



U.S. PRESIDENT'S MALARIA INITIATIVE



THE PMI VECTORLINK PROJECT ZAMBIA

2018 END OF SPRAY REPORT

SPRAY CAMPAIGN: OCTOBER 15, 2018 – DECEMBER 15, 2018

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ACRONYMS

AIRS	Africa Indoor Residual Spraying Project
BMP	Best Management Practices
DCV	Data Collection Verification
DEC	Data Entry Clerk
DHIS2	District Health Information System 2
DHO	District Health Office
ECO	Environmental Compliance Officer
EHT	Environmental Health Technician
EMMR	Environmental Mitigation and Monitoring Report
GRZ	Government of the Republic of Zambia
HFCA	Health Facility Catchment Area
IEC	Information, Education, and Communication
IRS	Indoor Residual Spraying
ITN	Insecticide-Treated Net
M&E	Monitoring and Evaluation
MOH	Ministry of Health
MOP	Malaria Operational Plan
MSP	Mobile Soak Pit
NMCP	National Malaria Control Program
NMEP	National Malaria Elimination Program
PMI	U.S. President’s Malaria Initiative
PPE	Personal Protective Equipment
PSECA	Pre-Season Environmental Compliance Assessment
RHC	Rural Health Center
SBCC	Social Behavior Change Communication
SEA	Supplemental Environmental Assessment
SOP	Spray Operator
TAC	Technical Advisory Committee
TL	Team Leader
TLA	Team Leader Assistant
TOT	Training of Trainers

TWG	Technical Working Group
USAID	United States Agency for International Development
UTH	University Teaching Hospital
WHO	World Health Organization
ZEMA	Zambia Environmental Management Agency

EXECUTIVE SUMMARY

The U.S. President’s Malaria Initiative (PMI) VectorLink Project, funded by the U.S. Agency for International Development (USAID) and implemented by Abt Associates, supports the implementation of indoor residual spraying (IRS) in Zambia. VectorLink Zambia aims to provide technical, managerial, and operational support to Zambia’s National Malaria Elimination Program (NMEP) through IRS.

VectorLink Zambia conducted its 2018 IRS campaign in two phases between October 15, 2018 and December 15, 2018. The project aimed to spray 540,000 structures in 26 high burden districts in Luapula, Northern, and Muchinga Provinces, and 90,000 structures in the three pre-elimination districts of Eastern Province (Katete, Sinda, and Chadiza). The project sprayed Actellic 300CS (the organophosphate, pirimiphos-methyl) in Luapula, Northern, and Muchinga, and SumiShield 50WG (active ingredient: clothianidin) in Eastern.

Project achievements during the 2018 spray campaign included (see Table 1 in main report):

- Sprayed 579,490 structures out of 644,677 structures found by spray operators (SOPs), resulting in 90 percent spray coverage. Protected 2,818,176 people, including 411,416 children under five years and 89,959 pregnant women.
- Trained 2,089 individuals to deliver IRS¹ in 29 districts. Of these, 147 were supervisors, 1,564 were SOPs, 295 were team leaders, and 83 were team leader assistants. Females accounted for 29 percent of all staff trained², and 29 percent of supervisory positions.
- Sprayed 491,873 structures in Luapula, Northern, and Muchinga Provinces with 127,079 bottles of Actellic 300CS (3.9 structures per bottle) and sprayed 87,617 structures in Eastern Province using 20,904 sachets of SumiShield (4.2 structures per sachet).
- Conducted wall bioassays within 24-48 hours of spraying and recorded 100 percent mortality of susceptible *An. gambiae* (Kisumu) on all wall surface types sprayed with both insecticides, signifying a high-quality spray.
- Began safely disposing of all IRS insecticide contaminated wastes, including empty Actellic bottles, empty SumiShield sachets, and used masks. Greenland General Limited, based in Lusaka, will help recycle the empty Actellic bottles into conduit pipes, while the University Teaching Hospital, also in Lusaka will incinerate empty SumiShield sachets. The project will dispose of other wastes (damaged gloves, boots, and assorted plastic items) according to best management practices.

¹ Based on the definition of the indicator “Number of people trained with USG funds to deliver IRS”, spray personnel trained to deliver IRS only include spray personnel such as spray operators, team leaders, and supervisors. Clinicians, data clerks, IEC mobilizers, drivers, washers, porters, pump technicians and security guards were excluded.

² This includes supervisors, mobilizers, spray operators, team leaders, team leader assistants, data entry clerks, M&E assistants, district storekeepers, and clinicians.

I. COUNTRY BACKGROUND

The United States Agency for International Development (USAID) began funding indoor residual spraying (IRS) activities in Zambia in 2006. In 2008, the U.S. President’s Malaria Initiative (PMI) started supporting IRS in Zambia, and worked in 15 districts across four provinces. In 2011, following delays in World Bank funding for district IRS operations, PMI bridged the gap and funded IRS in 25 high-malaria burden districts. In 2012 and 2013, PMI focused its support in 20 districts in three provinces with the highest malaria incidence, targeting an estimated 530,000 structures.

As resources for malaria vector control declined, the country switched to targeted spraying in 2014 to prioritize coverage of high-risk areas in 40 high-burden malaria districts, in line with Zambia’s 2011–2016 National Malaria Strategic Plan. These 40 districts included 15 districts in Luapula and Central Provinces funded by the United Kingdom’s Department for International Development. In 2016, PMI and the Africa Indoor Residual Spraying Project (AIRS) in Zambia benefited from NGenIRS/UNITAID co-funding, allowing the project to support IRS in 35 districts across Eastern, Luapula, Muchinga, and Northern Provinces.

In 2017, the government officially launched the National Malaria Elimination Strategic Plan 2017–2021, which aims to help transition Zambia from malaria control to malaria elimination. In the same year, PMI, AIRS Zambia, and the Zambia Ministry of Health (MOH) agreed to continue IRS in the same 36 high-burden districts across Eastern, Luapula, Muchinga, and Northern Provinces (one district, Mbala, was split into two, which brought the total to 36 districts in 2017). In the 2017 campaign, AIRS Zambia sprayed 634,410 structures out of 676,188 structures found. Table 1 provides a summary of USAID and PMI support to IRS in Zambia.

Table 1: USAID and PMI Support for IRS in Zambia, 2006 to 2018

Year	# of Structures Sprayed	# of Persons Protected	# of USAID Supported Districts	# of PMI Supported Districts	Insecticide Used
2006	537,877	—	15	—	DDT and pyrethroids
2007	657,219	—	15	—	DDT and pyrethroids
2008	1,039,154	—	36	3	DDT and pyrethroids
2009	1,191,517	—	—	36	DDT and pyrethroids
2010	740,699	2,721,166	—	25	DDT and pyrethroids
2011	814,706	3,351,158	—	35	Carbamates and pyrethroids
2012	460,358	1,710,833	—	20	Carbamates and organophosphates
2013	432,398	1,842,821	—	20	Organophosphates

Year	# of Structures Sprayed	# of Persons Protected	# of USAID Supported Districts	# of PMI Supported Districts	Insecticide Used
2014	409,544	2,000,824	—	40	Organophosphates
2015	519,598	2,544,290	—	39	Organophosphates
2016	559,550	2,626,718	—	35	Organophosphates
2017	634,410	3,005,878	—	36	Organophosphates
2018	491,873 (main)	2,504,775	—	26	Organophosphates
	87,167 (pre-elim)	313,401	—	3	Neonicotinoids (SumiShield)

In 2018, during the first year of the PMI VectorLink Project, the team targeted 540,000 structures for IRS in 26 districts in three provinces (Luapula, Northern, and Muchinga). PMI VectorLink targeted an additional 90,000 structures in three districts (Katete, Sinda, and Chadiza) in Eastern Province using supplemental pre-elimination funds. As in 2017, the project benefited from NGenIRS/UNITAID co-funding. Two districts were excluded from spraying in 2018; Lunga district in Luapula Province was not sprayed due to environmental concerns arising from high water table and widespread wetland characteristics, and Mpulungu in Northern Province was excluded due to unresolved USAID Office of Inspector General investigations arising from widespread fraud that affected the 2017 campaign.

2. PRE-SEASON ACTIVITIES

2.1 SELECTION OF IRS DISTRICTS AND CATCHMENT AREAS

In 2018, VectorLink targeted 630,000 structures for IRS across 29 districts in four provinces (Eastern, Luapula, Northern, and Muchinga) in Zambia. PMI Zambia and the National Malaria Elimination Program (NMEP), in coordination with VectorLink Zambia, selected the districts and catchment areas to receive IRS based on NMEP criteria such as malaria burden, population density, density of eligible structures, available resources, accessibility, and consideration of the universal coverage of insecticide-treated nets (ITNs) as the primary vector management intervention. The original FY18 PMI Zambia Malaria Operational Plan included funding for spraying 540,000 structures in three provinces (Luapula, Northern, and Muchinga) with Actellic 300CS. The goal was to attain 80 percent coverage of structures and population in all PMI-targeted districts in those three provinces. Additionally, VectorLink targeted 90,000 structures across three districts (Chadiza, Katete, and Sinda) in Eastern Province using SumiShield insecticide. This operation was part of a new PMI-supported malaria elimination strategy, funded by a supplement to the FY18 Malaria Operational Plan. The supplement specified a package of high-coverage malaria control interventions to accelerate pre-elimination in low-burden districts and health facility catchment areas in the plateau area of the province. In Year 1, VectorLink aimed to spray 80 percent of all eligible structures in the three districts, benefitting approximately 80 percent of the population in the Chadiza and Katete and 63 percent in Sinda. Section 3.2 describes the reasons for the low coverage in Sinda.

Of note, this approach was a change from the historic targeting of 50-60% of structures under the AIRS project to 2017, and was in line with the National Elimination Strategic Plan, which aspires to 80% population coverage across the country. Following NMEP guidance, the project effectively shifted its resources out of the six non-pre-elimination districts of Eastern Province to maximize coverage in Luapula, Northern, and Muchinga. The Government of the Republic of Zambia (GRZ) intended to cover those six districts of Eastern Province with SumiShield using non-PMI resources. (Unfortunately, the funding for that did not materialize in time for the 2018 season.)

To define the 20 percent of population that would not receive IRS, VectorLink facilitated district-level microplanning meetings across all four provinces. At the meeting, stakeholders used NMEP targeting criteria to determine which health facility catchment areas (HFCAs) would not receive IRS and, in some cases, which sub-areas within HFCAs would also be excluded. For example, the NMEP and District Health Offices (DHOs) exclude areas where structures are considered too scattered, or too difficult to reach; in practice, the definition and application of such criteria tend to be inconsistent. Participants considered different sets of data (estimates from satellite imagery from mSpray/Akros, population estimates from the Central Statistical Office, and estimates from the DHO) to determine district spray targets. In collaboration with the NMEP, provincial health offices, and DHOs, VectorLink determined the number of target structures per district.

PMI VectorLink Zambia planned to conduct IRS in 477 out of 514 catchment areas across the four target provinces, representing an estimated 93 percent of all catchment areas in the four target provinces. The other 7 percent of the excluded HFCAs comprised urban communities, which typically experience high rates of refusals, and/or included areas that are not suitable for IRS according to the NMEP criteria. Table 2 shows the number of catchment areas and individual structures targeted for IRS in the four provinces. Annex D provides a detailed breakdown of eligible and targeted structures in each province.

Table 2: Number of Targeted Structures for IRS by VectorLink Zambia in 2018 by Province

Province	Number of Catchment Areas	Catchment Areas Receiving IRS (% of total)	Total Eligible Structures	Number of Targeted Structures (% of total eligible structures)
Eastern*	75	70 (93%)	129,629	90,000 (69%)
Luapula	145	137 (95%)	254,632	235,368 (92%)
Northern	171	147 (86%)	212,353	180,354 (85%)
Muchinga	123	123 (100%)	127,392	124,278 (98%)
Total	514	477 (93%)	724,006	630,000 (87%)

*Note: As discussed in text, VectorLink Zambia sprayed only three districts in Eastern Province to maximize coverage in Luapula, Northern, and Muchinga.

2.2 DISTRICT PLANNING MEETINGS

To develop district-level IRS operational plans, PMI VectorLink organized a one-day planning meeting in June 2018 in each of the four provinces with active participation of district- and provincial-level officials. Issues discussed during the microplanning meetings included:

- Timing and duration of spray operations
- Targeting requirements (100 percent of eligible structures in each catchment area)
- Insecticide selection
- Procurement and logistics
- Spray performance targets
- Monitoring and supervision plan
- Recruitment of spray operators (SOPs)
- Role and responsibilities of stakeholders before, during, and after spray campaign

2.3 INSECTICIDE SELECTION

Zambia has a rigorous insecticide resistance management strategy that supports entomological monitoring to inform insecticide selection. The Insecticide Resistance Technical Advisory Committee (TAC) develops the strategy and advises the NMEP on execution. The TAC includes representatives from the Tropical Diseases Research Centre, the Macha Malaria Institute, University of Liverpool, Johns Hopkins University, Centers for Disease Control and Prevention, VectorLink Zambia, PMI, and the NMEP. At their annual meeting in September 2017, the Committee reviewed the most recent entomological data and determined that Zambia should spray pirimiphos-methyl (an organophosphate) in most parts of the country during the 2018 campaign. The Vector Control Technical Working Group, which ultimately selects the insecticide, ratified the Committee's recommendation to spray Actellic 300CS in most parts of the country. The exception was in Eastern Province, where IRS had been conducted using Actellic for a much longer period compared to that in other provinces. Following World Health Organization (WHO) prequalification (PQ) of SumiShield 50WG

in 2017, SumiShield (a clothianidin-based insecticide) was selected for Eastern. In May 2018, MOH gave a directive to conduct IRS with non-Actellic insecticide including DDT, SumiShield, or Fludora Fusion. By this time, PMI VectorLink had begun the procurement of Actellic based on the recommendation made by the TAC in 2017. Due to the difference between the MOH directive and TAC recommendation on insecticide deployment, 2018 IRS planning and training timetables were delayed and later compressed. Furthermore, procurement of non-Actellic insecticides (DDT and clothianidin) in non-PMI IRS supported districts did not take place due to non-materialization of the requisite funding. These districts ended up spraying a small proportion of the targeted areas with Actellic remaining from 2017. Additionally, PMI donated 18,589 leftover bottles of Actellic to NMEP to spray high-burden areas (discussed further under Section 3.6.1).

2.4 LOGISTICS NEEDS ASSESSMENT

For efficiency in meeting project spray procurement needs, VectorLink Zambia's logistics team conducted a second inventory assessment of all 2017 leftover IRS equipment and supplies in July 2018. This was necessary to update inventory counts because the GRZ-supported IRS used PMI-procured IRS equipment after the initial post-spray inventory assessment by the VectorLink Zambia logistics team. At the district level, the VectorLink Zambia logistics team worked with the IRS manager, public health officer, and VectorLink Zambia district coordinator to sort personal protective equipment (PPE) and other equipment. A report from this undertaking, coupled the microplanning meetings, served as a benchmark for procurement of IRS commodities for the 2018 spray campaign. A logistics needs assessment that emphasized the adequacy of existing operation sites also informed the decision to establish eight new operation bases during the 2018 spray campaign. This activity was necessitated primarily by the increase in coverage to 80% of the population from the historic 55% coverage. It also served to decongest the existing sites and to reduce the travel distances from the operation sites to the target communities. One new site was located in each of the following districts: Sinda, Katete, Kasama, Mungwi, Mpika, Mansa, Nchelenge, and Mwense.

2.5 PROCUREMENT

VectorLink procured both international and local commodities (see Annex A for full list). It is noteworthy to mention that the new spray pumps required for the 2018 campaign and procured were exclusively the Goizper model (previously, both Goizper and Hudson pumps have been used). The Goizper pump is generally viewed as more user-friendly than the Hudson pump. When possible, the project procured items locally to ensure cost effectiveness and timely delivery. The team used an open, competitive bidding process for local tenders of commodities and services, which were evaluated by the VectorLink Zambia procurement committee in Lusaka.

