The data on this form helped AIRS Benin calculate trends in use of insecticide. To validate the insecticide inventory, storekeepers worked with AIRS Benin logistics staff to compare the ICC for the unused insecticide bottles with the daily utilization records. This comparison also allowed the AIRS Benin team to note if spray operators were using too little or too much insecticide during their spraying and if various operation sites needed more insecticide.

With respect to PPE, every morning team leaders and storekeepers would organize, distribute, and sign out all PPE to be used for the spray operations. The warehouse managers also organized and distributed all PPE to the washers and other IRS staff as needed. At the end of each day, all PPE was turned over to the washers for cleaning. After the PPE was washed, the washers turned the PPE over to the storekeepers and team leaders who completed another inventory to ensure that all the equipment was returned.

Additionally, the storekeepers prepared a comprehensive weekly stock report and submitted it to the AIRS Benin Logistics Manager, who then generated aggregated total stock balances for the IRS campaign and noted where PPE and insecticide needed to be sent from the central warehouse to prevent stock-outs.

Every day, the store keepers sent the amount of insecticide used and remaining insecticide balance to the mHealth platform through SMS.

5.6 Issues Encountered and Addressed During the 2016 IRS Campaign

Listed below are some of the issues encountered during the 2016 IRS campaign:

Operations

- Planning for the use of vehicles

  The reduction of vehicles planned for mop up posed problem in some places since this period was not adequately estimated. This reduction should be flexible and take into account spray progress in each site/village

- Weak involvement of local authorities during implementation

  Despite strong commitment to involve local authorities in the preparation and implementation of IRS activities, they didn't assist with mobilization, intervening in cases of refusal, accompanying IRS teams to find remote villages / hamlets, etc. We will conduct a meeting with them to understand the reasons for their behavior as we prepare for the next campaign.

- House closures contributed to slow progress

  Some events slowed the progress of IRS campaign as houses were found closed, including: traditional worship, market days, and funeral services. As a corrective measure, information on the organization of these types of events was collected in advance to adjust spraying schedules accordingly.

- Recruitment criteria for SOP

  The recruitment of seasonal staff is an area of collaboration with local government. Some violations of the recruitment criteria were reported, especially regarding the geographical origin of staff : some came from outside of Atacora while all staff was supposed to have been recruited locally. AIRS Benin will be involved in all seasonal worker recruitment to ensure compliance with the recruitment criteria in future campaigns.

- Accessibility to some villages

  Some villages are hardly accessible by roadway. Spray operators had to walk long distances by foot which required significant effort and time. During the intervention, hard-to-reach villages were treated first while operators still had energy.

- Inconsistency in structure marking and in compliance with instructions received during training

  Some SOPs frequently forgot to mark the structures according to the AIRS marking guidelines. SMS reminders were sent to SOPs and team leaders for corrective measures, and refresher trainings were done in morning meetings.

- More IRS refusal cases in urban settings

  Reasons given for IRS refusal were mainly the bad smell of organophosphate insecticides, heavy household effects, use of other means of mosquito control, etc. Also, in some communes, household owners refused that structures storing part of their harvest be sprayed even though people slept in them, and steps were being taken to remove or adequately cover the harvest.

M&E

- CommCare Platform updates on smartphones and poorly translated questions

  This required making manual updates to the "CommCare" application by moving in all sites.

- Limited experience in the use of smartphones by some supervisors for data collection

  This meant that some supervisors did not manage to properly complete forms.

- Difficulty replicating training by trainers of the health system and monitoring of mobilizers

  AIRS Benin team will take steps to fix this situation in future campaigns.

IEC

- Mobilization approach

  The mobilization organized before the campaign does not offer guarantees on the acceptance of IRS since the population changes their mind by mere rumor. Corrective measures for this campaign included increasing radio spots and talk shows, advocacy for more commitment of political and administrative authorities. For the next campaigns, mobilization will also be done during the campaign.

- Poor distribution of IRS cards

  This problem is partly related to training where the concept of household and structure are sometimes misunderstood.

EC

- Incidents:

  - *A traffic accident*

    On May 7, 2016 the Guilmaro IRS team had just ended a successful work day and was going back to Guilmaro operation site when the driver, who was driving too fast, missed the turn between Kouarfa and Yarikou villages. The vehicle then flipped onto its back and caused injuries to thirteen spray operators. Intensive care was provided to the injured persons by a physician and a senior nurse of Kouandé Health Zone Hospital. After 24 hours, 12 of the 13 injured persons were doing well and released by the physician; the thirteenth person was released the day after.

    The project's health insurance for seasonal staff took care of health bills. To avoid accidents during further IRS campaigns, AIRS Benin will insist more on safe driving practices during drivers' training and recommend all seasonal workers to follow AIRS Benin instructions on security.

  - *An attempted insecticide theft, and an insecticide spill.*

    All these incidents were reported to PMI's COR Team. SOPs involved in the incidents reported no major harm, and the insecticide spill was adequately managed in accordance to standards. Close supervision helped to thwart an attempted insecticide theft. In line with our zero tolerance policy, the seasonal staff concerned was fired from the campaign.

  - *Pump dysfunction*

    Red flags of leaks from pumps were reported by team leaders. This was fixed daily by spray pumps technicians, and TLs received the instruction to carry additional spray pumps when departing to the field. Benin uses both Hudson and the older Giozper model, which now needs to be renewed.

- *Data falsification attempt*

  Recommendation via SMS and daily refreshers were done in each spray site for all spray operators to accurately fill data collection forms on structures found and sprayed. Random checks and Data Collection Verification were done by supervision teams to assess the accuracy of coverage and use findings to organize feedback messages for corrective actions.

- Finance Seasonal workers lists were sent late to Finance department.

  This problem often delayed payment or forced to proceed to partial payments. This has had repercussions on the collection of supporting documents. The delay in obtaining liquidity in some microfinance facilities has further exacerbated this situation. The possibility of using mobile banking will be explored ahead of time for future campaigns. An attempt was made this year but the process started too late to be completed before the start of the campaign.

6. ENTOMOLOGY

This section provides a brief explanation of entomological surveillance that was completed before and during the IRS campaign. To complete entomological surveillance for the 2016 IRS campaign, CREC was contracted directly by PMI/Benin.

The data were collected at three sentinel sites all sprayed with pirimiphos-methyl CS: Natitingou, Tanguiéta and Toucountouna. In each commune, two villages were selected (one in central area and the next in peripheral area). Bioassays were performed in Tanguiéta and Natitingou, and insecticide concentration was tested in Natitingou and Toucountouna. Below are the selected villages for bioassay cone test:

- Tanguieta Commune: Taïacou and Finta
- Natitingou Commune: Perporiyakou and Bérécingou
- Toucountouna Commune: Boribanfifa and Testibayaou

6.1 MATERIAL AND METHODS

6.1.1 MOSQUITOES AND MATERIAL TESTED

Because of the scarcity of the local strain of *Anopheles gambiae* larvae at the end of dry season, only the susceptible colony from laboratory (*Anopheles gambiae s.s,* Kisumu strain) was tested for bioassay cone tests for T_0. Various treated walls (walls made with cement, and mud) were bio assayed. Bioassays were performed a week after the beginning of the IRS campaign in accordance with WHO procedures (WHO, 2006).

6.1.2 BIOASSAYS PROTOCOL

Bioassays were done according to the WHO procedures for test cones. Cones were placed on the treated walls. About 10 females of *An. gambiae s.s.* Kisumu strain were introduced per cone and exposed for 30 minutes. For each house, the cones were put at 4 locations: 0.5 m, 1 m, 1.5 m and 2 m. During the tests, the temperature and the relative humidity of exposure and holding periods were registered. The number of mosquitoes knocked down after 30 min and dead at the end of 24 hours holding period were registered. The number of the houses and GPS coordinates was registered.

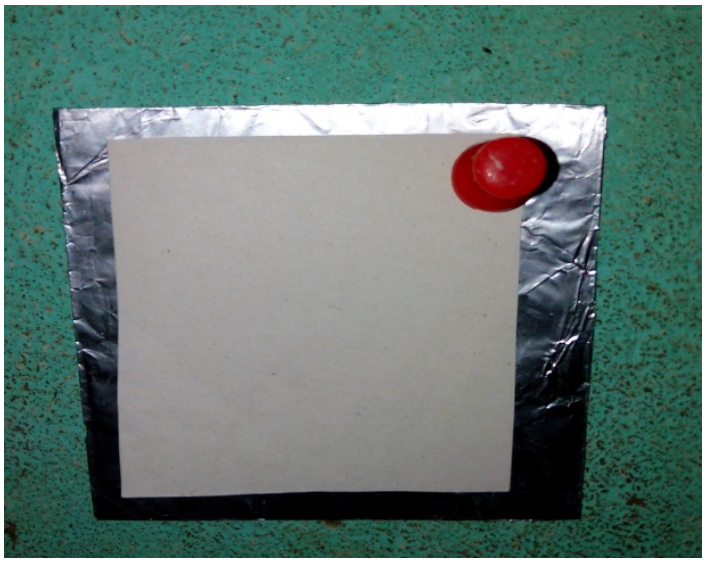
6.1.3 pH MEASURE

Two days before spraying, about 5g of substratum of the walls internal surface were deducted. The deduction aims to measure the wall pH so as to see a possible impact of the pH on insecticide half-life on the substratum.

6.1.4 QUANTIFICATION OF INSECTICIDE ACTIVE MATERIAL PER SURFACE UNIT

Before spraying, walls were labelled with Whatman papers (5 X 5 cm^2) at different location: 0.5m; 1m; 1,5m; 2m. 24hours post spray operation, the labels were picked up. A quantification of active material of insecticide applied on labels will be done later following WHO protocol (WHO, 2006).

FIGURE 6: LABELLING WALL IN OURBOUGA SITE, NATITINGOU COMMUNE



6.2 RESULTS

In total, 987 *An. gambiae* s.s. Kisumu strain were bioassayed on treated wall among which 463 *An. gambiae* were found in Tanguieta and 524 in Natitingou. During the tests, the number of mosquitoes knocked down after 30 min and dead after 24 hours were recorded (table I and II). After 24h, all mosquitoes exposed on cement walls died (100% of mortality) in Natitingou as well as in Tanguiéta. On mud walls, mortality rates at 24h were 99,38% and 99,66 % in Natitingou and Tanguiéta respectively. However, the observed mortality at 30 min post exposure was relatively low. For the control, mortality rate was consistently less than 5%.