2.6 HUMAN RESOURCES

VectorLink Zambia worked with each district to recruit spray teams, which generally consisted of one team leader supervising five SOPs. In Eastern Province, where mSpray was implemented as part of the pre-elimination program, one team leader supervised six SOPs and two team leader assistants (TLAs) who provided the required additional support to administer the mSpray platform. Each supervisor managed two team leaders and their teams and reported to the IRS manager. VectorLink district coordinators supported the IRS managers.

In total, VectorLink Zambia engaged 71 GRZ employees (29 IRS managers and 42 supervisors) in a temporary capacity and 2,177 seasonal staff (7 assistant district coordinators, 78 supervisors, 45 monitoring and evaluation (M&E) assistants, 52 data entry clerks (DECs), 247 team leaders, 71 TLAs, 1,500 SOPs, 73 storekeepers, and 104 washers). Additionally the project hired five assistant district coordinators to support particularly challenging districts. For door-to-door sensitization and mobilization activities, VectorLink Zambia engaged community-based volunteers including neighborhood health committee members, community health volunteers, and literate community members. Table 3 breaks down spray personnel hired for 2018 operations by gender and role.

Table 3: Hiring by PMI VectorLink Zambia for 2018 IRS Campaign

Category	Number of Staff Hired to Support IRS ³						Total (% Female)
	Spray Ops		Data Capture		Other		
	M	F	M	F	M	F	
Supervisors	105	42	–	–	–	–	147 (28%)
Mobilizers	–	–	–	–	3,068	1,173	4,241 (27%)
Spray operators	887	399	–	–	–	–	1,286 (31%)
Team leaders	141	70	–	–	–	–	211 (33)%
Team leader assistants	–	–	53	18	–	–	71 (25%)
Data entry clerks	–	–	37	27	–	–	64 (42%)
M&E assistants	–	–	38	8	–	–	46 (17%)
Storekeepers	–	–	–	–	52	21	73 (29%)
Clinicians	–	–	–	–	24	7	31 (22%)
TOTAL M/F	1,133	511	128	53	3,144	1,201	6,170 (29%)
TOTAL	1,644		181				

2.7 INFORMATION, EDUCATION, AND COMMUNICATION

To ensure successful spray operations, the project used various information, education, and communication (IEC) strategies before and during the spray campaign to create awareness and encourage households and communities to accept IRS. These strategies included door-to-door sensitization and mobilization, meeting with traditional leaders and section leaders, radio announcements, and use of the public address system.

2.8 TRAINING

Before spray operations began, VectorLink Zambia collaborated with DHOs to train personnel involved in IRS. Table 4 lists each type of IRS training conducted, a description of topics it covered, and its duration. Table 5 shows the number of people trained, disaggregated by gender.

³ Clinicians, supervisors, and 50% of hired storekeepers are GRZ staff.

Table 4: Type, Description, and Duration of Trainings

Type	Description of Training	Duration
Training of Trainers and Supervisors	The training was designed for provincial- and district-level IRS supervisors who would go on to train seasonal workers (SOPs, storekeepers, and community mobilizers). TOTs emphasized the importance of explaining and demonstrating current best practices in IRS when teaching other cadres of spray personnel. There was also a supervision component.	5 days
Spray Operators	VectorLink Zambia designed this training to build upon SOPs' capacity to conduct IRS and effectively communicate with householders. In particular, the training emphasized the importance of finding all eligible structures and conducting high-quality IRS. Other topics covered: introduction to malaria control, spray techniques, handling insecticides and spray pumps, personal and environmental safety, data collection forms, and the basics of IEC for IRS.	6 days
Team Leaders	The training was designed to prepare team leaders to lead at least five SOPs and ensure high-quality spraying. Team leaders were also trained in spray techniques.	6 days
Data Entry Clerks	DECs were trained on the use of data collection forms (Daily Spray Operator forms and Team Leader summary forms, and the VectorLink Zambia supervisory toolkit), understanding key IRS definitions (e.g., eligible structure) and indicators, staff responsibilities, communication protocol, and review and reporting of collected data in a timely, consistent, and accurate manner. The training also emphasized the VectorLink Zambia database, security protocols, and data quality assurance and control.	3 days
Team Leader Assistants	TLAs were trained on relevant data collection forms (Daily Spray Operator and Team Leader summary forms) and use of the mSpray tool for data collection in the three pre-elimination districts. They were also trained on key IRS definitions (e.g., eligible structure), indicators, staff responsibilities, communication protocol, review and reporting (quality assurance) of collected data in a timely, consistent, and accurate manner.	5 days
M&E Assistants	M&E assistants were trained on all VectorLink data collection and verification forms as well as the VectorLink Zambia supervisory toolkit. They were also trained on key IRS definitions (e.g., eligible structure), indicators, staff responsibilities, communication protocol, and review and reporting (quality assurance) of collected data in a timely, consistent, and accurate manner. Furthermore, they were oriented on the VectorLink Zambia database and security protocols.	2 days
Storekeepers	At least two storekeepers from each target district (one GRZ and one VectorLink Zambia seasonal storekeeper) were trained on store and inventory management.	2 days
Clinicians	Clinicians were recruited from at least one key health facility from each target district. The training focused on insecticide poisoning management, poisoning prevention and mitigation practices, health hazards and their management.	1 day

Type	Description of Training	Duration
Community mobilizers	Community health workers were trained on how to increase the community's understanding of malaria, acceptance for IRS, and awareness of IRS spray schedule.	1 day
Drivers	Drivers contracted to transport IRS materials and personnel were trained on safety procedures.	1 day
Procurement	District coordinators were trained in the use of the VectorLink Zambia Procurement Policy to ensure they strictly adhered to the Abt Procurement Policy and USAID regulations in their day-to-day procurement of goods and services.	1 day
Gender Sensitivity	All PMI VectorLink technical staff and district coordinators received training in gender issues and the importance of having more women recruited during 2018 spraying season. Moreover, all supervisors were oriented to this issue during the TOT.	1 day

Table 5: Number and Type of Seasonal Workers⁴ Trained, by Gender and Job Category

Category	Males	Females	Total (% Female)
Supervisors	105	42	147 (29%)
Mobilizers	3,068	1,173	4,241 (27%)
Spray operators	1,081	483	1,564 (31%)
Team leaders	197	98	295 (33%)
Team leader assistants	58	25	83 (30%)
Data entry clerks	42	30	72 (40%)
M&E assistants	42	8	50 (16%)
District storekeepers	52	21	73 (29%)
Clinicians	24	7	31 (22%)
TOTAL	4,669	1,887	6,556 (29%)

⁴ Clinicians, supervisors and 50% of storekeepers are GRZ staff.

3. IMPLEMENTATION OF IRS ACTIVITIES

The following sections describe activities and results before, during, and after the campaign.

3.1 OVERVIEW

VectorLink Zambia implemented the 2018 spray campaign within 34 operational days, compared with 55 days in 2017. Mporokoso and Kawambwa districts started the campaign ahead of the other 27 districts because the rainy season begins earlier there. The campaign took place from October 15 to November 22, 2018 in these two districts and from November 1 to December 15, 2018 in the other 27 districts. The earlier start in Mporokoso and Kawambwa gave the VectorLink Zambia technical team an opportunity to learn lessons that they applied to improve monitoring and supervision during the main campaign. Lessons learned included determining ways of handling caterpillar harvesting challenges, thereby adjusting the spray calendars in the districts that had not started spraying to prioritize certain areas depending on the extent of the problem. In some districts, caterpillar harvesting camps were prioritized whereas in other districts communities from where householders would migrate to the camps were targeted before they migrated. Additionally, it was observed that community sensitization and mobilization by CHWs in both Kawambwa and Mporokoso was ineffective, thus in the rest of the districts the project engaged traditional and section leaders in rural and urbanized areas respectively to conduct community sensitization and mobilization.

The project targeted 630,000 structures for IRS in four provinces (Luapula, Northern, Muchinga, and Eastern). The average number of operational days per district was 30. The spray season in 2018 started later than in 2017 in response to the 2017 recommendation to spray as close as possible to the start of the rainy season to maximize the short residual efficacy of Actellic 300CS (four to five months). The later start meant the Actellic 300CS would cover most of the malaria transmission period, which generally extends into April except for Nchelenge where transmission extends into September and October.

VectorLink Zambia's district-based IRS operations design has traditionally used vehicles for the duration of the campaign, to transport spray teams from their operation base to spray sites. In 2018 in Mpika, Luwingu, and Mwansabombwe districts, the project piloted a new SOP transportation approach, in which spray teams used bicycles during the last seven days of spray. (This cost-saving field operations initiative is described in Annex J.) In all spray districts, spraying started from the farthest locations from the operation site (hard-to-reach areas) and ended with communities surrounding the operation sites. In all districts, mop-up teams, which comprised 10 percent of the main team, helped ensure coverage of 85 percent of eligible structures in each targeted community. Two days of general mop-up at the end of the spray period helped achieve coverages above 85 percent in some areas. To improve the spray coverage, the spray calendar was extended for two days in Kasama and Samfya.

Spray teams camped in 16 districts where the distances between the operation sites and the targeted communities were so great that the spray teams could not spray the community and return to base in the same day. The districts included Chama, Milenge, Chinsali, Mpika, Shiwangandu, Mafinga, Isoka, and Kasama. Others were Nakonde, Mungwi, Mbala, Senga, Nsama, Luwingu, Mporokoso, and Chilubi. In the camp locations, the project used mobile soak pits (MSPs) to treat the insecticide effluent.

3.2 MICROPLANNING FOR PRE-ELIMINATION DISTRICTS

In 2018, VectorLink Zambia implemented mSpray in the three pre-elimination districts (Sinda, Katete, and Chadiza) of Eastern Province. The team previously had used the tool in Katete and Chadiza. mSpray is a spray data collection tool that tracks spray progress and records GPS coordinates on tablets,

In an mSpray district, a spray team comprises nine personnel (compared to six in a regular spray district) – one team leader, two TLAs, and six SOPs. In both mSpray and non-mSpray districts, the role of the team leader is to supervise SOPs and ensure quality spraying and data accuracy. The main role of TLAs is to guide the team to structures and update the mSpray application using maps that are loaded onto tablets. Each TLA is responsible for guiding three SOPs and entering household-level data for each structure those SOPs spray.

During the microplanning process held in June 2018, district malaria teams (IRS managers and district health information officers) and technical officers from the NMEP (IRS principal officer and vector control officer) agreed that the total number of eligible structures in the three districts was about 101,800 – 43,500 in Katete, 33,700 in Sinda, and 24,600 in Chadiza. During microplanning, the team estimated the number of eligible structures based on three data sets: Central Statistical Office population estimates, DHO estimates, and estimates from existing satellite imagery from Akros. Akros imagery for Sinda district was not available during the microplanning meeting because pre-elimination funding and the scope of work for Akros had not been approved by this time.

Following an exhaustive review of the numbers, the microplanning team agreed on a plan for how to target 90,000 structures for IRS in 2018; this constituted 88 percent of all estimated eligible structures in the three districts. Akros completed the satellite enumeration for Sinda about two months after the microplanning meeting took place. Its figures showed that the estimated number of eligible structures in Katete and Chadiza had not significantly changed but the estimated eligible number of structures in Sinda was significantly greater than the VectorLink and DHO estimates (58,944 versus 33,700). After discussion, VectorLink Zambia, Akros, and Sinda district officials agreed to proceed with the initial target figure of 31,500 which PMI had approved in the VectorLink Zambia pre-elimination work plan and budget. For operational purposes, they agreed to target based on ecological factors established by operational research that Akros conducted in six districts of Eastern Province during the 2017 IRS campaign, and ensured close coordination with district officials to proactively manage the communities' expectations given mobilization had already occurred. Going forward, VectorLink Zambia will strive to enumerate as early as possible prior to the start of the campaign and conduct microplanning early to avoid last-minute changes that could affect district and community perceptions of IRS.

3.3 MANAGING SOCIAL BEHAVIORAL CHANGE COMMUNICATION

Low IRS acceptance rates (62%) particularly in urban areas, have historically been a challenge for spray campaigns in Zambia, as in many countries. This has happened despite massive social behavioral change communication (SBCC) efforts in all districts, which included mobilizers visiting households, announcements, and sensitization through the media as well as informing traditional and section leaders at various levels within the communities. From the results obtained during the past three years, the main challenge faced by IRS implementation in Zambia has been low acceptance at the household level. Among the structures not sprayed (10 percent of all structures found) in 2018 and 2017, 38 percent were not sprayed due to refusals by the household; in 2016, refusals accounted for 44 percent of structures not sprayed. Refusals are largely due to the common myths of IRS increasing the density of fleas and other insects, or the idea that IRS is unsuitable for houses with babies below two weeks of age and/or asthmatic patients.

In 2018, the dynamics changed since the campaign began two weeks later in 27 of the 29 districts. While the later start date was beneficial to maximize the residual efficacy of the insecticide, it meant the campaign coincided with economic activities such as farming and the annual gathering of mopane worms (caterpillars) in woodland areas. The latter activity accounted for low accessibility rates in 15 districts because most household heads had migrated to the caterpillar harvesting camps and left their houses locked. In some instances, they had left minors at homes with instructions not to give spray teams access to their houses.

Given that the 2018 spray campaign was allotted 30 workdays (unlike earlier campaigns that lasted up to 55 days), VectorLink Zambia worked with the National Malaria Elimination Centre to develop a strategy to address this situation. The strategy entailed:

- Working with districts to actively engage chiefs and their headsmen to encourage acceptance of IRS;
- Ensuring district commissioners visited the field to assess the situation and to encourage acceptance of IRS;
- Ensuring that PMI VectorLink district coordinators and IRS managers reminded headsmen about the spray team visit a day in advance; and
- Ensuring that mobilizers also reminded communities a day in advance and that they accompanied the spray teams on the spray day.

In districts most affected by caterpillar harvesting activities (Shiwangandu and Senga), VectorLink Zambia temporarily suspended the campaign for approximately one week and allow household members to return to their homes after the end of the harvesting season. In Samfya, where many householders had left their homes for the fishing camps, the spray calendar was extended by two days to allow for the householders to return after the fish ban was effected. Similarly in Kasama, where IRS was characterized by high refusals in urbanized settings, the spray calendar was extended by two days. In Mpika, the lower-than-expected IRS coverage was a result of the combination of caterpillar harvesting and early rainfall.

Nchelenge district experienced high refusal rates for other reasons such as high proportion of immigrants from the Democratic Republic of Congo, high proportion of fishing households, and longstanding alienation of sectors of the population from the authorities. These reasons made acceptance of IRS by the householders difficult which compelled NMEP through the DHO to engage the police to convince householders to accept IRS. VectorLink deployed additional mobilization strategies such as community meetings with traditional and civic leaders, radio discussions and announcements, and use of a public announcement system in these communities before resuming spraying.

3.3.1 DOOR-TO-DOOR SENSITIZATION AND MOBILIZATION

The main strategies for disseminating IRS messages before the 2018 IRS implementation were door-to-door sensitization and mobilization. VectorLink Zambia trained 4,241 mobilizers who resided in the target communities to conduct community sensitization and mobilization activities starting two weeks before the campaign. The activities lasted three days in all districts, except in the three pre-elimination districts, where they lasted four days due to the fact that the use of mSpray tool required more time to capture mobilization data on tablets.

Mobilizers visited every household, explaining IRS and correcting residents' misconceptions about it, and educating households on their roles and responsibilities before, during, and after spraying. Mobilizers also distributed IRS cards, told the household when the spray team would arrive, collected household data (i.e., number of people reached with IRS messages), and marked each structure with a unique number.

The project supplied mobilizers with IEC materials such as job aids, IRS FAQ sheets, and IRS posters, as well as talking points they could suggest for use by traditional and religious leaders.

Despite these efforts, there were many challenges. Some mobilizers did not distribute IRS cards, did not tell communities when spray teams would visit, or did not accompany the spray teams. Overall, only about 29% of the IRS targeted population was reported to have been reached with vector control and/or SBCC messages via door-to-door messaging. This key lesson learned was mainly due to a lack of an effective supervision mechanism for mobilizers during the three day mobilization exercise. Additionally, most mobilizers did not hand over the data collection forms to the district health offices.

As noted above, some householders left their houses for the farm on the spray day. Others were unprepared to receive IRS or misplaced their IRS cards. About two-thirds of households visited by SOPs during the

campaign reported not having an IRS card. Table 6 summarizes IEC materials deployed during the 2018 campaign. Mass media communication via radio is discussed in the next section.

Table 6: Distribution of IEC Materials

District	Sexual Harassment Posters	Job Aids	IRS FAQs Sheets	Traditional Leader Pamphlets	Church Leader Pamphlets	Radio Announcements
Eastern	10	619	777	619	619	45
Luapula, Muchinga, Northern	90	3,712	4,658	3,712	3,712	508
Total	100	4,331	5,435	4,331	4,331	553

3.3.2 MASS MEDIA COMMUNICATION

Three main radio programming initiatives were used in the 2018 IRS campaign: radio spots (jingles), discussions (interactive shows), and announcements about IRS and its benefits. In total, 553 radio broadcasts were done in 12 districts that have radios stations covering 29 districts in total. Radio spots started airing two weeks before the start of spray operations and continued three times per day for three days each week throughout the campaign. Radio discussions aired in local languages included messages about household preparation, safety, and compliance and aimed to increase coverage by addressing the community’s concerns about IRS. VectorLink district coordinators monitored radio spots in their districts. Together with other IEC methods, mass media communication during IRS greatly affects community acceptability of IRS.

3.4 LOGISTICS

3.4.1 IRS STORAGE AND INSECTICIDE STOCK MANAGEMENT

The logistics coordinator managed the stock at the central level and supervised the 73 storekeepers. Each district store was managed by two storekeepers – one government employee, and one VectorLink seasonal storekeeper – according to the standard PMI Best Management Practice (BMP) guidelines for the storage of IRS commodities. Storekeepers used IRS Daily Insecticide Usage Registers, Insecticide Trackers, and stock control cards to account for the quantities of insecticide issued, used, and returned. They also used the registers to account for the empty bottles/sachets and identify any discrepancy between the amount of chemical issued and returned. In 2018, the project storekeepers implemented a new best management practice, serializing each bottle/sachet of insecticide to track it.

Table 7 shows the amount of insecticide that VectorLink Zambia procured and the amount it used in each province. It used 127,079 bottles of Actellic to spray 491,853 structures across three provinces, for a utilization ratio of approximately 3.9 structures per bottle. The project also used 20,904 of the 24,868 sachets of SumiShield procured to spray 83,139 structures (approximately 4 structures per sachet). Each SOP sprayed an average 12.8 eligible structures per day. The project reported one missing sachet of SumiShield in Katete and filed an incident report (see Section 8.9).

Table 7: Actellic and Sumishield Consumption in 2018, by Province

Bottles of Actellic 300CS				
#	Province	Qty Procured by PMI	Qty Used	Qty Remaining
1	Muchinga	33,532	28,181	5,351
2	Luapula	63,488	56,608	6,880
3	Northern	48,648	42,290	6,358
Total		145,668	127,079	18,589
Sachets of SumiShield 50 WG				
4	Eastern	24,866	20,904	3,960
Total		24,866	20,904	3,960

Note: VectorLink Zambia reported one sachet of SumiShield as missing in Katete district and it was never recovered. The project also sent one sachet of SumiShield to the PMI VectorLink Zimbabwe entomology team for susceptibility tests.

3.5 IRS CAMPAIGN RESULTS

Out of the 644,677 structures found in the targeted districts, VectorLink sprayed 579,490 for a spray coverage of 90 percent. The campaign protected 2,818,176 people, including 89,959 (3.2 percent) pregnant women and 411,416 (14.6 percent) children under the age of five. Table 8 provides additional summary statistics, and Table 9 shows provincial-level coverage. Annex B indicates campaign start and end dates for each district, and Annex C gives spray progress and coverage data by district.

Table 8: Summary of 2018 PMI VectorLink IRS Campaign

Dates of PMI-supported IRS campaign	October 15–December 15, 2018
Total operational days	34
Insecticides used	Actellic 300CS (organophosphate) and SumiShield 50 WG (neonicotinoid)
Number of provinces	4 (Luapula, Northern, Muchinga, and Eastern)
Number of districts	29
Number of structures found by SOPs	644,677
Number of structures sprayed by SOPs	579,490

2018 spray coverage	90%
Population protected	Total population: 2,818,176 Children under five years: 411,416 Pregnant women: 89,959
Number of people trained with U.S. Government funds to deliver IRS	2,006 ⁵

Table 9: Provincial Spray Progress and Coverage

Province	Targeted	Found	Sprayed	Spray Progress	Spray Coverage
Eastern	90,000	90,951	87,617	97%	96%
Muchinga	124,278	133,411	119,170	96%	89%
Luapula	235,368	239,806	213,069	91%	89%
Northern	180,354	180,509	159,634	89%	88%
Total	630,000	644,677	579,490	92%	90%

3.6 POST-SPRAY ACTIVITIES

3.6.1 POST-SPRAY INVENTORY

The VectorLink Zambia team conducted post-spray inventory activities for all IRS equipment and materials. The project returned all IRS materials and equipment, leftover insecticides, and insecticide-contaminated wastes to the district warehouses from the operation sites and identified defective IRS equipment for repair before the 2019 IRS campaign. After the 2018 spray season, 18,589 bottles of Actellic insecticide remained (expiration date: June 2020). Since 2018 is the last year Zambia will use Actellic (to avoid the emergence of resistance), VectorLink received PMI's concurrence to transfer its leftover Actellic to the GRZ for use in non-PMI supported districts. Additionally, the project donated 88 pumps to NMEP. Table 10 shows where the GRZ will use the leftover insecticide. VectorLink will also provide technical assistance to the NMEP to ensure environmental compliance.

⁵ This included; 1,564 SOPs, 295 Team Leaders, and 147 Supervisors.

Table 10: Distribution of Leftover Insecticides to GRZ by Province

Province	Bottles of Actellic 300CS Needed	Target Structures
Lusaka	2,405	9,620
Copperbelt	6,358	25,432
Central	1,649	6596
Eastern	2,177	8,708
North-western	6,000	24,000
Total	18,589	74,356

VectorLink Zambia will store the leftover SumiShield stock (3,963 sachets, expiration date: May 2021) in the central storage facility. It will serve as an opening stock in the 2019 IRS spray season. The VectorLink team has checked the quantity and functionality of all other IRS materials and equipment and documented any issues to help plan for the next spray season. The project will dispose of all unsalvageable equipment, such as plastic sheets and insecticide-contaminated waste, according to environmental compliance protocols by March 31, 2019, using disposal facilities available in Zambia. Please see Section 8 for details on disposal. See Annex I for a list of non-PMI supported districts.

3.6.2 POST-SPRAY REVIEW MEETINGS

On December 19, 2018, the project held a central-level, all-partners, post-spray review meeting at the National Malaria Elimination Centre. Participants discussed results and findings from the PMI-supported districts, including challenges, lessons learned, and recommendations for the 2019 IRS season. A similar meeting for Eastern Province happened in Katete in January 2019. One-day provincial post-spray review meetings with a similar agenda will take place in Mansa (Luapula), Kasama (Northern), and Mpika (Muchinga) in February 2019. Participants included district and provincial officials, PMI/Zambia, VectorLink Zambia, NMEP, and other stakeholders. VectorLink will incorporate key findings from these meetings into its Year 2 work plan.

4. ENTOMOLOGIC MONITORING

VectorLink Zambia supports the NMEP through routine entomological surveillance and generates data on key entomological indicators including malaria vector species composition, density, feeding behavior, feeding habits, and parity rate in seven districts. In addition, VectorLink conducts insecticide susceptibility tests, assesses the quality of spray during the IRS campaign, and monitors the duration of efficacy of the insecticide on the walls after IRS. These data guide the NMEP and other stakeholders on vector control decision making, including insecticide selection, IRS programming, and insecticide resistance management.

This section describes entomologic monitoring activities which were conducted during the 2018 spray campaign period. A comprehensive report on entomologic monitoring is available in separate progress reports and annual report.

VectorLink Zambia conducted cone bioassays to assess the quality of spray during the 2018 IRS campaign and to monitor the duration of the insecticide on the sprayed surfaces in seven PMI-supported districts. It collected spray quality data (insecticide decay rate baseline data) in October and November 2018. Post-spray entomological surveillance to assess the impact of IRS on malaria vectors began in December 2018. Figure 2 summarizes results from the cone bioassays.

To assess spray quality, the VectorLink Zambia team conducted cone bioassays in select houses in each district 24–48 hours after IRS. Selected houses were 42 sprayed houses (21 mud and 21 cement) and 14 control (unsprayed) houses (7 mud and 7 cement) at T0 (during the month of spray) and T1 and T2 (1 and 2 months after the spray date, respectively). The team conducted the T0 cone bioassay in Kawambwa and Mporokoso in October and in Kasama, Isoka, Milenge, Mwense, and Katete in November. All mosquitoes exposed to sprayed walls were dead after the 24-hour holding period at T0, T1, and T2 in Kawambwa, Mporokoso, Kasama, Isoka, Milenge, and Mwense (where Actellic 300CS was sprayed) and after the 48-hour holding period in Katete district (where SumiShield was sprayed). The data signify that the 2018 IRS campaign achieved a high quality of spray. VectorLink Zambia will provide more detailed information on the impact of IRS on malaria vectors in the entomological progress and final reports. All control mortality was below the 5% threshold and therefore corrected mortality was not necessary.

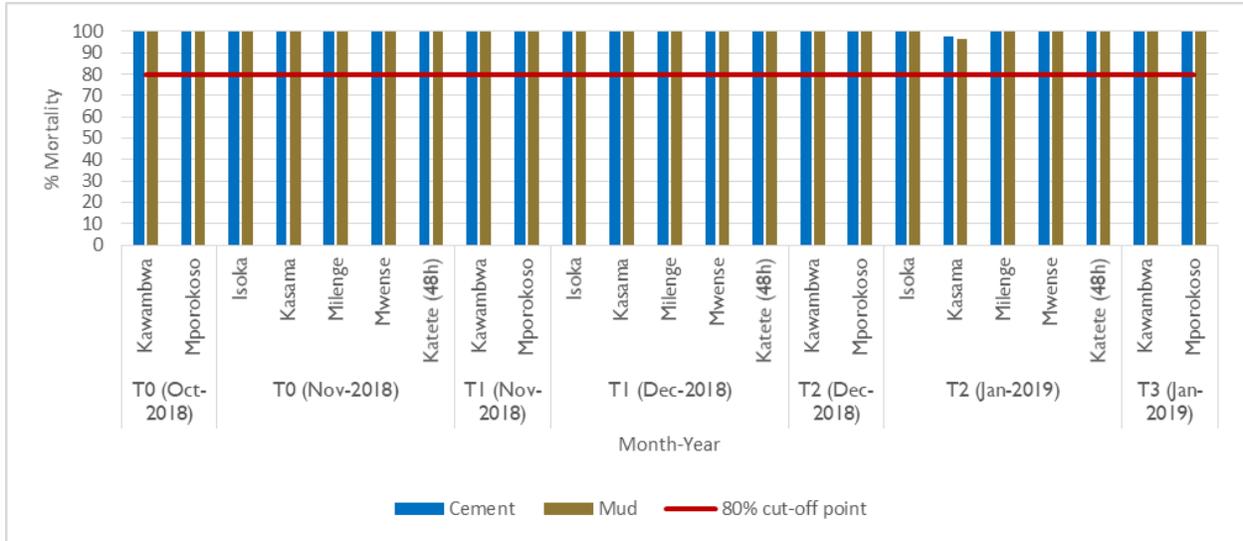


Figure 2: Mortality of *An. gambiae* s.s. Kisumu Susceptible Strain after Exposure to Pirimiphos-methyl and Clothianidin in Select Districts

5. MONITORING AND EVALUATION

The M&E approach of the 2018 IRS campaign followed the 2018 VectorLink Zambia work plan. It successfully incorporated lessons learned from the 2017 IRS campaign and best practices from other PMI VectorLink countries. Additionally, VectorLink Zambia was one of the first countries to use the new project database platform, built using the District Health Information System 2 (DHIS2).

5.1 KEY OBJECTIVES

The key objectives of VectorLink Zambia M&E activities were to:

- Emphasize accuracy of both the data collection and the data entry process through comprehensive training and supervision at all levels;
- Streamline and standardize data flow, minimize error, and facilitate timely reporting;
- Ensure IRS data security and storage for future reference through the establishment and enforcement of proper protocols; and
- Provide technical support to the NMEP through sharing of M&E tools, as well as data analysis and visualization.

5.2 M&E SYSTEM DEVELOPMENT AND IMPLEMENTATION

VectorLink Zambia drafted and defined the M&E system before implementing IRS to ensure the collection, management, and reporting of high-quality data. The Zambia team considered and adopted the successful aspects of the M&E system from the 2017 IRS campaign under the PMI AIRS project. During the TOT training for IRS managers and supervisors, the M&E team reviewed the Daily Spray Operator form, Team Leader form, and Directly Observed Spray form. IRS managers and supervisors demonstrated a good understanding of the forms and were able to explain the forms in detail during the cascade training for SOPs and team leaders. The SOP form served as the primary tool for data collection. To support data collection and entry, and the supervision of both activities, VectorLink Zambia hired M&E assistants and data collectors in all districts. The team, supported by the home office M&E specialist, used project partner BAO Systems (developers of the DHIS2 database system) for database system support. VectorLink Zambia technical staff also used the database to generate near “real-time” reports for quick feedback and to reconcile and prevent additional errors in data collection and entry.

In non-pre-elimination districts, SOPs collected spray data that were then verified by team leaders, supervisors, and M&E assistants. The M&E assistants gave the forms to the DECAs for entry; they performed a final verification of spray data before updating the database. At the end of each day, the M&E team reviewed the data entry progress for all of the districts and sent an electronic report to the central office in Lusaka. The Lusaka-based M&E team checked for errors and addressed any issues with the DECAs immediately.

Based on the team’s experience in 2017, the M&E team reviewed the data from the VectorLink Zambia database on a weekly basis and was able to provide feedback to provinces and districts on performance and coverage, highlighting areas that had not achieved 90 percent coverage. The report also indicated the number of structures to be revisited through a mop-up campaign to attain 85 percent coverage. The M&E team sent the weekly report to PMI VectorLink technical staff, district coordinators, and GRZ personnel, including the chief environmental health officers, IRS managers, provincial health directors, and district health directors.

For quality control and timely generation of the weekly spray progress reports for PMI, all data were expected to be entered and synced within 48 hours of spraying. In some instances, this did not happen, for several reasons including:

- Intermittent or weak internet connectivity
- Power outages in remote districts
- Issues with remote data uploads, that affected 10% of data entry centers: SOPs would sometimes camp overnight when they were spraying in remote areas. In these instances, DECs would camp with SOPs and enter data in the field but often not upload the data until they returned to the base. Alternatively, they waited until SOPs returned to the base to enter the data.

DECs filed SOP forms at the district data centers according to spray date and team number and backed up spray data daily to a computer hard disk and an external hard drive for data security and storage.

5.3 DIMAGI PLATFORM

VectorLink Zambia collaborated with Dimagi to ensure quality reporting and supervision in all target districts. The team implemented the best attributes of the IRS reporting system from 2017, including the content and format of inputs and outputs. The Dimagi platform included:

- Daily Reminder Messages: Daily SMS reminders (job aids) sent to SOPs, team leaders, supervisors, district coordinators and M&E assistants.
- Data Collection Verification (DCV) forms: M&E assistants entered and uploaded DCV forms daily to the database.
- Performance tracking sheets data: This system was used to update data and send daily reports. The Dimagi platform collected and sent out daily aggregated summary data on spray performance for target provinces and districts.
- Supervisory Checklists: This system was used to update and send out daily supervisory checklist reports and included:
 - SOP morning mobilization inspection
 - SOP transportation vehicle inspection
 - Homeowner preparation and SOP performance
 - Storekeeper performance inspection
 - End-of-day clean-up inspection
- Results from the Dimagi platform show that there was generally an underutilization of the supervisory checklist application. In most districts, on average, less than 40% of all target districts uploaded all of their checklists according to the assigned schedule, during the 2018 IRS implementation period. Refer to Annex G for outcomes of the inspections as captured on the Dimagi platform.