Given the results of 24 hours post exposure mortality rates, the quality of spray can be considered good in the evaluated houses. Further analyses of the dosage of active ingredient of insecticide per surface unit will confirm the quality of spraying.

TABLE 11: CONE BIOASSAY MEAN MORTALITIES OBTAINED FOR DIFFERENT SPRAYED SURFACE HEIGHTS IN NATITINGOU COMMUNE, MAY 2016.

Kind of wall	Height of surface (M)	Treated houses				Mortality (%) observed at the end of 30 mn exposure	Mortality (%) observed at the end of 24 hrs holding period	Control					
		No of house	Nb of females tested	No of dead at the end of 30mn exposure period	No of dead at the end of 24 hrs holding period			No of house	Nb of females tested	No of dead at the end of 30mn exposure period	No of dead at the end of 24 hrs holding period	Mortality (%) observed at the end of 30 mn exposure	Mortality (%) observed at the end of 24 hrs holding period
Cement	0.5	6	63	41	63	65,08	100	1	12	0	0	0,00	0
	1	6	68	42	68	61,76	100	1	11	0	0	0,00	0
	1.5	6	64	39	64	60,94	100	1	10	0	0	0,00	0
	2	6	69	41	69	59,42	100	1	12	0	0	0,00	0
	Average mortalities (%)	6	264	163	264	61,74	100	1	45	0	0	0,00	0
Mud	0.5	4	46	18	46	39,13	100	1	15	0	0	0	0
	1	4	42	23	41	54,76	97,62	1	13	0	0	0	0
	1.5	4	40	20	40	50	100	1	12	0	0	0	0
	2	4	33	21	33	63,64	100	1	14	0	1	0	7,143
	Average mortalities (%)	4	161	82	160	50,93	99,38	1	54	0	1	0	1,85

TABLE I2: CONE BIOASSAY MEAN MORTALITIES OBTAINED FOR DIFFERENT SPRAYED SURFACE HEIGHTS IN TANGUIÉTA COMMUNE, MAY 2016.

Kind of wall	Height of surface (M)	Treated houses				Mortality (%) observed at the end of 30 mn exposure	Mortality (%) observed at the end of 24 hrs holding period	Control					
		No of house	Nb of females tested	No of dead at the end of 30mn exposure period	No of dead at the end of 24 hrs holding period			No of house	Nb of females tested	No of dead at the end of 30mn exposure period	No of dead at the end of 24 hrs holding period	Mortality (%) observed at the end of 30 mn exposure	Mortality (%) observed at the end of 24 hrs holding period
Cement	0.5	2	21	7	21	33,33	100	1	10	0	0	0,00	0
	1	2	20	9	20	45	100	1	11	0	1	0,00	9,09
	1.5	2	22	10	22	45,45	100	1	10	0	0	0,00	0
	2	2	20	12	20	60	100	1	11	0	0	0,00	0
	Average mortalities (%)	2	83	38	83	45,78	100	1	42	0	1	0,00	2,38
Mud	0.5	7	80	32	79	40	98,75	1	12	0	0	0	0
	1	7	70	32	70	45,71	100	1	13	0	0	0	0
	1.5	7	73	35	73	47,94	100	1	10	0	0	0	0
	2	7	70	40	70	57,14	100	1	10	0	0	0	0
	Average mortalities (%)	7	293	139	292	47,44	99,65	1	45	0	0	0	0

7. Environmental Compliance

7.1 Pre-Spray Environmental Activities

7.1.1 Environment Documentation Changes

The AIRS Benin Supplemental Environmental Assessment (SEA) was valid through April 2016 therefore, the project hired a consultant to update the SEA in time of the 2016 spray campaign. The updated environmental assessment is countrywide valid up to 2020. Three classes of insecticide were included in this assessment: pyrethroids, organophosphates and carbamates; in addition, this SEA expands the authorization to include the use of Chlorfenapyr, once it completes the WHOPES' evaluation process.

The 2008 Environmental Compliance Certificate for IRS insecticides delivered by the Benin Agency for Environment (ABE) is still valid.

7.1.2 Digitization of Information

Since 2013 AIRS Benin has used smartphones to complete environmental compliance supervision and monitoring. Environmental compliance checklists for inspections taking place before, during, and after the IRS campaign are uploaded to smartphones, which also record GPS coordinates (latitude and longitude) of any operation site, as well as prompt the user to take photos with the camera.

Prior to the 2016 IRS campaign, the ECO performed the initial pre-season environmental compliance assessment (PSECA) using smartphones to assess the condition of all 16 operation sites and guarantee that the IRS campaign was compliant with the USAID's 22 CFR 216 Code. The information collected was uploaded and made available on the PMI AIRS Project's environmental compliance database. This enabled PMI AIRS staff to view the results of the inspections and note which refurbishments were needed in different operational sites in order to maintain the safety of the environment.

During the initial PSECA, the ECO ensured that both the NMCP and the Departmental Directorate of Environment and Climate Change Management (DDEGCC) were able to use the smartphone to collect environmental information. After rehabilitation activities, the same electronic device was used by the inspection team to collect required information for decision on the starting or not of the IRS campaign.

Smartphones were also used by the ECO and the inspection team to carry out the midterm inspection as well as routine supervision.

7.1.3 Pre-Spray Environmental Inspection

A pre-spray environmental inspection was carried out from February 22 to 27, 2016 throughout the 16 operational sites and was conducted jointly by the NMCP representative and the ECO along with the AIRS Benin site coordinator in Atacora and representatives from MAEP, MOE, DDS and DDEGCC.

The four main activities of the pre-spray inspection were to:

- Identify the possible causes of non-environmental compliance at each operational site and make recommendations as needed to assure compliance for the 2016 IRS campaign;
- Make appropriate recommendations to ensure environmental safety;

- Reinforce all partners' skills, especially the representative of NMCP in using smartphone to collect environmental compliance data.

The inspection allowed AIRS Benin to conduct a needs assessment of the number of first-aid kits and other PPE for each operational site, and to assure that all operation sites have access to guidelines on the management of insecticides and its side effects,.

Special attention was given to the transfer of experience to government counterparts, especially those from NMCP, in conducting environmental inspection using smartphones.

Table 14 notes the location of each operational site for the 2016 IRS campaign, and whether the operational sites received store room, soak pit, fencing, or soak pit cover refurbishments, following the pre-spray environmental inspection.

TABLE 13: LOCATIONS OF OPERATION SITES

Communes	Operation Site Location (sub commune)	Facility Type	Store Room Refurbished (*)	Soak Pit Refurbished	Fencing Refurished
Natitingou	Natitingou	Central warehouse	Yes (Y)	Y	No (N)
	Perma	Health center	Y	Y	Y
Toucountouna	Toucountouna	Health center	Y	Y	N
Boukoumbé	Natta	Municipal building, provided by community	Y	Y	N
	Manta	Health center	Y	Y	N
Tanguiéta	Taiacou	Youth center, provided by community	Y	Y	N
Matéri	Matéri	Municipal building, provided by community	Y	Y	N
	Dassari	Health center	Y	Y	N
Cobly	Cobly	Health center	Y	Y	Y
Kouandé	Kouandé	Health center	Y	Y	N
	Guilimaro	Health center	Y	Y	N
Péhunco	Péhunco	Health center	Y	Y	N
	Gnemasson	Health center	Y	Y	N
Kérou	Firou	Community building		Y	N
	Kaobagou	Health center	Y	Y	N
	Kérou	MAEP building	Y	Y	N

(*) Small maintenance according to the store room conditions: on roof, doors, windows, locks or floor.

7.1.4 Medical Check up

A medical check-up for all seasonal staff was conducted few days before the IRS campaign during the period of April 26-30 and May 02, 2016. Medical check-up included physical examination, the assessment of pre-existing conditions incompatible with the participation in IRS operations, like respiratory diseases (asthma, tuberculosis, etc.) and pregnancy testing. Only individuals deemed medically capable were selected among the seasonal staff. However, women found pregnant (3) had the right to perform other campaign activities that did not expose them to insecticide. The three women who tested positive for pregnancy became part of mobilization teams.

7.2 Mid-Spray Environmental Activities

7.2.1 Mid-Spray Environmental Inspections

From May 11 to 14, 2016, AIRS Benin ECO in collaboration with NMCP, DDEGCC and Community Hygiene and Sanitation Service (SHAB) completed a mid-spray environmental inspection for all operation sites and spraying activities using updated electronic and paper checklists. The four topics assessed through these forms are:

1. Spray Operator Morning Mobilization
2. Homeowner Preparation and Spray Operator Performance
3. Storekeeper Performance and
4. End of Day Cleanup

The inspection team reported the following findings during their mid-spray inspection:

- In almost all of villages where the "homeowner preparation and spray operator performance" was monitored, residents were aware in advance of spray activities. Most of them removed belongings from the houses and heavy items were adequately covered with a plastic sheet. The inspection team found that no food store was sprayed and no sick person was inside at the time of spraying. Residents understood precautionary measures to be taken before, during, and after spraying. However, some of residents stated they were unaware of spray activities and therefore were not ready to have their structures sprayed.
- All spray operators monitored by the inspection team wore full PPE during the spray operations.
- While preparing insecticide in the spray tanks, the SOPs triple-rinsed the bottles and they met the required pump pressure (55 psi for Hudson; safety valve and red marker for Goizper). But sometimes, the triple-rinse was not effective because it was done too quickly. In these cases, SOPs and team leaders were further trained by the inspection team.
- The inspection team did not observe any spray operator eating, drinking, or smoking during the spray operation.
- Only one incident of pesticide exposure occurred in Natitingou (Berecingou). This incident was reported; the injured person was treated and was subsequently out of danger.
- When handling pesticides, most of storekeepers wore full PPE and none were seen eating, drinking, or smoking inside the warehouse. Nevertheless, one of them started insecticide handling without gloves: he was immediately stopped by the inspection team who reminded him of the precautions to be taken. Every storage facility was provided with a spill kit, a fire extinguisher, the pesticide Material Safety Data Sheet (MSDS), and a thermometer to monitor temperature inside the storeroom. There was no insecticide beyond its expiration date.