5.4 MSPRAY IMPLEMENTATION

The mSpray platform is managed by Akros, an Abt sub-partner, and has been used in VectorLink Zambia (formerly AIRS) IRS campaigns since 2014. Using satellite mapping technology, mSpray allows for enumeration of eligible structures in a given geographical area. Furthermore, mSpray's cloud-based data recording and management system functionality allows spray personnel to collect spray data and GPS coordinates on a tablet. Data are uploaded to a shared folder, or cloud, for immediate viewing of campaign progress. Key mSpray features for data collection and management include:

- Data are captured directly on mobile forms that are loaded on a smartphone or tablet.
- Pre-programmed data entry controls on mobile devices reduce illogical data errors.
- Near real-time data are available via a shared, cloud-based monitoring and reporting platform to immediately address campaign challenges and improve spray progress.

As described in Section 3.1, VectorLink Zambia used the mSpray tool in the three PMI-supported districts in Eastern Province for mobile spray data collection and reporting. As in non-mSpray districts, SOPs collected the same spray data on paper Daily Spray Operator forms. TLAs updated household spray status (sprayed, not sprayed, or not eligible) and entered household-level data (for the three assigned SOPs) directly into their Android tablet. At the end of each day, the team leaders reviewed the paper forms before returning them to the TLAs. The TLAs used these paper forms to check that all data were captured in the mSpray tool and if not, to enter the data. Those data were then synced to a cloud-based database (ONA) using a mobile carrier internet connection. The uploaded spray data could be viewed online and be accessed at any time and as often as necessary. The paper data remained as backup.

- Due to several built-in data verification and validation processes, accurate data was collected and there were no data falsification incidents that were reported in the three districts.
- The IRS campaign was implemented within the 30 days in all three mSpray districts. Supervisors were able to assess and determine, in real time, all spray areas that needed to be revisited.
- The average reported spray coverage for the three mSpray districts was 96% compared to an average 89% spray coverage in all other non-mSpray districts
- An enumeration exercise was carried out for Sinda, just before the commencement of the 2018 IRS implementation which resulted in the total eligible structures for the district being updated from 33,700 to about 58,944. Since funds were already committed at this stage, a targeting approach was used which resulted in some communities not being sprayed entirely.
- Retention of huge amounts of data on the tablets and exposure to intense heat may have contributed to the slowing down of the tablets which affected the pace of data collection.

5.5 DATA QUALITY ASSURANCE AND CONTROL

During the 2018 spray season, VectorLink Zambia used the M&E Supervisory Toolkit, which comprises the following two tools to standardize and improve data collection:

- Team Leader Summary Forms: Team leaders completed these forms daily to verify the completeness and accuracy of spray data collected in the field. By filling out this form, the team leader systematically reviewed each SOP form and provided feedback to their team on common errors identified.
- DCV Forms: M&E assistants and supervisors used the DCV form to ensure that the data recorded on the Daily SOP Forms matched the information reported by households.

5.6 DHIS2 AND DATABASE QUALITY CONTROL

VectorLink Zambia was the second country to implement the VectorLink Collect DHIS2 system for data management and reporting. BAO Systems developed a customized DHIS2 instance to serve as the primary, centralized database across VectorLink Zambia. DEC's primarily used a desktop application to enter mobilization and spray data. The desktop application provided a platform to work offline, which was important given the interruptions in connectivity experienced at the district data centers. Both applications channeled data to the central DHIS2 database for final storage and reporting. All electronic data are securely stored and backed up on DHIS2 VectorLink servers, cloud-hosted by the BAO Systems team.

VectorLink Zambia used DHIS2 in 26 PMI-supported districts located across Luapula, Northern, and Muchinga provinces. DEC's conducted audit checks before entering the data into the database, to reduce the

number of data entry errors. VectorLink Zambia also used the data-cleaning/reporting tool to help the DECs clean and reconcile data. Additionally, we required DECs to enter data within 48 hours after structures were sprayed. First, the spray “Totals” (i.e., a summary of each Daily SOP Form) were entered within 24 hours to produce “real-time” reporting of spray progress. Later, the spray “Details” (household-level data) were entered within 48 hours for a more accurate picture of spray progress and coverage. By using the cleaning tool, DECs investigated and reconciled discrepancies between spray “Totals” and “Details” data for a final data set with the campaign results. Corrections were made to the paper spray forms and the database, where necessary.

5.6.1 DHIS2 AND PMT MOP UP DATA

During the 2018 IRS campaign, SOPs in the 26 DHIS2 implementing districts revisited a total of 48,669 structures for the purpose of mop ups. Mop-up visits are aimed at spraying the structures that had been visited earlier but were not sprayed due for various reasons such as locked structures and refusals. These structures were updated in the initial DHIS2 database instance as found and unsprayed along with their unique 8 digit IRS number. Since only about 30% of all targeted households were mobilized during the 2018 IRS season, it meant that most structures were assigned virtual IRS numbers (unique numbers assigned in the absence of physical IRS cards). It was observed that most of the virtual numbers that were recorded on structure walls, using chalk markings, were rubbed off by household owners especially in areas with high refusals. This meant that when SOPs visited these structures for the second time, they could not record the first IRS number and therefore had to issue a second virtual number. This resulted in several structures being assigned more than one unique IRS number.

Consequently, when DECs updated the database with information for these revisited structures, the database could only match IRS numbers in 11,848 mop-up instances out of a total of 48,669 mopped up structures as reported on the SOP forms and the performance monitoring tracking documents. Refer to Annex C for more details. This scenario may have contributed to the low spray coverage in several districts such as Mpika, Kasama, Nchelenge, and Samfya.

5.7 PHYSICAL DATA VERIFICATION

Physical data verification was performed at three different levels:

- Team leader level: Team leaders reviewed 100 percent of spray data collected on SOP forms and checked the math.
- District level: Each supervisor had to review five sprayed structures per week in their district while district coordinators had to review 20 sprayed structures in their districts.
- Staff from VectorLink Zambia and the NMEP central level performed random data verification as part of routine monitoring visits across the 29 target districts.
- Data entry level: DECs reviewed each form for typos and transcription errors, and verified the arithmetic before entering the data into the database.
- It was generally observed by the project technical team during IRS field visits that a significant number of supervisors did not pay close attention to detail when verifying data for accuracy and correctness. This contributed to a slow data entry by DECs who had to spend a significant amount of time cleaning paper based data before entering data.

5.8 RANDOM SPOT CHECKS

The Lusaka-based M&E team performed daily data verification activities of the DHIS2 database to guarantee the quality of the data. They scanned the database and ran spray progress reports to identify progress and anomalies in data entry. If they found discrepancies between data collected and data entered that could not be

reconciled at the data center, the M&E team contacted the field supervisor, M&E assistants, and DECAs as needed to clarify and resolve the issue.

M&E assistants conducted random field checks by visiting target areas that had been sprayed within the previous day to interview households. Moreover, PMI VectorLink technical staff and MOH supervisors conducted field spot checks to validate data authenticity.

This enabled VectorLink Zambia to validate spray data and, in a few instances, identify SOPs who falsified data. There were instances of data falsification in Chinsali (one instance involving one SOP), Kasama (three instances involving seven SOPs), and Mwense (three instances involving two SOPs and one team leader). A thorough review and investigation revealed that each of the 11 personnel had recorded non-existent structures as sprayed and were therefore guilty of data falsification. VectorLink dismissed all 11 implicated personnel.

5.9 IRS RESULTS

VectorLink Zambia monitored the structures that were found and sprayed and compared this to the target structures on a weekly basis. Figure 3 shows found and sprayed structures relative to the targeted structures over a period of 54 days. For complete campaign results, refer to Annexes C-F.

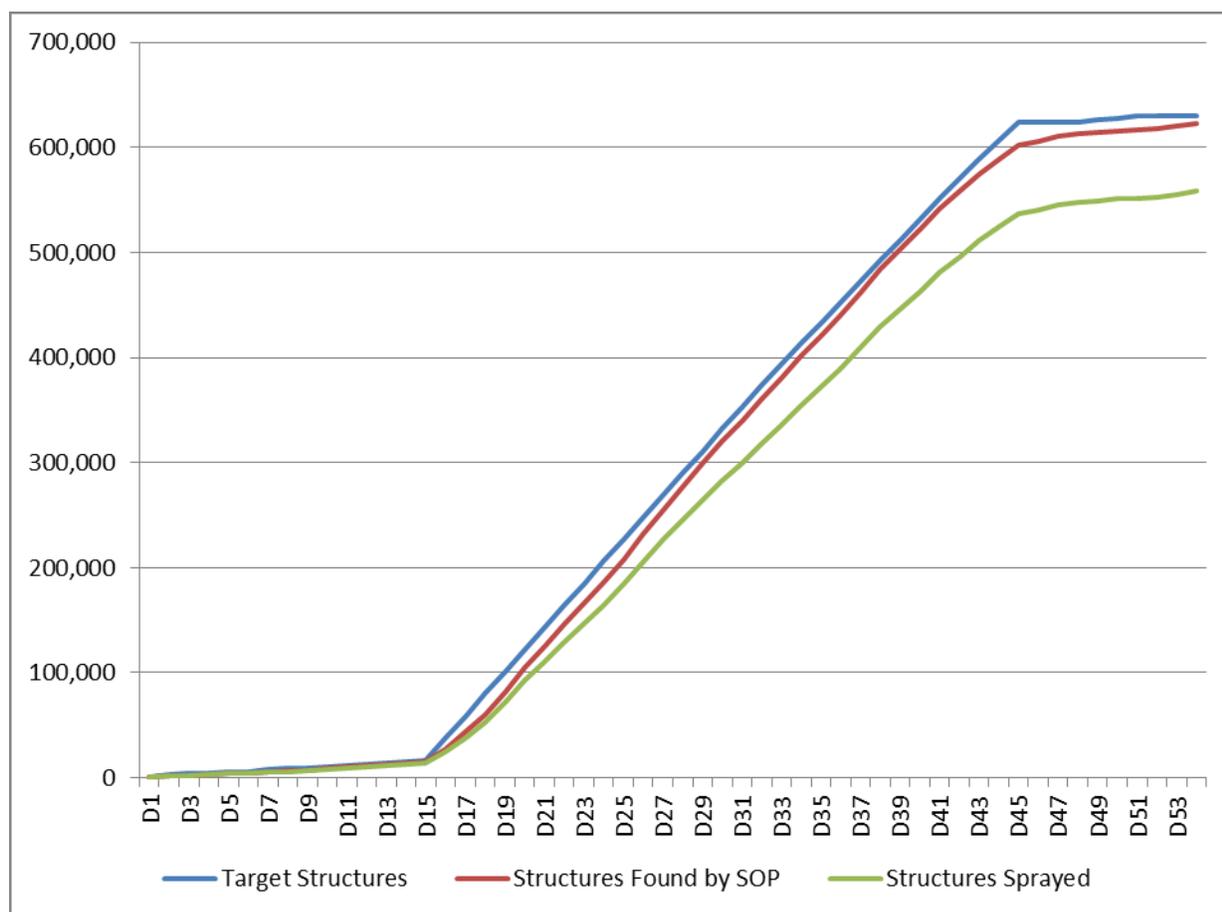


Figure 3: IRS Daily Performance Tracker

6. ENVIRONMENTAL COMPLIANCE

VectorLink Zambia implements IRS in compliance with the following policies:

- The United States Government: USAID Regulation 216;
- GRZ Environmental Regulations: Zambia Environmental Management Act (EMA) cap 204, No 12 of 2011; and
- The 2015-2020 Supplemental Environmental Assessment (SEA), which was produced in 2015, and its 2017 amendment, including the Pesticide Evaluation Report and Safer Use Action Plan.

This section discusses adherence to these, and the operational issues that arose during IRS implementation in 2018 and how the team responded to them. Annex G contains the Environmental Mitigation and Monitoring Report (EMMR).

VectorLink Zambia operates under an SEA that was approved in September 2015 and amended in 2017 to include clothianidin. The SEA and its 2017 amendment authorize the use by USG-funded programs of all four classes of insecticides recommended by the WHO (pyrethroids, carbamates, organophosphates, and organochlorine), as well as chlorfenapyr (a pyrrole) and clothianidin (a neonicotinoid). It is valid for IRS implementation by USG-funded programs nationwide during the period of September 2015 to August 2020.

6.1 ENVIRONMENTAL DOCUMENTATION

The 2015 SEA for Zambia stipulates that VectorLink Zambia must submit an annual Letter Report to PMI two months prior to the beginning of spraying. VectorLink submitted the 2018 Letter Report to USAID in August 2018.

6.2 PRE-SEASON ENVIRONMENTAL COMPLIANCE ASSESSMENT

In July 2018, the VectorLink Zambia environmental compliance officer (ECO) travelled to all 29 PMI-supported districts and all IRS operation sites to do a Pre-Season Environmental Compliance Assessment (PSECA), which checks the preparedness of IRS facilities such as warehouses, soak pits, shower rooms, pit latrines, and wash areas. The ECO used a smartphone application for the PSECA, assessing primarily the capacity of the soak pit, warehouse capacity to store and handle pesticides and other IRS supplies, and adequacy of wash rooms and toilets.

The PSECAs resulted in detailed environmental compliance findings for each operation site and work lists for renovations to address any deficiencies found. The ECO then developed a renovation implementation plan, which clearly stated the responsibilities of VectorLink Zambia and MOH staff. Renovations began after the home office ECO approved the plan.

VectorLink renovated two existing soak pits in Katete and Mpika. In districts where the distance between the fixed soak pit at the operation site and the spray site was too great for spray teams to return each day, the project installed MSPs at pre-selected camp sites, and SOPs conducted end-of-day clean-ups there. VectorLink Zambia constructed 95 MSPs in camp sites.

During the campaign, the team determined that it could not spray the catchment area of Kapisha, in Nsama district of Northern Province, due to environmental concerns. Kapisha comprises floating islands on Lake Tanganyika, and spraying there would require transport of insecticides and spray teams across the water, which would risk chemical spillages and accidents. The size of the available boat would have meant multiple transits (back and forth, and from one island to the next), and the high water table made the use of MSPs

unsuitable. Furthermore, structures eligible for IRS were less than 30 meters from the lake, posing an additional environmental risk. VectorLink Zambia advised the district to explore other means of vector control. Similarly, Chilubi Island in Northern Province, has also posed a challenge because it requires transportation of large amounts of insecticides across Lake Bangweulu.

6.3 NEW SPRAY AREAS, OPERATION SITES, AND OTHER MAJOR RENOVATIONS

As mentioned, in 2018, VectorLink Zambia collaborated with the NMEP to establish new sites in eight large districts to make operations manageable, as the number of SOPs in some districts increased drastically. A second operation site was established in Sinda Boma (Sinda district), Chimtende Rural Health Center (RHC) (Katete district), Chiombo RHC (Kasama district), Chimba RHC (Mungwi district), Lavushimanda (Mpika district), Lubende RHC (Mansa district), Nchelenge Clinic (Nchelenge district), and Lukwesa RHC (Mwense district). Warehouse, soak pit, shower/change rooms, pit latrines, and wash bays were set up at each new operation site under the supervision of the respective district coordinators and MOH district representatives, and given final approval by the ECO.

6.4 FOLLOW-UP ENVIRONMENTAL COMPLIANCE INSPECTIONS

After addressing all environmental compliance deficiencies identified during the initial PSECAs, two weeks prior to the launch of the spray campaign, the ECO and district coordinators revisited all IRS operation sites to confirm that the refurbishments were completed and that the district was prepared for the 2018 IRS campaign. All storage facilities in PMI-supported districts met the minimum environmental compliance requirements and were certified to receive and safely store pesticides. Additionally, all soak pits were suitable for an environmentally responsible disposal of pesticide-contaminated liquid waste.