- The inspection team checked the end-of-day clean-up activities and noted that rinsing areas, along with their soak pit, were environmentally compliant. However, a soak pit overflow issue occurred at Matéri operational site and was effectively fixed by renewing soak pit materials.
- All drivers had a cell phone and wore PPE when driving spray teams to villages and cleaned their vehicles. Additionally, all vehicles were provided with first aid kits and instructions for cleaning up in case of insecticide spill.

7.3 Post-Spray Environmental Assessment/Activities

The post-spray environmental inspection was performed from May 31 to June 3, 2016 by an inspection team led jointly by representatives from NMCP and the AIRS Benin ECO. The inspection team also included staff from the DDS/HAB and DDEGCC of Atacora-Donga department. The main objective was to check if all operation sites were properly closed and to note any environmental issues that needed to be resolved before the 2017 IRS campaign. The key findings of the post-spray environmental inspection are as follows:

- All of the IRS campaign commodities (including PPE and leftover insecticides) were transported back to the central warehouse in Natitingou for storage until the next campaign.
- All secondary store rooms were decontaminated thoroughly with water and soap, including Matéri, Cobly, Kouandé, Guilmaro, Péhunco, Dassari, Toucountoua and Birni where the inspection team supervised the decontamination process All rinsing / wash areas and soak pits at operation sites remained in good condition. Soak pits were covered and thoroughly secured with two locks. The barbed wire enclosures around the rinse areas and soak pits were intact.

7.4 Solid Waste Disposal

During the 2016 IRS campaign, the project generated the following quantities of solid waste:

- 18,890 used respiratory masks
- 1,200 unusable back sacks
- 46,632 empty bottles of pirimiphos-methyl
- 1,866 used plastic gloves

7.4.1 Disposal Methods

Three different methods were used to dispose the above solid wastes. These methods included incineration, grinding followed by recycling (for solid wastes with high-density of polyethylene, particularly the insecticide bottles), and burying used of low-density polyethylene like gloves.

7.4.2 Incineration of Solid Waste

AIRS Benin completed the incineration of used respirator masks and unusable SOP bags from the 2015 IRS campaign from June 3 to 4, 2016. For six consecutive years, the IRS program in Atacora used the incinerator of St. Jean de Dieu Hospital in Tanguiéta. This incinerator had already been reviewed by the AIRS ECO for its capacity, its ability to reach high enough temperatures (1,000 degrees Celsius) for incineration of IRS solid wastes, and its low level of smoke emissions. All loading of solid waste and the actual incineration were closely supervised by the AIRS Benin ECO in collaboration with DDS, DDEGCC and NMCP representatives. Overall the incineration was carried out properly.

7.4.3 Recycling of Empty Bottles

AIRS Benin continued working with the environmental non-governmental organization named Community Development and Environmental Sanitation (*Développement Communautaire et Assainissement du Milieu* (DCAM))/ Bethesda a non-profit NGO located in Cotonou, to recycle empty insecticide bottles generated during IRS campaign. After triple-rinsing, all of these bottles in the field and decontaminating them with soap and water at the central warehouse in Natitingou, AIRS Benin delivered all loading to the DCAM Bethesda's recycling plant warehouse in Pahou (Ouidah Commune).

7.4.4 Burying Wastes at a Landfill

The used rubber gloves from the 2016 IRS campaign contain low-density polyethylene, which releases gas by-products that are toxic or a nuisance when incinerated. Therefore, the AIRS Project's Environmental Compliance Manager has advised all project countries to thoroughly wash the gloves and contact local authorities to find out the safest place to dispose of them. AIRS Benin continued working with the Technical Direction (DST) of Cotonou municipal service which manages a landfill in Ouessè Ouidah Commune that complies with Law No 98-030 related to the framework law on environment in Benin. Following the IRS campaign, AIRS Benin properly washed the used rubber gloves. They were buried at Ouessè Landfill Site under the NMCP and ECO supervision was completed on June 24, 2016.

Please see EMMR table in Annex D.

8. Monitoring and Evaluation

M&E for the 2016 IRS campaign closely followed the processes outlined in the 2016 AIRS Benin Work Plan, the M&E Plan, and the M&E Concept Paper developed by the AIRS core team. M&E activities were led by the AIRS Benin M&E and Database Managers. The full monitoring and evaluation plan (MEP) can be found in Annex E.

The AIRS Benin project continued to use the Microsoft Access database designed by the AIRS Benin M&E Manager in 2012, which was updated before the IRS campaign to facilitate easy and rapid data checking during the entry process. The AIRS Benin database used several logic checks and controls to validate data entries and minimize data entry error.

8.1 Data Management

IRS campaign data was entered each time a spray operator visited a structure. This includes recording on the spray operator card if a structure was not sprayed, as well as the reason.

Data quality assurance protocols were followed to check the accuracy of all spray operator data collected. After the end of each IRS campaign day, the spray operators provided their completed spray operator forms to the team leaders. The team leaders then checked the accuracy of the spray operator's forms using the Error Eliminator (printed on the backside of the Spray operator data collection form to facilitate use), and assured that all computations on the spray operator forms were done correctly. Thereafter, the team leaders sent the spray operator forms to the operation site supervisor, who also checked the accuracy of the spray operators' forms with the Error Eliminator form and finally sent the spray operator forms to the site coordinators to complete a final check and validation of all spray operator forms. The commune and operation site coordinators sent the spray operator forms and the Team Leader forms to the data entry center in Natitingou, where data clerks processed the forms and entered the data into the AIRS Benin database.

Additionally, the M&E and Database Managers checked the accuracy of data entered by data clerks daily by randomly selecting 10 percent of the spray operator cards collected during a week and comparing the information on the cards with the data entered into the AIRS Benin database.

8.2 Data Quality Assurance

The AIRS project supervisory tools have improved the data quality assurance activities for both data collection and data entry verification. AIRS found that these forms helped formalize self-audits of the IRS campaign's data to ensure better data quality and reduce the number of errors found on Daily Spray Operator Forms and in the M&E database. Data analysis in Access showed that this year the spray operator forms came from the field with less data missing and fewer errors in logic.

Error Eliminator (EE)

The EE is used to check all Spray Operators forms and see if the information is complete and correct before they are submitted for data entry.

Data Collection Verification (DCV) Form

This tool was used by supervisors as a mini audit on the consistency of data and to check the spray coverage. In total, AIRS technical staff, national supervisors, and USAID/PMI Benin technical team completed 393 DCVs using smartphones. Site coordinators and operation site supervisors also completed 984 DCVs using paper forms in 110 villages out of the total 799 villages.

Corrective measures on observed anomalies were provided either on the field or through SMS to prevent repetitive errors. Moreover, the audit information made easier the mop-up operations.

Directly Observed Spray (DOS) Form

Developed recently by AIRS, this form was used by the team leaders to oversee and improve SOP's performance and spray quality. Team leaders conducted supervisory visits throughout the spray campaign to observe the performance of spray operators. For each supervised visit, supervisors recorded whether or not the SOP correctly performed the various components of their required job duties. Any errors made during the observed visit are recorded and create a red flag in the database. Daily alerts were sent to supervisors containing a summary of all red flags from the previous day, which allowed supervisors to closely monitor the quality of SOPs' performance and take corrective action to address any errors and ensure better quality of spray operations. Altogether 553 red flags were recorded: 291 the first week, 133 the second week, 109 the third week, and 20 during the last week. The majority of red flags (406) were related to leaks in the pumps, which was quickly addressed by redressed by the operations team.

Data Entry Verification Form

The AIRS M&E and Database Managers used the Data Entry Verification tool to verify that the data entered into the database matched the data on the Daily Spray Operator Forms. Of 8,769 records, 107 (1.22%) had errors, including wrong choice of the predefined village, and mistyping of dates and household codes. In addition to the Data Entry Verification Form, the database design enforced several logic rules aiming to ensure the quality of data entries (e.g., the number of pregnant women in the structure cannot exceed the number of women in the structure). AIRS Benin also provided each data clerk with data cleaner tool, which allowed the data entry clerks to run error reports and correct data entry mistakes each day before leaving the office.

At the end of every week, the AIRS Benin M&E Manager and Operations Manager provided feedback regarding errors found on spray operator cards and gave recommendations to the site coordinators, and spray team leaders, in order to avoid future data errors on the spray operator cards.

8.3 mHEALTH RESULTS

- SMS Reminder: A total of 46,436 SMS reminders (38 reminders sent for the 1,222 seasonal staff) were sent during the 2016 IRS campaign. The SMS reminders focused on environmental compliance (e.g. proper wearing of PPE) and spray operators' performance (e.g. remind the number of structures to be sprayed every day to reach the goal).
- Mobile based supervisory tools:
    - DCV: 393 forms completed
- Mobile Performance Tracker: Supervisors submitted daily reports on certain key targets (e.g. number of structures found/sprayed) via SMS. A total of 267,701 sprayed structures were tracked via SMS against 269,179 sprayed structures captured with IRS data collection forms. Data gathered through SMS informed daily decision-making, but the data collected through data collection forms remains as the official data source given that these forms collect more comprehensive information and undergo a thorough data entry verification and cleaning process.