6.5 PRE-CONTRACT MOTOR VEHICLE INSPECTIONS

In October, VectorLink Zambia and local traffic police inspected all vehicles (trucks) in accordance with PMI BMPs, to ensure they complied with safety and environmental requirements prior to finalizing the contracts. During the inspection, transporters were required to retrofit trucks with benches, tents, roll cages, and railings, and to ensure that all trucks were roadworthy. All 86 selected vehicles were equipped with spill management and first aid kits, Material Safety Data Sheets, and accident/emergency response procedures. PMI VectorLink Zambia stickers were issued to all vehicles that met the inspection criteria.

VectorLink Zambia also trained 86 drivers in Kasama, Mansa, Mpika, and Katete districts two weeks before the spray campaign began. All trained drivers received certificates.

6.6 MEDICAL CLEARANCES

All personnel hired for the 2018 spray season underwent medical examinations to assess their physical fitness for the project's demands. Additionally, all female recruits were administered pregnancy tests before the IRS campaign to ensure no expectant mothers were at risk of exposure to insecticide. The test was repeated on the 30th day after the first examination. Two female SOPs, one in Kasama and one in Nakonde, tested positive. VectorLink assigned them supportive roles with the spray teams to assist with household preparation and community mobilization during IRS implementation. These duties do not require handling or spraying insecticide.

6.7 MANAGEMENT OF INSECTICIDE ADVERSE EFFECTS

As previously mentioned, we trained thirty-one clinicians for one day on poison management to orient them to possible toxic effects of insecticides and their management. In districts where Actellic 300CS was sprayed, the project provided atropine, the antidote for pirimiphos-methyl (Actellic) insecticide poisoning, to all district hospitals and central medical stores.

6.8 MID-SPRAY ENVIRONMENTAL COMPLIANCE INSPECTIONS

VectorLink Zambia staff monitored environmental compliance throughout the campaign in close collaboration with MOH employees using environmental compliance tools embedded on smartphones. The team used smartphones to submit all mid-spray inspection reports. At the end of the campaign, the team summarized the inspection results, which formed the basis of the EMMR (Annex G).

6.8.1 ENVIRONMENTAL COMPLIANCE AUDIT

Environmental Compliance Operations Support (ECOS) conducted an IRS Environmental Compliance Field Evaluation as mandated by PMI. The ECOS auditor, accompanied by the ECO, went to five districts (Mansa, Mwenze, Kawambwa, Luwingu, and Mpika) to assess environmental compliance at operation sites.

VectorLink Zambia supported the assessment and minor areas for improvement observed by the auditor were immediately communicated to the teams.

6.8.2 MORNING MOBILIZATION

Morning mobilization was an integral and innovative aspect of the spray campaign introduced by VectorLink in Zambia this year to coordinate spray teams at the beginning of each day and emphasize key concepts from training throughout the campaign. As part of morning mobilization, SOPs first reported to a restaurant to have their morning meal. After breakfast, the teams demonstrated correct mixing of insecticide, marking of structures, cleaning of spray pumps, and homeowner preparedness. To ensure SOP and householder safety, the ECO, team leaders, and IRS supervisors inspected all SOPs to identify any symptoms of illness such as difficulty breathing, fatigue, weakness, or dizziness. This morning routine, which was a novel activity in Zambia, was a daily reminder for SOPs on correct field operations. As a result, the only recurring compliance issue was that some SOPs did not don full PPE before boarding the truck.

6.8.3 HOMEOWNER PREPARATIONS AND SOP PERFORMANCE

Household inspections were performed while SOPs were in the field conducting IRS. They involved interviewing homeowners to assess whether they had received adequate information on their responsibilities.

Among the few environmental compliance irregularities reported were the following:

- Some residents refused IRS because they claimed they had not been fully informed about IRS; that not all mosquitoes died after the last spray season; and that there was an increase in other pests, such as bedbugs, after the last IRS campaign.
- Some SOPs did not spray all recommended surfaces, especially the eaves.
- Some SOPs did not spray at the correct speed and could not maintain the swath.
- Some SOPs' flashlights were not functional. This issue was noted in many electronic reports and was addressed by replacing the flashlights.

These issues occurred primarily in the initial stages of the IRS campaign. As supervisors reported them, VectorLink Zambia took immediate corrective measures including coaching on spray techniques as part of morning mobilization, and also by ensuring that team leaders directly observed each of their SOPs spray one structure daily and corrected them as necessary. This drastically reduced the reports of non-compliance.

6.8.4 STOREKEEPER PERFORMANCE INSPECTIONS

In 2018, VectorLink Zambia fully sponsored 42 seasonal storekeepers. Each worked closely with district medical office storekeepers, which brought the total number of storekeepers to 74. Because most of the storekeepers had worked for a previous IRS campaign, they were accustomed to adhering to PMI BMP guidelines. Additionally, PMI VectorLink staff monitoring and supervising IRS operations were able to identify and immediately rectify a number of compliance issues. Most minor discrepancies observed in stock

management occurred in the first few weeks and were addressed by conducting a physical count of the stock until the number of empty and full bottles matched the opening stock. As the project progressed, the storekeepers improved their performance and, by the end of the campaign, no compliance issues were recorded.

6.8.5 END-OF-DAY CLEAN-UP INSPECTIONS

These inspections were conducted at the IRS operation and camp sites. The 2018 IRS campaign saw a drastic reduction in compliance issues compared with previous spray seasons. This was attributed to the daily review of correct end-of-day clean-up protocols with SOPs.

6.9 INCIDENTS

The project reported 10 incidents to PMI during the 2018 spray campaign, in accordance with incident report requirements. Table 11 provides a brief summary of each.

Table 11: Environmental Incidents Reported during the 2018 IRS Campaign

Date	Type	Brief Description
11/8/18	Insecticide Spill	A male SOP in Chinsali District poured mixed insecticide that remained in his spray pump into a pit latrine of one of the houses. SOP contract was terminated.
11/9/18	Dog Bite	A female SOP in Nchelenge district was bitten twice on the left thigh by a dog during field operations.
11/14/18	Data Falsification	A male SOP in Chinsali District recorded more structures on the form than he had sprayed. The SOP was dismissed.
11/19/18	Vehicle Accident	A car rear-ended a truck carrying SOPs to spray sites in Senga District. No spray personnel were injured.
11/27/18	Data Falsification	Three SOPs in Mwense District recorded more structures on their forms than they had sprayed and mixed two bottles of insecticide for each sprayer. Two SOPs added 13 structures to the two that had been sprayed while the other one added 12 structures to the three that had been sprayed. All were dismissed.
11/29/18	Data Falsification	An SOP in Kasama District added two structures that had not been sprayed to the total number (20) of structures recorded on the Daily Spray Operator form.
12/01/18	Dog Bite	A supervisor in Isoka District was bitten by a dog while conducting community sensitization at one household.
12/01/18	Missing Insecticide (SumiShield)	A team leader could not account for a sachet of insecticide he was given at the beginning of the spray day. He had not recorded the serial numbers of the sachets he gave each SOP and therefore could not identify which SOP had lost the sachet. The team leader was dismissed.

Date	Type	Brief Description
12/07/18	Data Falsification	Four SOPs in Kasama District falsified data by adding structures that did not exist to their Spray Operator forms. All four SOPs were dismissed.
12/07/18	Data Falsification	Two SOPs in Kasama District increased the number of structures sprayed on their Daily Spray Operator forms. One added four structures and the other added 17. Both SOPs were dismissed.

6.10 POST-SEASON ENVIRONMENTAL ASSESSMENT

The logistics coordinator, ECO, and district coordinators, with MOH district representatives, conducted post-spray inventory audits of IRS commodities between December 5 and 21, 2018.

6.10.1 CLOSURE OF STOREROOMS AND SOAK PITS

The ECO decommissioned all IRS facilities, specifically storerooms and soak pits, with support from district MOH personnel. During the inspection, the ECO ensured that:

- All records for all IRS commodities were updated and balanced.
- The amount of chemical used equaled the empty bottles in the storeroom.
- Medical examination records were submitted for record keeping at the central level.
- Certificates of completion regarding environmental compliance rehabilitation work were submitted for record keeping.

6.10.2 IRS WASTE DISPOSAL

Liquid Waste: During the campaign, liquid effluent from the rinsing of pumps was reused as water for mixing insecticide the next day. Water used to wash the outside of the spray tank and rinse the strainer and nozzles drained into soak pits sited according to the PMI BMP manual. The soak pits' charcoal layer absorbs traces of pesticides in rinse water and holds them until they degrade.

Solid Waste: At the end of the spray season, non-contaminated wastes such as worn-out overalls, gumboots, gloves, and used mutton cloth were cleaned thoroughly with soap and water, and clearly labeled and stored until ready for distribution to SOPs.

6.10.3 DISPOSAL STREAMS

Below are the disposal streams for waste that was generated in the 2018 IRS campaign:

Insecticide Containers: Supervisors monitored SOPs to ensure they triple rinsed the empty Actellic bottles after emptying the insecticide into the spray tank in the field. Storekeepers subsequently punctured the bottles (so they are not reused) and repacked them in empty cardboard boxes. After the campaign, VectorLink Zambia will use VectorLink and NMEP trucks to collect the empty bottles and take them to the Lusaka City Council Cleansing Depot. Workers will thoroughly clean them with soap and water and remove their labels and seals before Greenland General Limited, a Zambia Environmental Management Agency (ZEMA)-approved recycling company based in Lusaka, shreds them into pellets and recycles them into conduit pipes.

Insecticide Sachets: SumiShield sachets are rinsed in the field after the insecticide is emptied into the spray tank. Empty sachets returned to the storeroom are tied in packs of 20 and repacked into the empty cardboard boxes before weighing, collected, and transport to UTH for incineration.

Cardboard Boxes: Incineration of cardboard boxes can be costly and can generate large amounts of carbon dioxide and other air contaminants. To reduce these effects, VectorLink Zambia will give used uncontaminated boxes to Zambezi Paper Mills Company as raw manufacturing material. Contaminated cardboard boxes (i.e., cardboard boxes that contain insecticides with damaged packaging) will be incinerated with masks and sachets at the ZEMA-approved UTH incinerator.

Gloves and Boots: Because these items contain greater than 1 percent chlorine, they will not be incinerated because they can create dangerous Persistent Organic Pollutants (POPs). Gloves and boots that VectorLink Zambia will not use in future IRS campaigns will be thoroughly washed before they are donated to deserving SOPs for their personal use.

Nose Masks, Overalls, and Backpacks: Used nose masks are always considered contaminated and hazardous and will be incinerated at UTH. VectorLink Zambia will consolidate, label, weighed, and correctly store masks before UTH incineration. The project will wash and then give overalls and backpacks that it will no longer use to deserving SOPs for their personal use.

Table 12: Type, Quantity, and Disposal Method of 2018 IRS Solid Waste

Type	Quantity	Disposal Method
Empty bottles	127,097 bottles	Thorough cleaning and label removal at Lusaka Cleansing Depot, then recycled at Zambia at Greenland General Limited company
Empty sachets	20,904 sachets	Incinerated at UTH in Lusaka
Plastic sheets	387.8 kg	Disposal at national dumpsite in Lusaka after thorough cleaning
Helmets and face shields	118.7 kg	Disposal at national dumpsite in Lusaka after thorough cleaning
Boots	417.1 kg	Given to deserving SOPs after thoroughly cleaning with soap and water
PVC gloves	362.4 kg	Cleaned with soap and water, shredded, then disposed of in a landfill
Nose masks	773.6 kg	Weighed at each of the IRS sites, then incinerated at UTH in Lusaka
Mutton cloth	149.5 kg	Mutton cloth used during mixing of insecticide will be weighed and incinerated at UTH in Lusaka. SOPs may keep mutton cloth used as neck protection after washing with soap and water
Overalls and backpacks	418.1 kg	Worn-out overalls and bags will be given to deserving SOPs after being thoroughly cleaned with soap and water
Empty boxes	641.2 kg	VectorLink will incinerate contaminated boxes and will donate uncontaminated boxes to Zambezi Paper Mills company as raw material

7. GENDER MAINSTREAMING

VectorLink Zambia implemented several activities to promote gender mainstreaming. To ensure that all project activities aligned with USAID’s policy on Gender Equality and Female Empowerment, VectorLink Zambia included modules on gender in all trainings. To emphasize this issue at the provincial and district levels, provincial medical officers, chief environmental health officers, and district medical officers were oriented to gender awareness and integration to help them lead in addressing gender issues. IRS managers and supervisors also received an orientation during the microplanning and TOT meetings on the importance of gender inclusion for a successful IRS campaign. As a result, most participants understood the importance of integrating more women into the spray teams and increase equal participation in all aspects of IRS.

VectorLink Zambia used IEC materials such as posters with pictures of female SOPs to motivate women to join the IRS campaign. Such images have proven important to women in their decision to apply for positions on the campaign. Sexual harassment posters were posted in all operation sites and all district health offices to encourage SOPs to report all forms of harassment they observe.

VectorLink Zambia also maintained individual privacy at operation sites by clearly labeling separate wash/change rooms for men and women.

The project distributed sanitary pads to female SOPs in all four provinces during the 2018 spray season. Undocumented reports from seasonal workers suggest that these supplies were appreciated and allowed more women to consistently work. In addition, VectorLink Zambia ensured that sanitary bins were placed in washrooms to promote hygienic disposal. Zambian labor law allows women a day off from work per month while menstruating. VectorLink Zambia increased its communication efforts this year to ensure that all seasonal workers were aware of this “mother’s day” benefit and supervisors understood that these absences were paid.

The Zambia VectorLink team advocated for increased participation by women in all IRS activities. In the 2018 IRS season, it trained and hired 644 women to support IRS as SOPs, team leaders, DECAs, TLAs, and M&E assistants; they represented about 31 percent of the seasonal staff hired. Despite project efforts to increase the number of women SOPs, this percentage was a slight decrease from 33 percent in 2017. VectorLink Zambia will continue to dialogue with the NMEP and other stakeholders to work toward equitable engagement of women and men in future IRS campaigns.

8. CAPACITY BUILDING

To ensure GRZ staff at the national, provincial, and district levels use BMPs to implement IRS, VectorLink Zambia provided opportunities for them to enhance their technical knowledge and management capacity to implement IRS with minimal outside support. In 2018, spray quality remained a focus area of the project and as such, the project incorporated this important message into all trainings and mentoring and supervision visits.

VectorLink continued to provide capacity building to district-level environmental health technicians (EHTs) and human landing collectors to manage entomological data collection in 12 sentinel sites. VectorLink established two additional sentinel sites in Mambwe to complement the two in Katete, which is now considered in the pre-elimination phase and therefore not representative of Eastern Province.

In addition, VectorLink mentored the EHTs in mosquito collection and morphological identification activities. VectorLink staff previously conducted these activities during their supervision visits. EHTs in the districts are now using the acquired skills to do this under the supervision of project staff.

In 2018, VectorLink Zambia improved the managerial and administrative capacity of provincial and district health directors in PMI-supported districts in IRS planning, operations, and supervision. All trained GRZ staff were actively involved in monitoring and supervising IRS implementation.

Although VectorLink has shared microplanning, monitoring, and supervision tools with the NMEP, IRS was not successfully implemented in the GRZ-run IRS districts in 2018. The concept of the “race-to-the-starting line” was shared but not employed and therefore planning, mapping, training, deployment, environmental compliance, and supervision all occurred late and at below optimum standards. The procurement procedures at the Program Management Unit of the MOH and the Ministry of Finance also could not factor in the tight procurement lead time that IRS commodities require in order for the spray campaign to be successfully implemented. As a result, only limited areas were sprayed using leftover Actellic from 2017 and surplus Actellic stock which remained in the PMI-supported districts.

VectorLink is working closely with the NMEP to conclude the capacity assessment document before the 2018 work plan year ends. The completed form will feed into the capacity-building activities planned for 2019 to assist both the NMEP and the Program Management Unit at the MOH to embrace and implement the concept of the “race-to-the-starting line”.