TABLE 14: COMPARISON OF SMS STRUCTURES TO CONFIRMED STRUCTURES

	Data Collection Form	SMS	Difference (%)
Number of structures found	296,409	295,540	0.29
Number of structures sprayed	269,179	267,701	0.55
Coverage rate	90.8%	90.6%	0.84

8.4 Number of Structures Covered by the 2016 IRS Campaign

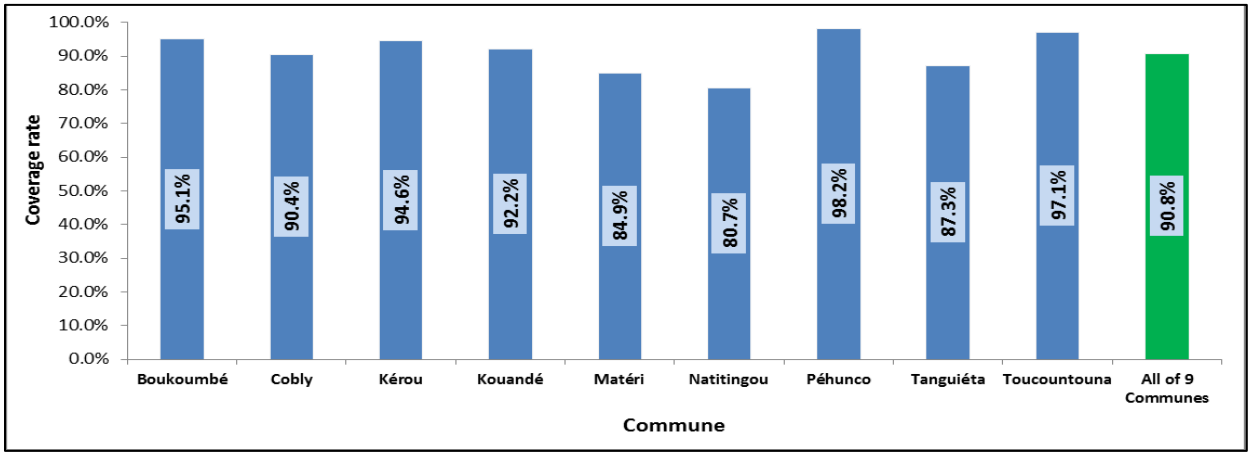
The 2016 IRS campaign sprayed 269,179 structures out of the 296,409 eligible structures found by spray operators. Spray coverage was over the 85 percent minimum as coverage was 90.8 percent for the total number of eligible structures found by spray operators. Table 15 describes the overall spray coverage rate.

TABLE 15: SPRAY COVERAGE BASED ON STRUCTURES FOUND BY SPRAY OPERATORS PER COMMUNE

Commune	Eligible Structures Found by SOPs	Eligible Structures Sprayed 2016	Coverage Rate 2016
Boukoumbé	25,635	24,375	95.1%
Cobly	19,826	17,919	90.4%
Kérou	45,000	42,567	94.6%
Kouandé	52,428	48,351	92.2%
Matéri	51,461	43,682	84.9%
Natitingou	33,317	26,871	80.7%
Péhunco	37,986	37,290	98.2%
Tanguiéta	17,702	15,449	87.3%
Toucountouna	13,054	12,675	97.1%
Total	**296,409**	**269,179**	**90.8%**

Figures 7 and 8 show the IRS coverage rates per commune and the progress of daily coverage rate respectively.

FIGURE 7: SPRAY COVERAGE BASED ON STRUCTURES FOUND BY SPRAY OPERATORS PER COMMUNE



With the exception of the Natitingou commune, all other communes reached or exceeded the minimum required coverage rate of 85 percent. Heavy household items and the bad smell of OP insecticide were the main reasons reported for refusal cases in urban areas.

FIGURE 8: PERCENTAGE OF DAILY SPRAYED STRUCTURES VS. FOUND

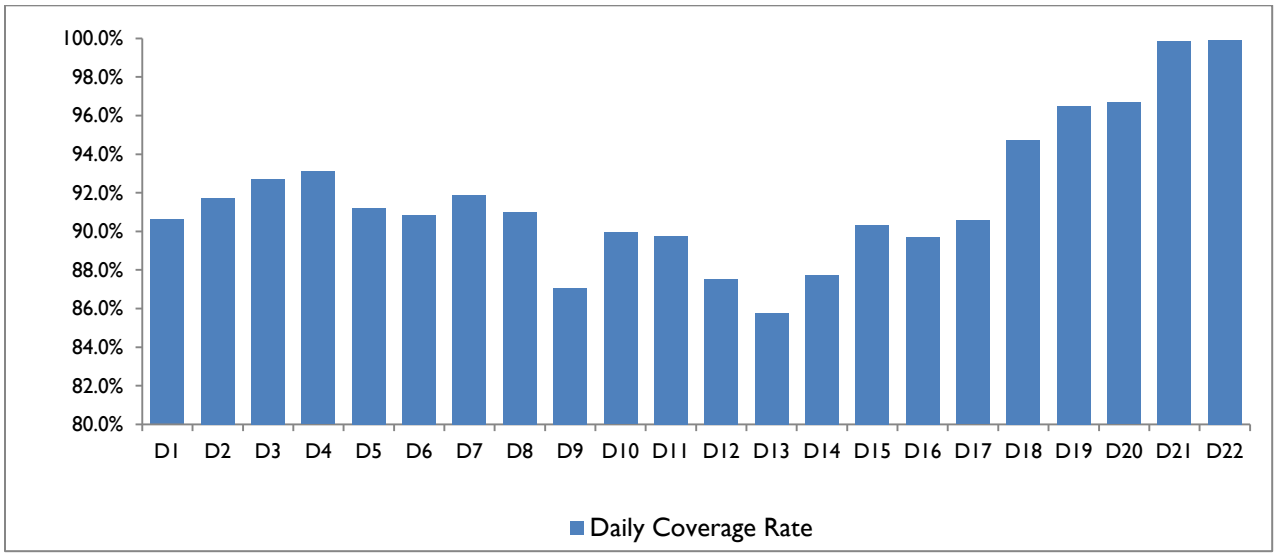
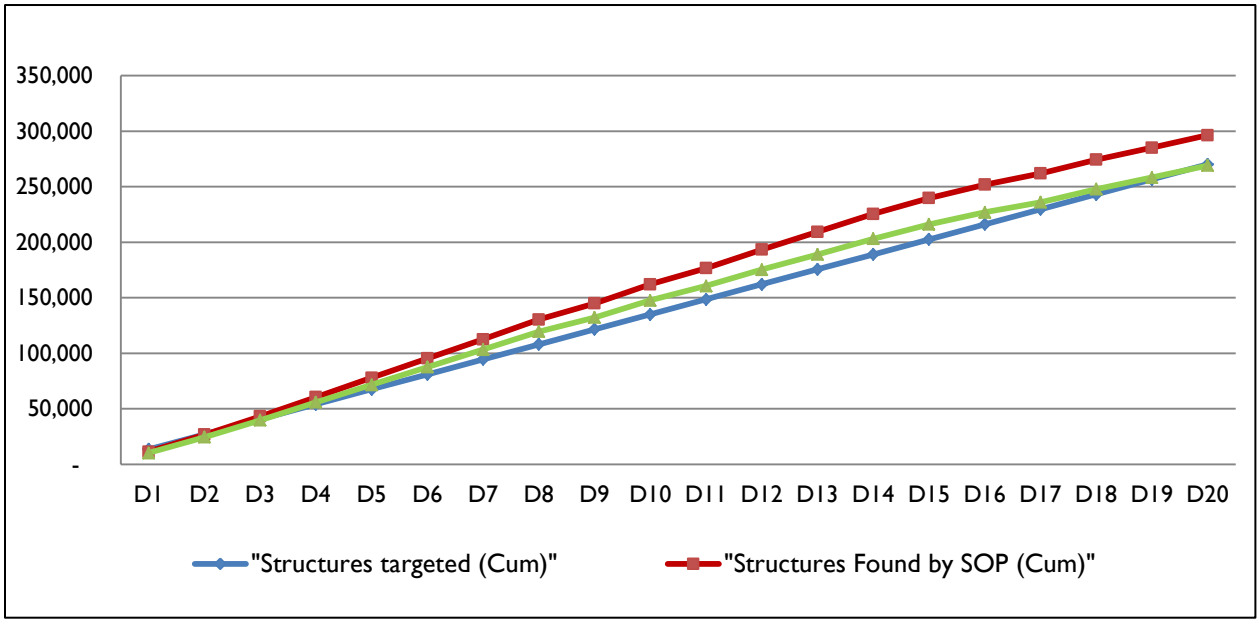


Figure 8 above shows the progress of daily coverage rate. The coverage rate (# eligible sprayed structures / # eligible structures found) evolved from 90.6% (Day 1) to 97.2% (Day 20). The coverage rate increased significantly the last three days of the campaign, from 90.6% (Day 17) to 99.9% (Day 22) due to the mop-up performed the last days of the campaign to capture eligible structures that weren't sprayed in the middle and beginning of the campaign. Most eligible structures visited during the last five days of the campaign were sprayed.

To increase the coverage rate in Matéri and Natitingou, which recorded the lowest coverage rates, the AIRS team decided to extend the spray campaign by two days in these two districts. By the end of the 20 official working days the coverage was 90.76%. After the two additional days, this percentage increased to 90.81%; which was not very significant.

Figure 9 shows the trend of the performance of operators during the 20 official working days in the field.

FIGURE 9: DAILY SPRAY PERFORMANCE



8.5 Population Protected

A total of 858,113 people, including 438,912 men and 419,195 women, were protected by the IRS during the 2016 campaign. Those protected included vulnerable populations: 167,041 children under five years old, including 83,852 males and 83,189 females; and 36,088 pregnant women. Table 16 provides a breakdown of the population protected during the 2016 IRS campaign per commune.

TABLE 16: POPULATION PROTECTED DURING 2016 IRS CAMPAIGN PER COMMUNE

Communes	Total Population			Children <5 years			Pregnant Women
	Men	Women	Total	Male	Female	Total	
Boukoumbé	36,907	35,785	72,692	7,063	6,904	13,967	1,953
Cobly	26,783	26,188	52,971	4,401	4,371	8,772	1,681
Kérou	78,534	71,395	149,929	15,871	15,030	30,901	7,844
Kouandé	80,092	75,289	155,381	16,461	16,696	33,157	8,364
Matéri	65,773	64,468	130,241	10,410	10,265	20,675	3,805
Natitingou	46,456	45,026	91,482	7,640	7,383	15,023	2,510
Péhunco	59,430	56,171	115,601	13,722	14,369	28,091	7,578
Tanguiéta	24,117	23,454	47,571	3,635	3,588	7,223	1301
Toucountouna	20,826	21,419	42,245	4,649	4,583	9,232	1,052
Totals	**438,918**	**419,195**	**858,113**	**83,852**	**83,189**	**167,041**	**36,088**

Overall, an estimated number of 27,230 eligible structures (9.2% vs 6.45% in 2015) and 67,391 people (7.3% vs 4.8% in 2015) found by spray operators during the IRS campaign didn't benefit from spraying during the 2016 campaign.

The main reasons of non-sprayed structures included: the transformation of eligible structures into granaries during the time of spray (39.0%), absence of households' owners (26.1%), and home owners refused treatment (26.0%).

8.6 Use of Long-Lasting Insecticide-Treated Nets (LLINs)

As requested by the NMCP, spray operators collected data on the number of people in Atacora (particularly children under five years and pregnant women) sleeping under LLINs the night before, including in households that were not sprayed. Among the 858,113 people protected by IRS, spray operators noted that 701,874 (81.8 percent) of the people protected slept under LLINs the night before. Table 17 below provides the breakdown of the LLIN data collected by spray operators.

TABLE 17: BREAKDOWN OF LLIN DATA COLLECTECTED BY SOPS

Communes	Total number of people (in sprayed structures) who slept under a mosquito net the night before the spraying		Total number of children under 5 years of age (in sprayed structures) who slept under a mosquito net the night before the spraying		Total number of pregnant women (in sprayed structures) who slept under a mosquito net the night before the spraying	
	N	(%)	N	(%)	N	(%)
Boukoumbé	65,297	89.8	12,920	92.5	1,634	83.7
Cobly	51,350	96.9	8,527	97.2	1,587	94.4
Kérou	109,065	72.7	24,055	77.8	6,082	77.5
Kouandé	120,702	77.7	27,415	82.7	6,804	81.3
Matéri	117,542	90.2	19,002	91.9	3,357	88.2
Natitingou	65,737	71.9	11,451	76.2	1,771	70.6
Péhunco	95,067	82.2	24,501	87.2	6,326	83.5
Tanguiéta	40,838	85.8	6,283	87.0	1083	83.2
Toucountouna	36,276	85.9	8,230	89.1	909	86.4
Total	**701,874**	**81.8**	**142,384**	**85.2**	**29,553**	**81.9**

8.7 Insecticide Use and Spray Operator Performance

A total of 46,609 bottles of pirimiphos-methyl CS formulation were used to treat 269,179 eligible structures during the 2016 IRS campaign (May 3-27, 2016). There were 7,424 bottles of pirimiphos-methyl CS left in stock after the spray campaign. This leftover stock will be used in its entirety during the 2017 spray campaign.

On average, spray operators in all communes sprayed 13.9 structures per day and 5.8 structures were treated per bottle[1] of Pirimiphos-methyl CS.

Table 18 provides a breakdown of the average number of structures covered by one bottle, per commune.

TABLE 18: INSECTICIDE USED PER COMMUNE

Communes	Number of Organophosphate Bottles Used	Number of Structures Sprayed	Number of Structures Sprayed per Bottle
Boukoumbé	4,289	24,375	5.7
Cobly	3,124	17,919	5.7
Matéri	7,050	43,682	6.2
Toucountouna	1,970	12,675	6.4
Tanguiéta	2,376	15,449	6.5
Natitingou	4,911	26,871	5.5
Kouandé	9,430	48,351	5.1
Péhunco	6,065	37,290	6.1
Kérou	7,402	42,567	5.8
Total	46,617	269,179	5.8

[1] Please note that one bottle of organophosphate are is formulated to cover an average of 250m^2.

9. Post-Spray Activities

9.1 Post-Spray Inventory

Starting June 27, as PPE and insecticide returned to the central warehouse in Natitingou, the AIRS Benin logistics manager and warehouse managers completed an inventory of all remaining commodities from the 2016 IRS campaign (See detail in Annex A)

9.2 Post-Spray Campaign Radio Programs

The post-spray campaign radio programs include the following activities:

- Raise awareness on the benefits of sleeping in sprayed structures and the need to keep the effectiveness of the insecticide (not applying paint, plaster, or other materials to walls).
- Broadcast information on other malaria prevention measures in addition to the correct and daily use of the LLINs, especially during the rainy season: sanitation, clearing water collection used as breeding sites by mosquitoes around houses.
- The benefits of being properly tested and treated as soon as one feels malaria symptoms, including fever.

10. GENDER

During the 2016 campaign, AIRS Benin sought to hire more female SOPs, team leaders, and supervisors like in 2015. Strategies to further these efforts include:

- Delivering the gender awareness training at TOT and posting project policies against sexual harassment in all operational sites.
- Working directly with local hiring authorities and sharing information as to the importance of hiring female SOPs and showing data that shows women are as effective as their male counterparts in terms of structures sprayed per day.
- Continue promoting a respectful working environment based on sexual harassment policy for all seasonal workers.
- Ensuring recruitment, mobilization, and training that respect women time constraints (when possible).
- Ensure women have accommodations, both at the sites, where they feel safe and comfortable.
- Create a buddy system so that at least two women are together in each spray team (when possible).

SOP Performance

Based on the total number of structures expected for this year, SOPs were expected to spray 14 structures per day to achieve a performance of 100% of coverage. Table 19 shows the SOPs performance disaggregated by sex. On average, there is an increase of the SOP performance compared with the previous year, from a total of 12.8 structures sprayed per day in 2015 to 13.9 in 2016 with the exception of three communes (Boukoumbé, Cobly and Natitingou) where women and their male colleagues were unable to achieve the stated performance (13.9). Female spray operators performed better than men in Kouandé and in general women sprayed at approximately the same rate as men. These results should be used to bolster women's recruitment efforts to strengthen gender equity in IRS during future spray campaigns.

TABLE 19: FEMALE SOP PERFORMANCE (2016 IRS CAMPAIGN)

Commune	Number of Structures Sprayed by sex		Number of SOPs by Sex		Structures Sprayed per Day by Sex	
	Female	Male	Female	Male	Female	Male
Boukoumbé	3,206	21,169	14	90	11.5	11.8
Cobly	1,657	16,262	8	71	10.4	11.5
Kérou	5,017	37,550	18	126	13.9	14.9
Kouandé	4,321	44,030	14	144	15.4	15.3
Matéri	5,015	38,667	18	131	13.9	14.8
Natitingou	2,510	24,361	12	93	10.5	13.1
Péhunco	7,108	30,182	26	107	13.7	14.1
Tanguiéta	2,623	12,826	9	39	14.6	16.4
Toucountouna	1,841	10,834	7	39	13.2	13.9

Commune	Number of Structures Sprayed by sex		Number of SOPs by Sex		Structures Sprayed per Day by Sex	
	Female	Male	Female	Male	Female	Male
Total	**33,298**	**23,5881**	**126**	**840**	**13.2**	**14.0**
		269,179		**966**		**13.9**

Challenges/Lessons Learned:

- AIRS Benin will continue to emphasize the importance of increasing the numbers of women contributing to and benefiting from the IRS campaign. Lower literacy levels of rural women relative to men restrict the recruitment of more women in IRS seasonal roles, including SOPs, storekeepers, and team leader positions. To ensure the project continues to increase the number of women hired, the AIRS Benin team will work with and train local village mayors and chiefs to recruit and hire more women. Also, the good performance of women will be used as testimony for increasing the numbers of women as seasonal staff.

Recommendations:

- To increase women participation in the upcoming IRS operation, advocacy and training for local authorities (administrative, health system, opinion leaders) will be carried out four months before the spray campaign in order to get their support for a gender integrated approach. In addition, AIRS Benin will closely follow up the recruitment process by setting an expected quota for women.

11. CAPACITY BUILDING

The activities below describe NMCP involvement in the 2016 IRS campaign and AIRS Benin's support:

- Capacity building on IRS implementation process: the NMCP took full responsibility (under AIRS Benin's mentorship) of the management of the health zone of Tanguiéta (Tanguiéta, Cobly and Matéri);
- Participation in pre-, mid-, and post-spray EC inspections.
- Assignment of one database manager who worked with the AIRS database manager during the IRS campaign;
- The IEC/BCC focal point from the DDS fully carried out his tasks with the AIRS Benin focal point.

To run the IRS operation in Tanguiéta health zone, MOH/NMCP assigned three nurses from the Health Zone Hospital as commune coordinator respectively for each commune; they participated in the IRS campaign action plan development in Porto Novo in April 2016. After attending the TOT on IRS technical components, the commune coordinators led the spray operator and mobilization trainings in their three respective communes of Tanguiéta health zone.

With AIRS Benin's support, commune coordinators established the IRS operation micro plan for Tanguiéta health zone and managed the IRS activities such as supervising the secondary warehouse with the store keeper, preparing the SOP teams for field work, supervising their work, validating the recorded IRS data, and sending data to the main data center every day. In addition, the commune coordinators were also in charge of following the mobilizer's activities and coordinating all IRS components in their respective geographic area. The Health Zone Officer (from the government) was supporting the commune coordinators specifically on supervisory activities and daily monitoring of IRS operation progress.

In general, the IRS coverage in two of the three communes of Tanguiéta are all above the objective stated by the National Malaria Strategic Plan. In Materi however, many structures had been transformed into granaries accounting for the majority of the 39% of unsprayed structures. Nevertheless some key interventions can be improved such as:

- Strengthen leadership and management at the national, departmental, and commune level in spray operations, planning, and implementation;
- Conduct close supervision and reinforce field activity coordination to improve results;
- Identify the best role(s) for NMCP (national, departmental, and commune) staff that maximizes their strengths within their human resource constraints;
- Increase NMCP leadership in determining long- and short-term strategies envisioned for IRS in Benin;
- Train the M&E staff (focal point) on database management; Reinforce NMCP competencies on site preparation and soap pit/wash area building.

12. Challenges and Lessons Learned

Administration and Logistics

- The payment for seasonal workers done in two installments motivated them.
- Assigning a vehicle to financial services throughout the campaign facilitated the collection and auditing of supporting documents.
- Gathering mobilization agent's attendance lists remains a challenge due to the lack of coordination between coordinators and Head of health centers at the operational site level.
- A challenge related to the first seasonal worker payment is related to delayed receipt of attendance lists and lack of diligence from the site coordinators to schedule payments with the respective micro finance institution.