9. CHALLENGES AND LESSONS LEARNED

9.1 CHALLENGES

- Inaccurate enumeration of structures in Sinda during micro planning led to:
 - Last-minute adjustments in determining the spray areas which required the team to rapidly change the strategy from blanket spraying to a targeted approach
 - IRS coverage of only 63% of the total eligible structures based on the data from Akros using updated maps
 - The deployment of ecological approach for targeting which excluded areas which had already been sensitized and mobilized, and in some cases known high burden areas within the district.
- mSpray Data Collection:
 - Data collected using mSpray tool was duplicative of what SOPs collected on paper.
 - Data collected on tablet does not utilize DHIS2 platform, unlike the data entered by data entry clerks utilizing data from the SOP forms.
- Ineffective community sensitization and mobilization by mobilizers (community health workers), led to:
 - Unavailability of IRS cards in communities in 26 out of the 29 districts. SOPs used “dummy” numbers extensively for initial and mop-up visits. These virtual numbers, which were marked on the doors using chalk, were frequently rubbed off by homeowners which resulted in SOPs assigning new IRS numbers during mop-up visits. This meant that structures could not be tracked in the database and likely contributed to the low spray coverage in some areas since some houses were likely counted twice.
 - High rates of refusals (38%) in three districts, namely Nchelenge, Kasama, and Samfya
 - Poor coordination in some areas between spray teams and mobilizers, resulting in low levels of household preparation
- Disruption of spray operations by rains which led to:
 - Householders were reluctant to take their belongings outside.
 - Poor accessibility of hard-to-reach areas. This majorly affected 5 out of the 29 districts (Mpika, Chinsali, Mafinga, Chama, and Luwingu).
 - Rescheduling of farming activities by communities in 27 districts which affected the spray calendar if an area or community had previously been scheduled to receive IRS on a day that became a farming day.
- Migration of the communities to camps for caterpillar harvesting, which affected 15 of the 29 districts. In two such districts (Shiwangandu and Senga), IRS progress was impacted so seriously that a 1-week suspension of operations was warranted.

- Rains and inadequate community sensitization and mobilization led to failure by the team to achieve a minimum of 85% coverage in Kasama, Mpika, and Nchelenge. Caterpillar harvesting also played a role in Kasama and Mpika.
- Limited internet connectivity led to delays in data reporting and cleaning:
 - While the DHIS2 desktop application allows for offline data entry, an internet connection is required at some point to sync data to the central server. In some areas, this proved challenging.
 - The data-cleaning process relies on a constant, stable internet connection, which was not available in some areas. Data cleaning was supposed to happen in real time but lack of connectivity forced data cleaning to take place after the campaign ended. This happened in about 30 percent of the data entry centers; as a result of delayed data cleaning it was difficult to accurately track mop up activities in real time.
 - As a result of delays in data reporting, VectorLink Zambia relied heavily on Performance Management Tracker data in some districts. In some cases, these data were inaccurate, which was discovered only after the data were cleaned in DHIS2.
- Households are assigned an IRS number, which uniquely identifies the household and tracks its spray status during the campaign. At the beginning of the campaign, there were instances where SOPs did not properly assign IRS numbers to households. For example, in communities where householders were away collecting caterpillars, some SOPs assigned locked structures an IRS number ending in “000000.” This mistake was addressed during the first few days of the campaign. However, when structures were later sprayed during mop-ups, it was difficult to match the mop-up (sprayed) visit with the unrecorded (unsprayed) one. As a result, some structures were likely counted twice. In certain districts, particularly Kasama and Nchelenge, we believe this contributed to lower than expected coverage.
- Districts sometimes deviated from the agreed operational plan. For example, 16 out of 29 districts decided to camp without informing the project about the challenges that required them to camp. Other districts failed to make district vehicles available to supervisors. In addition, 8 districts did not rehabilitate their portion of the operation sites (toilet and bathroom facilities) on time.
- In Kasama, Chinsali, and Mwense, VectorLink Zambia documented five falsification of spray data incidents involving 12 SOPs falsifying a total of 119 structures. This may have been partly attributable to ineffective supervision by IRS supervisors.
- There were discrepancies in the inventory conducted immediately after the 2017 spray campaign to the inventory conducted during needs assessment for the 2018 spray campaign. This was because leftover IRS commodities and PPEs were kept in district store houses overseen by the GRZ storekeeper during off-season who failed to account for the shortfall.
- The concept of the “race-to-the-starting line”, though shared, was not used in the GRZ-supported districts and therefore planning, mapping, training, deployment, environmental compliance and supervision all occurred late and at below optimal standards.

9.2 LESSONS LEARNED

- Engaging traditional and sectional leaders in community sensitization and mobilization enhanced the acceptability of IRS in the rural and urban parts of the districts, respectively.
- Collaboration between district spray teams within some provinces improved spray coverage and progress in districts that were struggling in their performance.
- Use of bicycles for the end period of the spray campaign in three districts (Mpika, Luwingu, and Mwansabombwe) reduced the cost of SOP transport.

- Introduction of a second IRS operation site in large districts such as Mwense, Kasama, Mungwi, Mansa, and Nchelenge helped in the smooth running of the IRS implementation and enhanced adherence to environmental compliance guidelines.
- The use of MSPs reduced the costs and compliance issues associated with long distances between the fixed IRS operation site and spray areas.
- Using mSpray tools to enumerate, guide SOPs in the field, determine true spray coverage, and plan the next target areas was useful for district field teams. In addition, mop-up teams were able to easily navigate back to structures that required re-visits.

9.3 RECOMMENDATIONS

- Overhaul the mobilization strategy and engage chiefs and headmen (in rural communities) and section leaders (in urban areas) instead of community health workers.
- Where feasible, return to the previous spray campaign schedule, before the onset of rains and caterpillar season. This will depend on the availability of insecticides which have longer residual efficacy than Actellic.
- Establish additional operation sites in districts where the number of SOPs exceeds the maximum of 50 per site and ensure distance between the operation site and the furthest community to be sprayed does not exceed 70 km.
- Use SOPs to distribute IRS cards during the campaign (instead of community mobilizers ahead of the campaign).
- Reconsider the use of community mobilizers for enumeration for the districts to populate prior to microplanning meetings to avoid deviation from the agreed operational plans during microplanning.
- Collect leftover insecticide and PPE from all districts and store in central location after the spray campaign.
- Combine district data centers into more centralized locations with better internet connectivity. VectorLink Zambia will evaluate the feasibility of doing this.
- Finalize the capacity building assessment document to support the NMEP and the Program Management Unit at the MOH to effectively implement on-time, qualitative IRS by adopting and using the ‘race-to-the-starting line’ document.

ANNEX A: PROCUREMENT

Table I3: International Procurements

Item	Quantity Required	Opening Balance	Quantity Procured	Total at Start of Campaign	Quantity Used	Quantity Damaged	Total at End of Campaign
Goizper Pumps	1149	324	825	1149	1040	193	1053
Nozzle Nuts	321	221	100	321	40		281
Face Shields	3460	0	3,460	3460	2784		676
Nose Masks	70440	0	70,440	70440	59365		11075
Actellic 300CS (bottles)	145668	0	145,668	145668	127079		18589
SumiShield (sachets)	24868	0	24868	24868	20904		3963 ¹
Disc Plunger	50	0	50	50	25		25
Filter nylon	292	192	100	292	127		165
Cup plunger	100	0	100	100	26		74
Pump Gasket	50	0	50	50	40		10
Flashlights	1,577	0	1,296	1,590	1,590	1296	294
Gloves	3,712	0	3,456	3,712	2,812	2,812	900
Gumboots	2,033	1311	648	2,033	2,033	225	1,808
Overalls	4,230	1,786	1,283	4,230	4,230	1786	2,444
Insecticide bags	1,530	0	1,283	1,530	1,530	0	1,530
Constant Flow Valves	451	51	400	451	302		149
Nozzles 8002	458	358	100	458	124	0	334

¹One insecticide sachet was reported missing in Katete District

Table 14: Local Procurements

Item	Quantity Required	Opening Balance	Quantity Procured	Total at Start of Campaign	Quantity Used	Quantity Damaged	Total at End of Campaign
Overalls	4,230	1,786	1,161	4,230	4,230	1,786	2,444
Bath soap	4,913	0	4,913	4913	4913		0
Gumboots	2,033	1311	74	2.033	2,033	225	1,808
Socks	2,474	0	2,474	2474	2474		0
Tooth brushes	1,647	0	1,647	1647	1647		0
Plastic Roll	100	0	100	100	100		0
Refuse Bags	628	483	145	628	145		483
Gloves	3,712	0	256	3,712	2,812	2,812	900
Insecticide bags	1,530	0	247	1,530	1,530	0	1,530
Soap bars	6,183	0	6,183	6183	6183		0
Face cloths	2,294	0	2,294	2294	2294		0
Mutton cloths	2,078	0	2,078	2078	2007		71
IRS cards	58,393	0	58,393	58,393	58,393		0
Mobilization cards	15,750	0	15,750	15,750	15,750		0
Team Leader Forms	11,400	0	11,400	11,400	11,400		0
DCV Forms	1,794	0	1,794	1,794	1,794		0
IRS Cards	630,000	0	630,000	630,000	630,000		0
Flashlight LED	1,577	0	294	1,590	1,590	1,296	294

ANNEX B: CAMPAIGN LENGTH BY DISTRICT

Province	District	Campaign Details		
		Spray Days	Spray Start Date	Spray End Date
Eastern	Chadiza	30	01-Nov	05-Dec
	Katete	30	01-Nov	05-Dec
	Sinda	30	01-Nov	05-Dec
Muchinga	Chinsali	30	01-Nov	05-Dec
	Isoka	30	01-Nov	05-Dec
	Mpika	30	01-Nov	05-Dec
	Mafinga	30	01-Nov	05-Dec
	Shiwang'andu*	30	01-Nov	14-Dec
	Nakonde	30	01-Nov	05-Dec
Northern	Chilubi	30	01-Nov	08-Dec
	Kaputa	30	01-Nov	05-Dec
	Kasama*	32	01-Nov	08-Dec
	Luwingu	30	01-Nov	05-Dec
	Mbala	30	01-Nov	05-Dec
	Mporokoso	30	15-Oct	19-Nov
	Mungwi	30	01-Nov	05-Dec
	Senga	32	01-Nov	11-Dec
	Nsama	28	01-Nov	05-Dec

Province	District	Campaign Details		
		Spray Days	Spray Start Date	Spray End Date
Luapula	Mansa	30	01-Nov	08-Dec
	Chembe	30	01-Nov	05-Dec
	Chipili	30	01-Nov	05-Dec
	Samfya	32	01-Nov	05-Dec
	Mwense	30	01-Nov	05-Dec
	Kawambwa	30	15-Oct	22-Nov
	Mwansabombwe	30	01-Nov	05-Dec
	Nchelenge*	34	01-Nov	15-Dec
	Chiengi	30	01-Nov	05-Dec
	Milenge	30	01-Nov	05-Dec

*Note: Campaigns in these districts were suspended for 1-2 weeks, then resumed.

ANNEX C: SPRAY PROGRESS AND COVERAGE BY DISTRICT

Province	District	Spray Progress	Target	Found	Sprayed	Revisited (mop up) Structures Physically Verification	Revisited Structures Overwritten in DHIS2	Spray Coverage	Total Population Protected			
									Male	Female	Pregnant Women	Children under five
Eastern	Chadiza	94%	22,800	22,851	21,485	mSpray	mSpray	94%	39,604	40,058	1,419	13,392
	Katete	95%	35,700	34,570	33,855	mSpray	mSpray	98%	61,111	62,543	2,078	18,863
	Sinda*	102%	31,500	33,530	32,277	mSpray	mSpray	96%	54,981	55,104	2,061	17,071
	Total	97%	90,000	90,951	87,617			96%	155,696	157,705	5,558	49,326
Muchinga	Chama	90%	23,544	23,360	21,256	654	0	91%	47,961	47,554	2,114	13,797
	Chinsali	99%	19,919	22,922	19,642	1,771	872	86%	52,190	50,946	3,493	12,353
	Isoka	91%	13,869	13,699	12,572	10	1	92%	26,322	25,781	1,742	7,174
	Mafinga	95%	11,745	11,609	11,148	368	23	96%	23,036	23,159	1,461	6,895
	Mpika	98%	25,019	29,060	24,514	5,258	1,189	84%	60,219	58,427	3,340	14,259
	Nakonde	100%	20,819	22,420	20,890	362	5	93%	46,226	45,839	2,606	14,152
	Shiwang'andu	98%	9,363	10,341	9,148	2,738	2,233	88%	21,191	20,877	1,117	5,787
	Total	96%	124,278	133,411	119,170	11,161	4,323	89%	277,145	272,583	15,873	74,417

Province	District	Spray Progress	Target	Found	Sprayed	Revisited (mop up) Structures Physically Verification	Revisited Structures Overwritten in DHIS2	Spray Coverage	Total Population Protected			
									Male	Female	Pregnant Women	Children under five
Northern	Chilubi	104%	16,184	17,679	16,826	132	74	95%	44,919	45,064	2,753	14,748
	Kaputa	93%	13,772	14,018	12,830	232	9	92%	34,852	32,773	2,402	11,799
	Kasama	90%	46,798	50,444	42,348	10,223	1,452	84%	106,549	102,843	7,474	26,824
	Luwingu	82%	20,552	19,761	16,848	553	46	85%	43,474	42,665	2,399	12,868
	Mbala	85%	16,267	14,452	13,873	1,174	56	96%	34,735	32,979	1,881	10,794
	Mporokoso	88%	14,260	14,217	12,589	1,031	83	89%	30,358	28,736	1,764	8,197
	Mungwi	83%	29,639	28,513	24,645	647	42	86%	61,226	59,566	3,480	17,613
	Nsama	89%	10,148	9,173	9,013	0	0	98%	24,661	23,971	1,792	8,586
	Senga	84%	12,734	12,252	10,662	894	374	87%	25,115	24,045	1,250	7,216
	Total		89%	180,354	180,509	159,634	14,886	2,136	88%	405,889	392,642	25,195

Province	District	Spray Progress	Target	Found	Sprayed	Revisited (mop up) Structures Physically Verification	Revisited Structures Overwritten in DHIS2	Spray Coverage	Total Population Protected			
									Male	Female	Pregnant Women	Children under five
Luapula	Chembe	86%	6,470	5,949	5,533	167	3	93%	14,055	13,660	856	4,191
	Chienge	99%	44,884	47,065	44,211	2,641	950	94%	119,796	114,860	12,442	33,963
	Chipili	95%	5,056	5,120	4,821	3	1	94%	12,596	12,462	676	4,027
	Kawambwa	95%	24,742	24,932	23,526	1,062	149	94%	62,328	60,690	4,085	17,400
	Mansa	95%	31,850	32,955	30,298	2,274	1,001	92%	78,406	78,131	5,920	22,038
	Milenge	80%	6,470	5,661	5,198	389	159	92%	12,601	12,718	621	4,067
	Mwansabombwe	89%	10,413	9,865	9,234	210	3	94%	27,015	27,369	1,539	8,103
	Mwense	82%	27,450	25,436	22,607	1,450	53	89%	67,706	67,326	5,134	18,908
	Nchelenge	82%	34,367	36,737	28,327	10,951	2,349	77%	84,066	81,674	5,435	25,767
	Samfya	90%	43,667	46,086	39,294	3,475	720	85%	104,575	104,482	6,625	30,564
	Total	91%	235,369	239,806	213,069	22,622	5,388	89%	583,144	573,372	43,333	169,028
Total		92%	630,000	644,677	579,490	48,669	11,848	90%	1,421,874	1,396,302	89,959	411,416

*Note: Only a portion of Sinda District (about 50%) was targeted for spraying during the VectorLink IRS campaign.

Note: Spray progress is the proportion of structures sprayed among target structures, while spray coverage is structures sprayed over structures found.