M&E

Given the importance of the M&E component and the volume of work required to properly monitor the spray campaign, it would be desirable to hire a few M&E assistants during the campaign. Their SOW would include:

- Assist with data entry to decrease time between submission of forms and entry into database
- Check the consistency and completeness of data collected on the field
- Ensure adequate marking on eligible structures
- Ensure high coverage of the DCV and availability of data collection tools / forms
- Support the supervision of trainings and mobilization

IEC

- For more efficient distribution, IRS cards should be entrusted to the storekeepers contrary to current practice where the IRS cards are managed by health centers.
- The involvement of health and political authorities in advocacy activities is often jeopardized by other competing activities in which these authorities are involved. AIRS should reach out to other organizations with IEC expertise working in-country (e.g. PSI) to leverage and coordinate relevant activities.

Logistics

- Fuel was scarce in almost all gas stations in the communes of Atacora (Kerou, Materi, Cobly and Kouandé) during the 2016 IRS campaign due to the national fuel shortage in producer countries like Nigeria. Proper planning and a smart deployment of vehicles are necessary to avoid inadequate number of vehicles experienced during the mop up of.
- The two day training for storekeepers is not adequate to master all of the competencies in relation to proper management of stores and other assigned responsibilities during the campaign.

- Increase the number of days for the reception and verification of equipment coming from the field after the campaign.

Environmental Compliance

- Compliance with the progressive rinsing procedures will be strengthened to avoid possible SOP cases of intoxication.
- Due to the overflow issue experienced in 2016 with the soak pit at Matéri operational site, all materials acting as filters (sawdust, charcoal, porous stones) will be renewed in 2017 in all other existing operation sites, should spraying continue in Atacora.
- In order to avoid overcrowding in Perma's wash area and to reduce transportation costs, it is advisable to create an operational site in Birni before the 2017 IRS campaign, should spraying continue in Atacora.

Operations/Trainings

- Active participation of NMCP and DDS staff in daily debriefing meetings during the IRS campaign was a sign of strong collaboration between AIRS Benin and all local stakeholders.
- Heavy household effects and "bad smell of OP insecticide" were the main reasons mentioned for refusal cases in urban areas. For upcoming campaigns, AIRS Benin will require experienced mobilizers to help convince households of the benefit of IRS and help them remove their belonging when needed.

13. RECOMMENDATIONS

The recommendations listed below are suggestions to improve future IRS campaigns in Benin:

1. Review pros and cons of having commune coordinators as opposed to heads of health posts conduct door-to-door mobilization and IRS card distribution.
2. Review selection criteria and strengthen supervision of seasonal workers for better performance
3. Hire M&E assistants during IRS campaign to strengthen the monitoring of activities and ensure data quality
4. IEC activities should start one week before the campaign and continue throughout the campaign. More IEC channels should be explored.
5. Promote a collaboration with other USAID's implementers in critical components of IRS intervention, including IEC
6. Each spray team should have a carrier to help home owners who cannot remove their belongings during household preparation (e.g. old, sick, alone, or disabled people).To save operational costs, PMI should consider piloting a community-based IRS model in Benin where SOPs and mobilizers are recruited from and spray their own community.
7. Review the IEC component and ensure that payments of local community leaders are handled by financial assistants or IEC focal point as done in previous years.
8. Reinforce awareness for safe driving practices in the training of drivers.
9. Increase the number of days allocated for the training of storekeepers to 3 days.

Annex A: IRS Commodities and Inventory

TABLE 20: IRS COMMODITIES AND INVENTORY

Item	Initial Stock before IRS Campaign	Number of Items Procured	Stock before Campaign	Defective Items after IRS Campaign + Consumable (Single use)	Usable Stock Remaining for 2017
Insecticide (Pirimiphos - methyl-CS)	12,815	41,220	54,035	46,611	7424
Spray Pumps X-PERT (Hudson)	675	0	707	207	500
Spray Pumps IK12 VC (Goizper)	400	0	400	0	400
Overalls	2,833	125	2,948	5	2943
Vest	274	120	394	5	389
Helmet	1,495	48	1,543	152	1391
Gumboots	1,529	0	1,529	32	1497
Gloves for Spray Operator	741	1,071	1,812	1656	156
Gloves for Washer	97	0	97	9	88
Respirator Mask	21,190	12,000	33,190	23,710	9480
Operator Flashlight (head lamp)	160	1,310	1,470	1417	53
Stock-keeper Flashlight	8	0	8	8	00
Caps (used for mobilization)	67	61	128	69	59
First aid Kits	128	0	128	72	56
Thermometers	33	0	33	0	33
Fire Extinguishers	30	5	35	0	35
O Ring for Supply Tube	535	0	535	58	477
Filters x PER	3	650	653	11	642
Filter Goizper Pump	66	150	216	216	0
White Washers (spare part for pumps)	26	500	526	0	526
Elbow with Nozzles Goizper	00	150	150	0	150
Nozzle Blues	50	00	50	0	50
Face Shield for Helmets	237	300	537	383	154
Filter Assembly, for Pressure Gauge	460	0	460	100	360

Item	Initial Stock before IRS Campaign	Number of Items Procured	Stock before Campaign	Defective Items after IRS Campaign + Consumable (Single use)	Usable Stock Remaining for 2017
Leaflets	0	104,924	104,924	83,424	21500
Pregnancy Test Kits	0	500	500	345	155
Generators	2	1	3	0	3
Buckets for Spray Operators	2,010	0	2,010	256	1754
Plastic Buckets for Dustbin (100L)	154	0	154	7	147
Two-component Hose New Pumps/Goizper	11	0	11	6	5
Two-component Hose Old Pumps/Goizper	18	0	18	0	18
Valve Goizper	11	0	11	0	11
Safety Valves Goizper	73	50	123	42	81
Collar Seal/Goizper	22	50	72	38	34
Lance Filter New Pumps/Goizper	0	150	150	0	150
Lance Filter Old Pumps/Goizper	13	0	13	0	13
Lance Tube Old Pumps/Goizper	15	50	65	17	48
Lance Tube New Pumps/ Goizper	24	50	74	13	61
Pressure Regulator/Goizper	72	150	222	75	147
Pressure Regulator/Hudson	835	0	835	160	675
Pumps Goizper/ Spare Parts Kit	10	20	30	10	20
Spare Part Kit Hudson	0	50	50	15	35
Complete Handle/Goizper	34	50	84	35	49
Pressure Gauge Xp Hudson	68	600	668	111	557
Barrel (100l)	84	0	84	0	84
Barrel (150L)	84	0	84	0	84
Fuel Tank (200L)	0	15	15	0	15
Water Tank (1000L)	11	2	13	1	12
Water Tank (2000L)	3	0	3	1	2
Motorcyles	5	3	8	0	8

ANNEX B: CERTIFICATE OF ANALYSIS

CEMAS

Certificate of Analysis

Actellic 300CS
BSN5A0680

Batch Identification	**BSN5A0680**
Product Code	**Actellic 300CS**

Chemical Analysis
(Active Ingredient Content)

– **Identity of the Active Ingredient(s)**	**confirmed**
– **Content of Pirimiphos Methyl**	**27.1 % w/w corresponding to 289 g/L**

The Active Ingredient(s) content is within the FAO limits.

Stability:

– **Recertification Date**	**16 January 2017**

Raw data, documentation and reports pertaining to this/these study/studies are stored under the study number(s) referenced below within the archives of the CEMAS GLP Archive within two months of issue of the Certifiate of Analysis, for a minimum period of three years, after which it will be returned to the Sponsor.

Study number: CEMS-6942

Authorization: 20 January 2015

P Jutsum
CEMAS Ltd

Certificate of Analysis BSN5A0680 Page 1 of 1

ANNEX C: NUMBER OF PEOPLE TRAINED

TABLE 21: NUMBER OF PEOPLE TRAINED BY TYPE OF TRAINING

Cadres of People Trained	Training on IRS Delivery						Other Trainings															
	TOT		Spray Operations		Data Capture		Logistics Training		Technical Maintenance		Mobilization/ IEC TOT		Mobilization/ IEC Training		Medical Treatment of Intoxication Cases		Washer Activities		Fire Security		Transport Security	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M
DDS (AD/OP)	0	1																				
SHAB Regional																						
NMCP Regional	0	1																				
DDEHU	0	1																				
Commune Coordinators	2	10									2	9										
Health Zone Coordinator	0	1									0	1										
Commune Chief Doctors/ Other Doctors	1	3									4	5			4	5						
Chiefs of Health Post/Midwife											25	44			25	44						
Hygiene Staff	24	84																				
Spray Operators			163	994																		
Data clerks					18	19																
Storekeepers							2	15											1	11		
Logistics Assistants							0	2											0	3		
Service Technicians									8	61												

Cadres of People Trained	Training on IRS Delivery						Other Trainings															
	TOT		Spray Operations		Data Capture		Logistics Training		Technical Maintenance		Mobilization/ IEC TOT		Mobilization/ IEC Training		Medical Treatment of Intoxication Cases		Washer Activities		Fire Security		Transport Security	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M
IEC Agents													299	1125								
Washers																	65	0				
Drivers																			0	117	0	117
Guards																			0	16		
CommCare / Dimagi	2	11					2	15														
TOTAL M/F	**29**	**112**	**163**	**994**	**18**	**19**	**4**	**32**	**8**	**61**	**31**	**59**	**299**	**1125**	**29**	**49**	**65**	**0**	**1**	**147**	**0**	**117**
TOTAL/ training	**141**		**1157**		**37**		**36**		**69**		**90**		**1424**		**78**		**65**		**148**		**117**	

Annex D: Environmental Mitigation and Monitoring Report

TABLE 22: ENVIRONMENTAL MITIGATION AND MONITORING REPORT (EMMR)