ANNEX D: TARGETED CATCHMENT AREAS

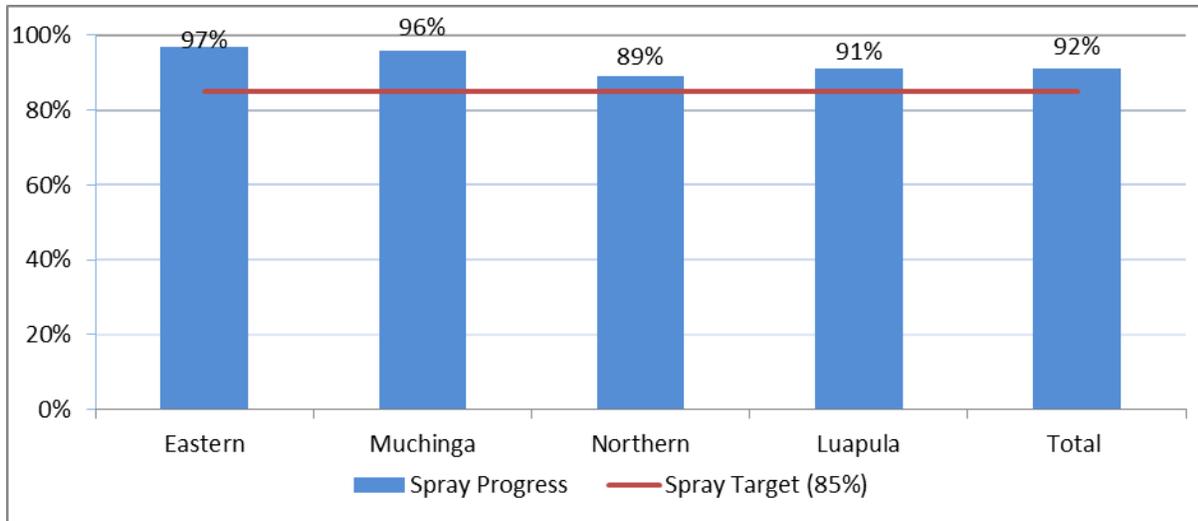
District	Catchment Areas	Targeted Catchment Areas	Total Structures (Reported by District)	Eligible Structures	Eligible Structures in Targeted Catchment Areas	Eligible Structures in Non-Targeted Catchment Areas	Sprayed Structures per District/ Province	% of Structures Sprayed
Eastern	75	70	157,409	128,746	90,000	38,746	87,617	68%
Chadiza	20	20	23,358	24,600	22,800	1,800	21,485	87%
Katete	32	28	70,625	45,202	35,700	9,502	33,855	75%
Sinda	23	22	63,426	58,944	31,500	27,444	32,277	55%
Muchinga	123	123	165,706	127,392	124,278	3,114	119,170	94%
Chama	28	28	24,001	23,859	23,544	315	21,256	89%
Chinsali	10	10	22,627	19,919	19,919	0	19,642	99%
Isoka	11	11	20,660	14,049	13,869	180	12,572	89%
Mafinga	11	11	22,658	13,085	11,745	1,340	11,148	85%
Mpika	35	35	37,959	25,019	25,019	0	24,514	98%
Nakonde	13	13	24,177	20,819	20,819	0	20,890	100%
Shiwang'andu	15	15	13,624	10,642	9,363	1,279	9,148	86%

District	Catchment Areas	Targeted Catchment Areas	Total Structures (Reported by District)	Eligible Structures	Eligible Structures in Targeted Catchment Areas	Eligible Structures in Non-Targeted Catchment Areas	Sprayed Structures per District/ Province	% of Structures Sprayed
Northern	171	147	259,092	212,353	180,354	31,999	159,634	75%
Chilubi	15	12	24,350	16,647	16,184	463	16,826	101%
Kaputa	11	9	19,755	13,772	13,772	0	12,830	93%
Kasama	38	26	66,478	66,478	46,798	19,680	42,348	64%
Luwingu	23	23	30,603	22,731	20,552	2,179	16,848	74%
Mbala	18	16	26,869	18,767	16,267	2,500	13,873	74%
Mporokoso	18	18	19,520	14,578	14,260	318	12,589	86%
Mungwi	22	22	34,150	29,808	29,639	169	24,645	83%
Nsama	8	7	15,792	12,750	10,148	2,602	9,013	71%
Senga	18	14	21,575	16,822	12,734	4,088	10,662	63%
Luapula	145	137	270,515	254,632	235,368	19,264	213,069	84%
Chembe	7	7	6,470	6,470	6,470	0	5,533	86%
Chienge	12	12	48,248	47,724	44,883	2,841	44,211	93%
Chipili	11	11	5,155	5,056	5,056	0	4,821	95%
Kawambwa	15	15	27,306	24,742	24,742	0	23,526	95%

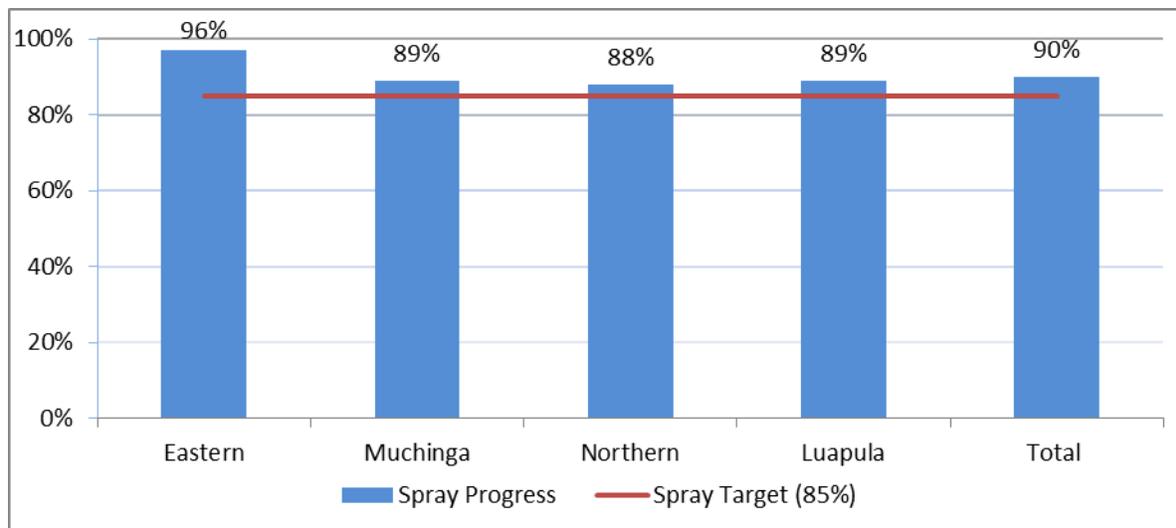
District	Catchment Areas	Targeted Catchment Areas	Total Structures (Reported by District)	Eligible Structures	Eligible Structures in Targeted Catchment Areas	Eligible Structures in Non-Targeted Catchment Areas	Sprayed Structures per District/ Province	% of Structures Sprayed
Mansa	25	25	34,696	32,686	31,850	836	30,298	93%
Milenge	8	8	7,086	6,470	6,470	0	5,198	80%
Mwansabombwe	6	6	12,368	10,413	10,413	0	9,234	89%
Mwense	13	13	33,051	27,700	27,450	250	22,607	82%
Nchelenge	16	14	41,177	39,413	34,367	5,046	28,327	72%
Samfya	32	26	54,958	53,958	43,667	10,291	39,294	73%
Total	514	477	852,722	723,123	630,000	93,123	579,490	80%

ANNEX E: SPRAY PROGRESS AND COVERAGE

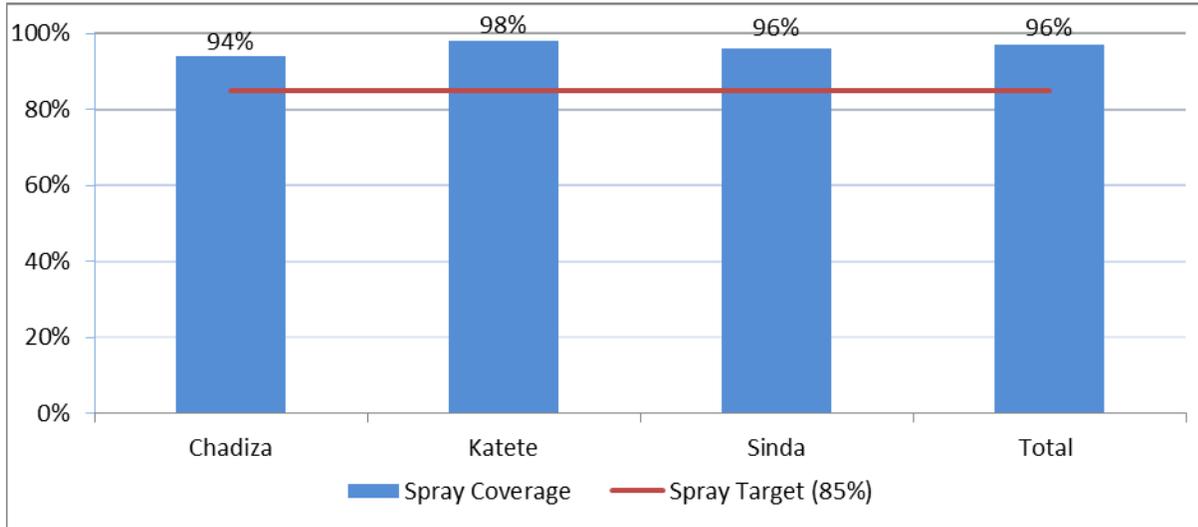
[E1] PROVINCIAL SPRAY PROGRESS



[E2] PROVINCIAL SPRAY COVERAGE

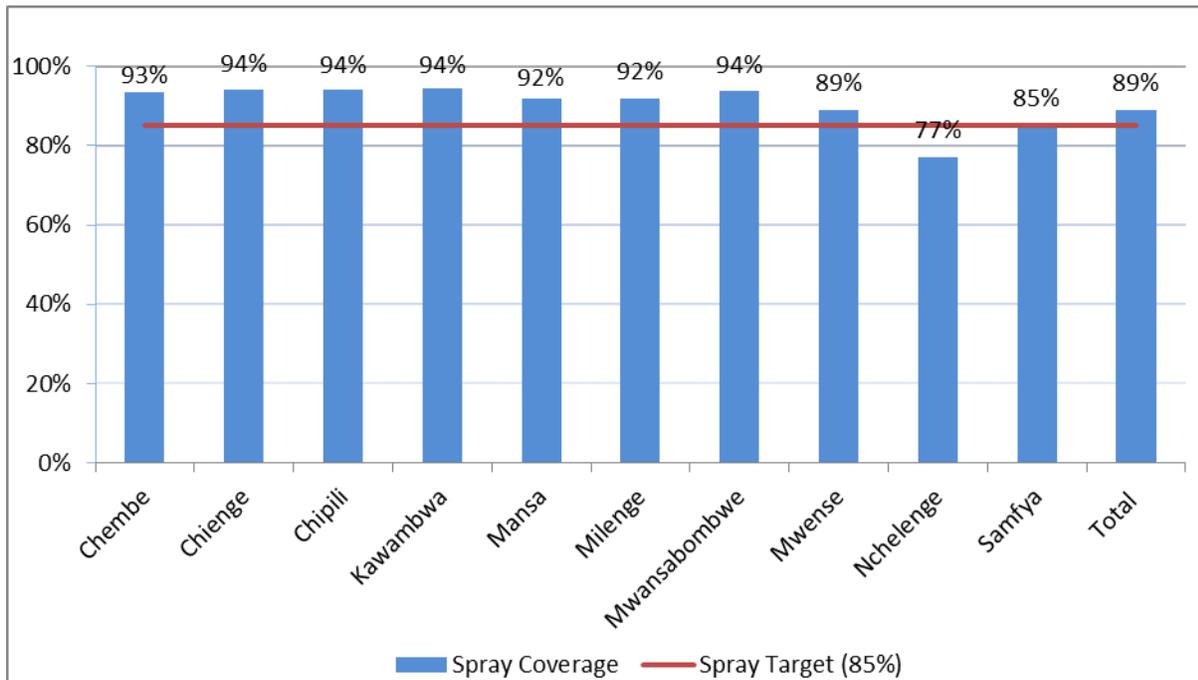


[E3] DISTRICT SPRAY COVERAGE, EASTERN PROVINCE

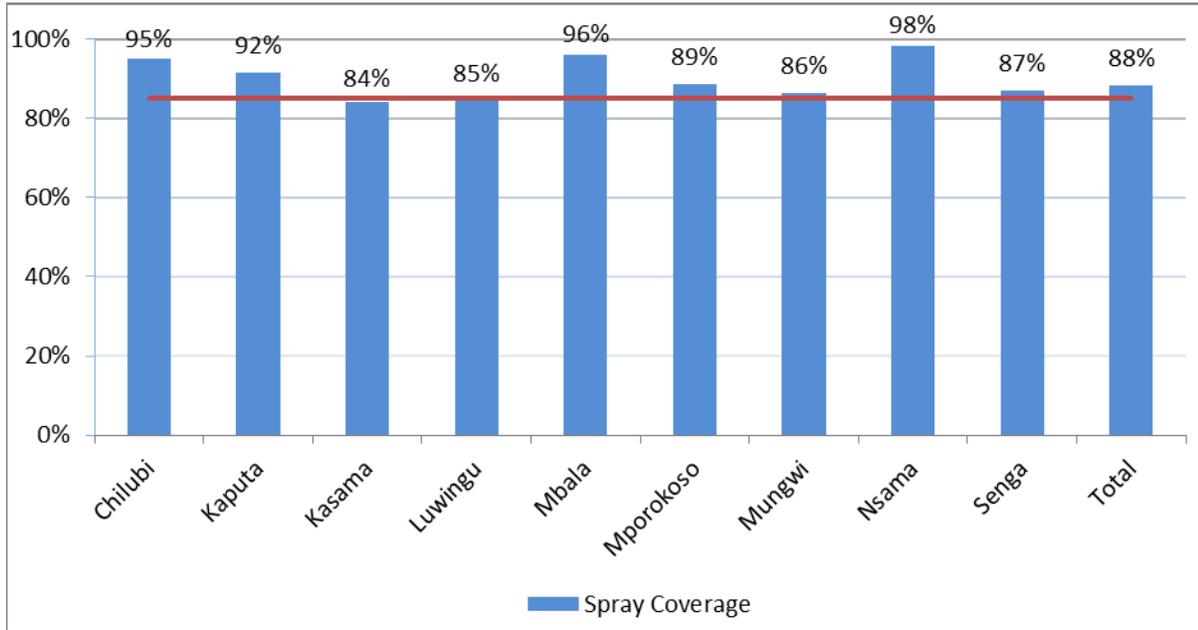


*Only a portion (about 50%) of eligible structures in Sinda District were targeted for spraying during the 2018 campaign.