Mitigation Measure	Status of Mitigation Measures	Outstanding Issues Relating to Required Conditions	Remarks
1a. Pre-contract inspection and certification of vehicles used for pesticide or spray team transport.	All transport vehicles were provided with an inspection certificate on-board	None	
1b. Driver training	It took place on May 2, 2016 and involved all of transport vehicles drivers	None	
1c. Cell phone, personal protective equipment (PPE) and spill kits on board during pesticide transportation.	100% of transport vehicle drivers had their cell phone and PPE on board; every transport vehicle was provided with a skill kit	None	Every driver came with his cell phone; every transport vehicle was equipped with PPE and spill kit
1d. Initial and 30-day pregnancy testing for female candidates for jobs with potential pesticide contact.	All of female candidates for jobs with pregnancy testing were submitted to pregnancy testing	The three females tested positive were declared unfit by the physicians	Each storekeeper had records of pregnancy testing for all female team members.
1e. Health fitness testing for all operators	All spray operators were submitted to health fitness testing	None	Every storekeeper had medical exam results for all team members
1f. Procurement of, distribution to, and training on the use of PPE for all workers with potential pesticide contact.	Spray operators and other workers wore complete PPE during spraying and clean-up	None	Spray operators, storekeepers or washers not wearing complete PPE were recalled and sensitized for immediate use
1g. Training on mixing pesticides and the proper use and maintenance of spray pumps.	Operators were trained on pro-per mixing of pesticide; they also used and most of them correctly maintained spray pumps	Frequent leakages in spray pumps	Spare parts were available and needed repairs often made

Mitigation Measure	Status of Mitigation Measures	Outstanding Issues Relating to Required Conditions	Remarks
1h. Provision of adequate facilities and supplies for end-of-day cleanup,	Compliant rinsing areas, soak pits and drums with sufficient water for end-of-day cleanup were available	None	
1i. Enforce spray and clean-up procedures.	Spray and clean-up procedures were taught during trainings and applied at all of operation sites over the IRS campaign	No issue	Mid-inspection and daily super-visions were performed as sche-duled, with immediate implemen-tation of corrective actions
2a. IEC campaigns to inform homeowners of responsibilities and precautions.	Pre-spray IEC campaigns were executed. Homeowners knew their responsibilities and precautions		Some beneficiaries declared not to be informed: SOPs and supervisors provided them with due information
2b. Prohibition of spraying houses that are not properly prepared.	No house improperly prepared was sprayed	None	SOPs and/or Supervisors, if needed, helped properly prepare houses before spraying
2c. Two-hour exclusion from house after spraying	Beneficiaries observed 2 hours (and even more) exclusion	None	
2d. Instruct homeowners to wash itchy skin and go to health clinic if symptoms do not subside.	Instructions were given; no incident related to skin issue was noted or reported	None	
3a. Indoor spraying only.	No spray operator was observed spraying outside the house	None	
3b. Training on proper spray technique	Operators were trained on proper spray technique and most of them used it correctly	Improper use of spray technique by a few number of operators	
3c. Maintenance of pumps	Pumps were maintained by SOPs and maintenance technicians; however, many leaks were noted and repaired	None: there were spare parts enough	Plastic pumps were more vulnerable
4a. Choose sites for disposal of liquid wastes, including mobile soak pit sites, according to PMI BMPs.	The current 16 operation sites are compliant with PMI BMPs	None	Mobile soak pits sites will be chosen according PMI BMPs when AIRS Benin starts using this facility
4b. Construct fixed and mobile soak pits with charcoal to adsorb pesticide from rinse water.	AIRS Benin fixed soak pits perfectly comply with the BMP guidelines	None	

Mitigation Measure	Status of Mitigation Measures	Outstanding Issues Relating to Required Conditions	Remarks
4c. Maintain soak pits as necessary during season.	All soak pits performed properly over the spray season	Matéri soak pit experienced an overflow issue that was quickly and effectively resolved	
4d. Inspection and certification of solid waste disposal sites before spray campaign.	The disposal site of Tanguieta used since 2011, the unique in Atacora, was confirmed before spray campaign due to its technical characteristics. The landfill site of Ouessè, used since 2014, complies with the national law on environment and confirmed before IRS campaign	None	Solid waste incineration was completed as soon as the IRS campaign ended
4e. Monitoring waste storage and management during campaign.	During campaign, solid waste were stored and managed in compliance with the PMI BMPs	No major issue	The rare non-compliance cases detected were immediately corrected
4f. Monitoring disposal procedures post-campaign.	Solid waste disposal procedures are underway, and disposal certifi-cates will be delivered as required	None	Solid incineration is finished; empty bottles disposal procedure has started on July 20.
5a. Maintain records of all pesticide receipts, issuance, and return of empty sachets/bottles.	All pesticide, masks and empty bottles movements were properly recorded over campaign	None	Monitoring completed during supervision and mid-spray inspection
5b. Reconciliation of number of houses sprayed vs. number of sachets/bottles used.	These numbers were reconciled thanks to the tracking sheet monitoring completed during campaign	None	Monitoring completed during supervision and mid-spray inspection
5c. Visual examination of houses sprayed to confirm pesticide application.	100% of examined houses were effectively sprayed with insecticide	None	Monitoring completed over mid-spray inspection
5d. Perform physical inventory counts during the spray season.	Physical inventories of insecticide and empty bottles performed during campaign matched with the quantities recorded	None	Inventories completed during IRS supervision

ANNEX E: MONITORING AND EVALUATION PLAN

TABLE 23: BENIN MONITORING AND EVALUATION PLAN INDICATOR MATRIX

Last Updated: 15 June 2016

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
Component 1: Establish cost-effective supply chain mechanisms and execute logistical plans								
1.1 Procurement								
1.1.1 Number and percentage of insecticide procurements that had a pre-shipment QA/QC test at least 60 days prior to spray campaign	*Data source*: Project records – insecticide procurements *Reporting frequency*: Each spray campaign	By Spray Campaign	1; 100%	1; 100%	1; 100%	1; 100%	TBD; 100%	
1.1.2 Number and percentage of international insecticide procurements delivered in country, at port of entry, at least 30 days prior to the start of spray operations	*Data source*: Project records – international procurements *Reporting frequency*: Each spray campaign	By Spray Campaign	1; 100%	1; 100%	1; 100%	1; 100%	TBD; 100%	
1.1.3 Number and percentage of international equipment procurements, including PPE, delivered in country, at port of entry, at least 30 days prior to start of spray operations	*Data source:* Project records *Reporting frequency*: Each spray campaign	By Spray Campaign	1; 100%	2: 100%	1; 100%	2; 100%	TBD; 100%	

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
1.1.4 Number and percentage of local procurements for PPE delivered 14 days before the start of spray operations	*Data source:* Project records *Reporting frequency*: Each spray campaign	By Spray Campaign	1; 100%	1;100%	1; 100%	1;100%	TBD; 100%	
1.1.5 Successfully completed spray operations without an insecticide stock-out	*Data source:* Project records *Reporting frequency*: Each spray campaign	By Spray Campaign	Completed	Completed	Completed	Completed	Completed	
1.2 In-Country Exemption and Custom Clearance Process								
1.2.1 Complete exemption and clearance process within the minimum 2 weeks	*Data source:* Project records *Reporting frequency:* Each spray campaign	By Spray Campaign	Completed	Completed	Completed	Completed	Completed	
1.3 In-Country Logistics, Warehousing, and Training								
1.3.1 Number and percentage of logistics and warehouse managers trained in IRS supply chain management	*Data source*: Training records *Reporting frequency*: Each spray campaign	By Spray Campaign By Gender	18; 100%	17; 94%	19; 100%	19; 100%	TBD; 100%	
1.3.2 Number and percentage of base stores where physical inventories are verified by up-to-date stock records	*Data source:* Project records *Reporting frequency*: Each spray campaign	By Spray Campaign	16 (including central warehouse); 100%	16; 100%	18; 100%	18; 100%	TBD; 100%	

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
1.3.3 Submit up-to-date inventory records 30 days after the end of each spray campaign	*Data source:* Project records *Reporting frequency*: Each spray campaign	By Spray Campaign	Completed	Completed	Completed	Completed	TBD; 100%	
Component 2: Implement safe and high-quality IRS programs and provide operational management support								
2.1 Planning and Design of IRS Programs								
2.1.1 Annual PMI AIRS country work plan developed and submitted on time	*Data source:* Project records *Reporting frequency*: Annually	By Spray Campaign	Completed	Completed	Completed	Completed	Completed	
2.1.2 Percentage reduction in project operational expenses per structure from the previous year,excluding insecticide costs .	*Data source:* Project financial records *Reporting frequency*: Annually	By Spray Campaign	5%	1.65%	5%	TBD	5%	
2.2 Support of Safety and Health Best Practices and Compliance with USAID and Host Country Environmental Regulations								
2.2.1 SEA/letter reports submitted on time based on schedule agreed upon with the-PMI COR team	*Data source*: Project records – submitted SEAs/ letter reports Reporting frequency: Each spray campaign	By Spray Campaign	Completed	Completed	Completed	Completed	Completed	

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
2.2.2 Number of spray personnel trained in environmental compliance and personal safety standards in IRS implementation	*Data source:* Project records – Training reports *Reporting frequency:* Each spray season	By Spray Campaign By Gender	1584[2]	1577	1,331[3]	1,310 M: 1,072 F: 238	TBD	
2.2.3 Number of health workers receiving insecticide poisoning case management training	*Data source:* Project records – Training reports *Reporting frequency*: Each spray season	By Spray Campaign By Gender	75	80	75	78 M: 49 F: 29	TBD	
2.2.4 Number of adverse reactions to pesticide exposure documented	*Data source:* Incident report forms *Reporting frequency*: Each spray campaign	By Spray Campaign By Residential/ occupational exposure	0	1	0	1	0	
2.2.5 Number and percentage of soak pits and storehouses inspected and approved prior to spraying	*Data source:* Project records – Reports submitted by commune environmental officers *Reporting frequency:* Each spray season	By Spray Campaign By Soak Pit By Storehouse	33; 100% 16 17	33; 100% 16 17	33; 100% 16 17	33; 100% 16 17	TBD; 100%	

[2] This number includes: spray operators, team leaders, storekeepers, logistic assistants, service technicians, and washers
[3] This number includes: spray operators, team leaders, storekeepers, logistic assistants, service technicians, and washers

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
2.3 Conduct Communications Activities and Community Mobilization								
2.3.1 Number of radio spots and talk shows aired	*Data source:* Project records *Reporting frequency:* Per spray campaign	By Spray Campaign	7,796	7,796	7,796	5494	TBD	
2.3.2 Number of IRS print materials disseminated	*Data source:* Project records *Reporting frequency:* Semi-annually	By Spray Campaign By Type of printed material and message(s)	165,500	165,500 Leaflets: 74,500 IRS cards: 91,000	200,000	200,000 Leaflets: 100,000 IRS cards: 100,000	TBD	
2.3.3. Number of people reached with IRS messages via door-to-door mobilization	*Data source:* Mobilization Data Collection Forms *Reporting frequency:* Daily per mobilization conducted	By Spray Campaign By Gender	383,889	437,714 M: 210,606 F: 227,108	437,714	434,038 M: 206,052 F: 227,986	TBD	
2.4 Spray Targeted Structures According to Technical Specifications								
2.4.1 Number of structures targeted for spraying	*Data source:* Previous spray campaign data, enumeration data (targets); Daily Spray Operator Forms (results) *Reporting frequency:* Daily per spray campaign	By Spray Campaign	265,907	270,141	270,141	296,409	TBD	

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
2.4.2 Number of structures sprayed with IRS	*Data source:* Daily Spray Operator Forms *Reporting frequency:* Daily per spray campaign	By Spray Campaign	226,020	252,706	229,620	269,179	TBD	
2.4.3 Percentage of total structures targeted for spraying that were sprayed with a residual insecticide (Spray Coverage)	*Data source:* Daily Spray Operator Forms *Reporting frequency:* Daily per spray campaign	By Spray Campaign	85%	93.55%	85%	90.8%	85%	
2.4.4 Number of people residing in structures sprayed (Number of people protected by IRS)	*Data source:* Daily Spray Operator Forms *Reporting frequency*: Daily per spray campaign	By Spray Campaign By Gender By pregnant women By children <5 years old	790,000	802,597 M: 406,862 F: 395735 30,454 156,863	802,597	858,113 M: 438,918 F: 419,195 36,088 167,041	TBD	TBD
Component 3: Ongoing Monitoring and Evaluation and Quality Control Measures								
3.1 Submit PMI-approved M&E plan to PMI-BENIN for approval	*Data source:* Project records *Reporting frequency*: Semi-annual	By Spray Campaign	Completed	Completed	Completed	Completed	Completed	

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
3.2 Conduct a post-spray data quality audit within 60 days of completion of spray operations	*Data source*: Spray operations reports *Reporting frequency*: Per spray campaign	By Spray Campaign	N.A	N.A	Completed	ongoing	Completed	
Component 4: Contribute to Global and Country-Level IRS Policy Setting and Develop and Disseminate Experiences and Best Practices								
4.1 Number of guidelines/checklists/tools related to IRS operations developed or refined with project support	*Data source:* Project records – Activity reports *Reporting frequency*: Semi-annually	By Spray Campaign By Guideline/checklist/tool	19 7 Environnment Checklist 4 M&E supervision tools 1 Environnment tool 3 AIRS operation guidline 3 operation checklist 1 mhealth checklist	9	12 3 Environnment Checklists 4 M&E supervision/control tools 1 mhealth checklist 4 operation/Environnment checklist	12 Environnment Checklists 4 M&E supervision/control tools 1 mhealth checklist 4 operation/Environnment checklist	TBD	
4.2 Number of articles/best practices documents published	*Data source:* Project records – Activity reports *Reporting frequency:* Semi-annually	By Spray Campaign By IRS Technical Area	1 Epidemiology	1 Epidemiology	1 Operations	1 Operations	TBD	

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
4.3 Number of best practice presentations given at national/ regional/international workshops and conferences	*Data source:* Project records – Activity reports *Reporting frequency:* Semi-annually	By Spray Campaign By IRS Technical Area	3 1 epidemiology 1 environnment 1 Operation	2	3 1 epidemiology 1 environnment 1 Operation	2 1 epidemiology 1 Operation	TBD	
4.4 Number of enterprises engaged through public-private partnerships	*Data source:* Project records – Activity reports *Reporting frequency:* Semi-annually	By Spray Campaign	0	0	1	0	TBD	
5.1.1 Number of entomological sentinel sites supported by the PMI AIRS Project established to monitor vector bionomics and behavior (vector species, distribution, seasonality, feeding time, and location)	*Data source:* Entomological reports *Reporting frequency:* Annually	By Spray Campaign	5	N/A	N/A		TBD	

[4] The entomological monitoring is ensured by the Entomology Research Center of Cotonou (CREC)

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
5.1.2 Number and percentage of entomological monitoring sentinel sites measuring all the five primary PMI entomological monitoring indicators	*Data source:* Entomological reports *Reporting frequency:* Annually	By Spray Campaign	5; 100%	N/A	N/A		TBD	
5.1.3 Number and percentage of entomological monitoring sites measuring at least one secondary PMI indicator	*Data source:* Entomological reports *Reporting frequency:* Annually	By Spray Campaign	5; 100%	N/A	N/A		TBD	
5.1.4 Number and percentage of insecticide resistance testing sites that tested at least one insecticide from each of the four classes of insecticides recommended for malaria vector control	*Data source:* Entomological reports *Reporting frequency:* Annually	By Spray Campaign	4; 100%	N/A	N/A		TBD	
5.1.5 Number of wall bioassays conducted within 2 weeks of spraying to evaluate the quality of IRS*	*Data source:* Entomological reports *Reporting frequency:* Per spray campaign	By Spray Campaign	18 tests total 1 test on 16 treatment structures and 2 control structure	N/A	N/A		TBD	
5.1.6 Number of wall bioassays conducted after the completion of spraying at monthly intervals to evaluate insecticide decay*	*Data source:* Entomological reports *Reporting frequency:* Per spray campaign	By Spray Campaign	108	N/A	N/A		TBD	

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
5.1.7 Number of vector susceptibility tests for different insecticides conducted in selected sentinel sites*	*Data source:* Entomological reports *Reporting frequency:* Per spray campaign	By Spray Campaign By Type of Insecticide	1 test for pyrethroid class 1 test for carbamate 1 test for organophosphate 1 test for organochlorine	N/A	N/A		TBD	
5.2 Support Epidemiological Malaria Data Collection and Analysis								
5.2.1 Collect routine epidemiological data	*Data source:* Project Reports *Reporting Frequency:* Annually	By Spray Campaign	1 per trimester	1	1 per trimester	1	TBD	
5.2.2 Number of targeted health facilities with routine epidemiological malaria data collection supported by the PMI AIRS Project	*Data source:* Epidemiological reports *Reporting frequency:* Annually	By Spray Campaign	30 Atacora 16 Banicoara 14	33 Atacora 17 Banicoara 16	33 Atacora 17 Banicoara 16	33 Atacora 17 Banicoara 16	TBD	

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
Component 6 (Cross-cutting): Capacity Building, Knowledge Transfer, Gender Inclusion								
6.1 Increasing the Role of Women and Addressing Gender Barriers								
6.1.1 Number of people trained to deliver IRS in target communes *	*Data source:* Project records – Training reports *Reporting frequency*: Semi-annually	By Spray Campaign By Spray Campaign By Gender Percentage of Women Trained	1,495	1,500 M:1,285 F: 215 14.3%	1,301	1,372 M:1,151 F: 221 16.1%	TBD	
6.1.2 Total number of people trained to support IRS in target communes	*Data source:* Project records – Training reports *Reporting frequency*: Semi-annually	By Spray Campaign By Spray Campaign By Gender Percentage of women trained	3,627	3,333 M: 2,663 F: 559 16.8%	3,218	3,104 M: 2,423 F: 576 18.6%	TBD	

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
6.1.3 Number of women recruited for IRS employment	*Data source:* Project records – Recruitment reports reports *Reporting frequency*: Semi-annually	By Country By Percentage of women recruited	907 19.0%	559 16.8%	691 25%	576 18.6%	TBD	
6.1.4 Number of people trained as IRS Training of Trainers	*Data source:* Project records – Training reports *Reporting frequency*: Semi-annually	By Spray Campaign By Gender Percentage of women trained	128	134 M: 106 F: 28 20.8%	125	141 M: 112 F: 29 20.6%	TBD	
6.1.5 Total number of people hired to support IRS in target communes	*Data source:* Project records – Contracts signed *Reporting frequency*: *Semi-annually*	By Spray Campaign Gender Percentage of women hired	3,061 19.0%	2,984 M : 2,525 F: 459 15.4%	2,764 M: 2073 F 691 25%	2,835 M: 2,292 F: 543 19.2%	TBD	

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
6.1.6 Number of women hired in supervisory roles in target communes (this number includes site supervisors, team leaders, M&E assistants and others who supervise seasonal staff)	*Data source:* Project records – Contracts signed *Reporting frequency*: *Semi-annually*	By Spray Campaign Percentage of women hired	64[5] 21,2%	54 Team Leaders:35 Commune Coordinators : 3 Supervisors: 16 18.7% of supervisory roles were held by women	64	51 Team Leaders: 28 Commune Coordinators: 2 Supervisors: 21 19.8% of supervisory roles were held by women	TBD	
6.1.7 Number of staff (permanent and seasonal) who have completed gender awareness training	*Data source:* Project records – Training reports *Reporting frequency:* Annually	By Spray Campaign Gender Percentage of women hired	1	1,431 Seasonal: 1,428 Permanent: 3 M: 1,236 F: 195	1,314	1,301 Seasonal: 1,298 Permanent: 3 M: 1,106 F: 192	TBD	

[5] This number includes Team Leaders, district coordinator, site coordinator, supervisors

Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregate	Annual Targets and Results					
			Year 1		Year 2		Year 3	
			Target	Results	Target	Results	Target	Results
6.2 Capacity Building								
6.2.1 Number of government officials trained in IRS oversight	*Data source:* Project records – Training reports *Reporting frequency*: annually	By Spray Campaign By Gender Percentage of Women Trained	219	111 M: 79 F: 32 28.8%	111	105 M: 70 F: 35 33.3%	TBD	
6.2. Implement all activities outlined in their yearly Capacity Building Action Plan	*Data source:* Project records – Capacity assessment reports *Reporting frequency*: Semi-annually	By Spray Campaign	Completed	Completed	Completed	Completed	Completed	
6.2.3 Benin government implements at least one aspect of the IRS program independently.	*Data source:* Project records – MOUs *Reporting frequency*: Semi-annually	By Spray Campaign	Completed	Completed	Completed	Completed	TBD	