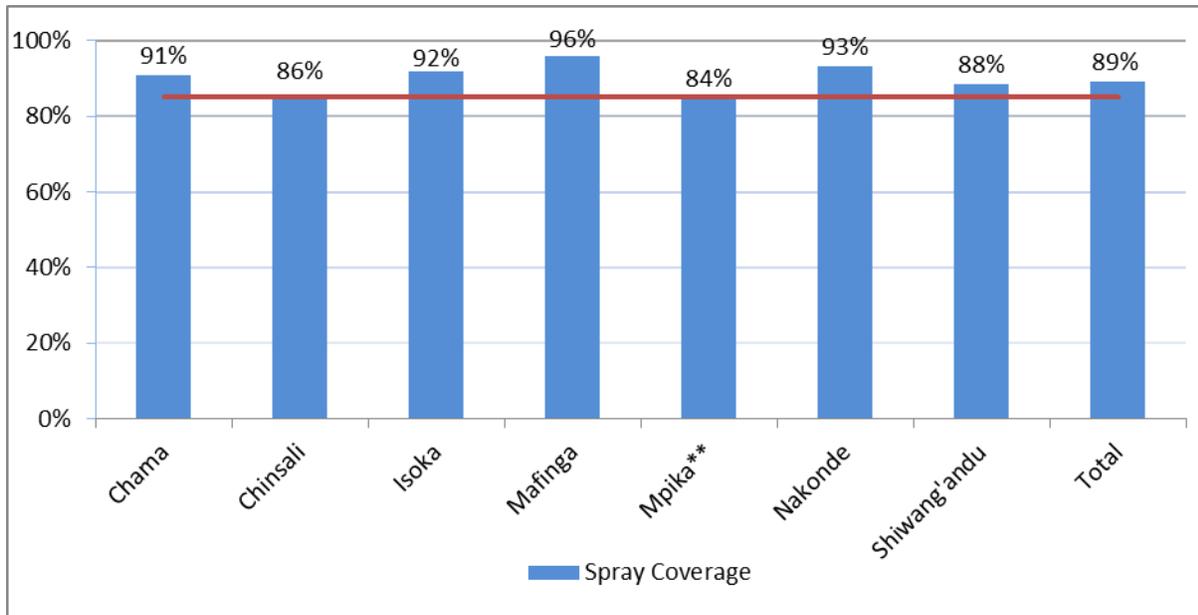
[E4] DISTRICT SPRAY COVERAGE, LUAPULA PROVINCE



[E5] DISTRICT SPRAY COVERAGE, NORTHERN PROVINCE



[E6] DISTRICT SPRAY COVERAGE, MUCHINGA PROVINCE



ANNEX F: M&E PLAN MATRIX – 2018 CAMPAIGN RESULTS

#	Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregation(s)	Annual Targets and Results									
				Year 1		Year 2		Year 3		Year 4		Year 5	
				Target	Result	Target	Result	Target	Result	Target	Result	Target	Result
Objective 1: Implementation of Malaria Vector Control Interventions													
1.1	Successfully Execute IRS and Other Malaria Vector Control Programs												
1.1.1	Number and percentage of complete annual country work plans developed and submitted on-time	Project records Annually	Country	1	1; 100%								
1.1.2	Number of eligible structures targeted for spraying	Project records Annually	Country	630,000	630,000								
1.1.3	Number of eligible structures sprayed with IRS	Project records Annually	Country	535,500	579,490								
1.1.4	Percentage of total structures targeted for spraying that were sprayed with a residual insecticide (spray coverage)	Project records Annually	Country	85%	92%								

#	Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregation(s)	Annual Targets and Results									
				Year 1		Year 2		Year 3		Year 4		Year 5	
				Target	Result	Target	Result	Target	Result	Target	Result	Target	Result
1.1.5	Number of people protected by IRS	Project records Annually	Country Sex Pregnant women Children <5	2,558,542	2,818,176; 1,421,874 males; 1,396,302 females; 411,416 children <5; 89,959 preg women								
1.1.6	Number and percentage of vector control project country programs submitting an EOSR within 45 days after the end of spray (including completing MEP and EMMR)	Project Annually	Country	1	1; 100%								
1.1.7	Number of IRS country programs that conduct a Post-spray Data Quality Audit within 90 days of spray completion	Data Collection Forms Annually	Country	N/A	N/A								
1.1.8	Number of ITNs distributed, by channel	Project Records Annually	Country Channel	N/A	N/A								
1.1.9	Number and percentage of ITN country programs that conduct at least one process assessment of the quality of ITN distribution planning, the quality of household registration, and or ITN distribution implementation during a mass ITN distribution campaign	Project Records Annually	Country Channel	N/A	N/A								

#	Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregation(s)	Annual Targets and Results									
				Year 1		Year 2		Year 3		Year 4		Year 5	
				Target	Result	Target	Result	Target	Result	Target	Result	Target	Result
1.1.10	Number and percentage of ITN country programs with operational routine monitoring systems for continuous ITN distribution, disaggregated by channel	Project Records Annually	Country Channel	N/A	N/A								
1.1.11	Number and percentage of countries completing ITN durability monitoring data collection on time as planned in a given project year	Project Records Annually	Country	N/A	N/A								
1.2	Provide Technical Assistance and Planning Support for IRS and Other Integrated Malaria Vector Control Activities												
1.2.1	Number of PMI VectorLink project training workshops targeting NMCP and other host country staff	Project Training Records Annually	Country Technical Area Job Function	1	4 ⁶								
1.2.2	Number of NMCP and other vector control host country staff accessing DHIS2	DHIS2 Logs Annually	Country Job Function	2	4								

⁶ This refers to the four Training of Trainers (TOTs) workshops that took place; NMCP personnel were present at these workshops.

#	Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregation(s)	Annual Targets and Results									
				Year 1		Year 2		Year 3		Year 4		Year 5	
				Target	Result	Target	Result	Target	Result	Target	Result	Target	Result
1.3	Ensure Safe and Judicious Use of Insecticides and Other Malaria Vector Control Products												
1.3.1	Number of PMI VectorLink personnel trained in environmental compliance and personal safety standards in vector control implementation	Project Training Records Annually	Country Sex (# and %) Job Function	2,008 ⁷ 803 (40%) Females	2,079 ⁸ 561 (27%) Females								
1.3.2	Number of health workers receiving insecticide poisoning case management training	Project Training Records Annually	Country Sex (# and %)	26 10 (40%) Females	31 7 (23%) Females								
1.3.3	Number of adverse reactions to pesticide exposure documented	Incident Report Forms Annually	Country Type of Exposure	0	0								
1.4	Strengthen Capacity of NMEP, Vector Control Personnel, and Other Institutions to Implement and Manage IRS and Other Vector Control Activities												
1.4.1	Total number of people trained to support PMI VectorLink in targeted areas	Project Training Records Annually	Country Sex (# and %) Intervention Type	1,935 ⁹ 774 (40%) Females	2,006 ¹⁰ 542 (27%) Females								

⁷ This includes 1,497 SOPs, 292 team leaders, 146 supervisors, and 73 storekeepers.

⁸ This includes 1,564 SOPs, 295 team leaders, 147 supervisors and 73 storekeepers.

⁹ This includes 1,497 SOPs, 292 team leaders, and 146 supervisors.

¹⁰ This includes 1,564 SOPs, 295 team leaders, and 147 supervisors.

#	Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregation(s)	Annual Targets and Results									
				Year 1		Year 2		Year 3		Year 4		Year 5	
				Target	Result	Target	Result	Target	Result	Target	Result	Target	Result
1.4.2	Number of people trained during IRS Training of Trainers	Project Training Records Annually	Country Sex (# and %)	146 58 (40%) Females	147 35 (24%) Females								
1.4.3	Total number of people hired to support PMI VectorLink in target districts	Project Records Annually	Country Sex (# and %) Job Function Intervention Type	1,935 ¹¹ 774 (40%) Females	1,893 ¹² 509 (31%) Females								
1.4.4	Number of government/district officials who acted as supervisors during PMI VectorLink campaigns	Project Records Annually	Country Intervention Type	73	73								
1.5	Promote Gender Equality in All Facets of Planning and Implementation												
1.5.1	Number of women hired to support PMI VectorLink campaigns	Project Records Annually	Country Returning female seasonal workers hired in a more senior capacity	730	565								
1.5.2	Number and percentage of women hired in supervisory roles in target areas for PMI VectorLink Zambia activities	Project Records Annually	Country Intervention Type Job Function	199 99 (50%) Females	123 38 (31%) Females								

¹¹ This includes 1,497 SOPs, 292 team leaders, and 146 supervisors.

¹² This includes 1,500 SOPs, 247 team leaders, and 146 supervisors.

#	Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregation(s)	Annual Targets and Results									
				Year 1		Year 2		Year 3		Year 4		Year 5	
				Target	Result	Target	Result	Target	Result	Target	Result	Target	Result
1.5.3	Number and percentage of staff (permanent and seasonal) who have completed gender awareness training	Project Training Records Annually	Country Sex Job Function	2,285 ¹³ ;	2,370 ¹⁴ ; 782 (33%) Females								
1.5.4	Number and percentage of women in senior leadership roles in VectorLink country offices	Project Records Annually	Country Sex (# and %)	N/A ¹⁵	1								
1.6	Implement and Support Social Behavioral Change Communication and Mobilization Activities												
1.6.1	Number of radio spots and talk shows aired	Project Records Annually	Country Intervention Type	495	553								
1.6.2	Number of print materials disseminated	Project Records Annually	Country Intervention Type	18,820 ¹⁶	18,820								
1.6.3	Number of people reached with vector control and/or SBCC messages via door-to-door messaging	Project Records Annually	Country Intervention Type Sex	2,558,542	745,454 ¹⁷								

¹³This includes 1,497 SOPs, 292 team leaders, 146 supervisors, 73 storekeepers, 72 DECs, 39 M&E assistants, 100 washers, 26 clinicians, and 38 PMI VectorLink staff.

¹⁴This includes; 1,564 SOPs, 295 team leaders, 147 supervisors, 73 storekeepers, 72 DECs, 50 M&E assistants, 100 washers, 31 clinicians, and 38 PMI VectorLink staff.

¹⁵Since VectorLink Zambia retained most senior staff, the target for Year 1 was not applicable as most positions were already filled.

¹⁶ This includes; 5,435 FAQs, 4,331 Job Aids, 8,662 Talking Points, 100 Sexual Harassment Posters, and 292 IRS Team Leader guides. These materials were distributed to community leaders, mobilizers, and team leaders.

¹⁷ During the 2018 IRS campaign, the project faced major challenges with the mobilization exercise; the supervision of mobilizers was not effective and this resulted in fewer than expected mobilization forms being handed back to the data centers.

#	Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregation(s)	Annual Targets and Results									
				Year 1		Year 2		Year 3		Year 4		Year 5	
				Target	Result	Target	Result	Target	Result	Target	Result	Target	Result
1.6.4	Number and percentage of people who feel that the proposed action (sleeping under an ITN/accepting IRS) will reduce their risk of malaria	Project Records Annually	Country	N/A	N/A								
1.6.5	Number and percentage of people with a favorable attitude toward the practice/product (i.e., ITNs, IRS)	Project Records Annually	Country Intervention Type	N/A	N/A								
1.6.6	Number and percentage of people who believe that the majority of their friends and community members practice the behavior	Project Records Annually	Country Intervention Type	N/A	N/A								
1.7	Environmental Compliance												
1.7.1	Number and percentage of SEAs (with EMMPs) or Letter Reports submitted at least 60 days prior to the commencement of vector control campaigns	Project Records Annually	Country	1	1								
1.7.2	Number and percentage of permanent and mobile soak pits inspected and approved prior to IRS campaigns	Project Records Annually	Country Soak Pit Type	44	50; 114%								
1.7.3	Number and percentage of storehouses inspected and approved prior to IRS campaigns	Project Records Annually	Country Storehouse Type	44	50; 114%								
1.7.4	Number and percentage of fixed soak pits that are compliant with PMI's Best Management Practices	Project Records Annually	Country	44	50; 114%								

#	Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregation(s)	Annual Targets and Results										
				Year 1		Year 2		Year 3		Year 4		Year 5		
				Target	Result	Target	Result	Target	Result	Target	Result	Target	Result	
2. Entomological and Epidemiological Data to Drive Decision-Making														
2.1	Vector Control Activities Monitored via Entomological and Epidemiological Data													
2.1.1	Number and percentage of project-supported entomological sentinel sites established to monitor vector bionomics and behavior (vector species, distribution, seasonality, feeding time, and location)	Entomological Reports Annually	Country Intervention Type	14	14;100%									
2.1.2	Number and percentage of entomological monitoring sentinel sites measuring all five basic PMI entomological monitoring indicators (i.e., species composition, abundance, and seasonality of malaria vector; insecticide susceptibility and resistance intensity; mechanism of resistance; quality assurance and residual efficacy monitoring of IRS programs; or vector behavior: feeding time and, location)	Entomological Reports Annually	Country Intervention	5	5; 100%									
2.1.3	Number and percentage of entomological monitoring sentinel sites measuring at least one advanced PMI indicator (i.e., identification of mosquito infectivity; parity rates; or blood-meal analysis)	Entomological Reports Annually	Country Intervention	14	14;100%									

#	Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregation(s)	Annual Targets and Results									
				Year 1		Year 2		Year 3		Year 4		Year 5	
				Target	Result	Target	Result	Target	Result	Target	Result	Target	Result
2.1.4	Number and percentage of insecticide resistance testing sites that tested at least one insecticide from pyrethroid, organophosphate, carbamate, clothianidin, and chlorfenapyr insecticides	Entomological Reports Annually	Country Insecticide Type	16	16; 100%								
2.1.5	Number of wall bioassays conducted within 2 weeks of spraying to evaluate the quality of IRS	Entomological Reports Annually	Country	42	42; 100%								
2.1.6	Number and percentage of cone bioassays conducted within two weeks of spraying with greater than 98% test mortality recorded	Entomological Reports Annually	Country	42	42; 100%								
2.1.7	Number of wall bioassays conducted after the completion of spraying at monthly intervals to evaluate insecticide decay	Entomological Reports Annually	Country Insecticide Type	54 Actellic CS, 48 SumiShield, 6	42 Actellic CS, 36 SumiShield, 6								
2.1.8	Number of vector susceptibility tests for different insecticides conducted in selected sentinel sites	Entomological Reports Annually	Country Insecticide Type	72	31; 43%								

#	Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregation(s)	Annual Targets and Results									
				Year 1		Year 2		Year 3		Year 4		Year 5	
				Target	Result	Target	Result	Target	Result	Target	Result	Target	Result
2.1.9	Number of countries with an integrated vector control analytics dashboard available for decision making	Project Records Annually	Country	0	0 ¹⁸								
2.1.10	Number of staff (VectorLink-contracted or non-VectorLink) trained in entomological monitoring	Project Training Records Annually	Country Sex (# and %) Job Function	32	24								
2.2	NMCPs/NMEPs Develop Country-level IRS and Other Malaria Vector Control Strategies												
2.2.1	Number and percentage of countries with an integrated malaria vector control strategy, including a plan for monitoring and managing insecticide resistance supported by the project	Project Records Annually	Country	1	1								
2.2.2	Number and percentage of countries with integrated data and visualization landscaping for vector control decision making complete	Project Records Annually	Country	0	0								
2.2.3	Number and percentage of countries that implement sub-national insecticide as part of an IRM strategy	Project Records Annually	Country	1	1; 100%								

¹⁸ PATH, a PMI VectorLink partner, is creating an integrated vector control analytics dashboard.

#	Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregation(s)	Annual Targets and Results										
				Year 1		Year 2		Year 3		Year 4		Year 5		
				Target	Result	Target	Result	Target	Result	Target	Result	Target	Result	
2.3	Build Capacity of NMCP/NMEPs and Local Institutions to Collect, Analyze, and Use Data for Strategic Malaria Control Decision Making													
2.3.1	Number of individuals trained from NMCPs/NMEPs and national institutions to review and interpret data for integrated vector control decision making	Project Training Records Annually	Country Job Function Organization	4	0 ¹⁹									
2.3.2	Proportion of targeted individuals who report using new analytical tools and/or skills in their planning, resourcing, implementation, or measurement activities	Capacity Assessments Thrice Over Project Life	Country Job Function Organization	4	0									
3. Procure insecticides for IRS and support the delivery and storage of IRS and other malaria vector control products														
3.1	Cost-effective Procurement Mechanism Established													
3.1.1	Number and percentage of insecticide procurements that had a pre-shipment QA/QC test at least 60 days prior to spray campaign	Procurement Records Annually	Country Insecticide Type	1	1: 100%									
3.1.2	Number and percentage of insecticide procurements received on-time to allow for the initiation of spray operations as scheduled	Procurement Records Annually	Country Insecticide Type	1	1; 100%									

¹⁹ PATH, a PMI VectorLink partner, is creating an integrated vector control analytics dashboard and will present to NMEC, PMI and other key stakeholders at a data review meeting currently planned for February.

#	Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregation(s)	Annual Targets and Results									
				Year 1		Year 2		Year 3		Year 4		Year 5	
				Target	Result	Target	Result	Target	Result	Target	Result	Target	Result
3.1.3	Number and percentage of targeted countries with international equipment procurements, including PPE, received on-time to allow for the initiation of vector control campaigns as scheduled	Procurement Records Annually	Country Intervention Type	1	1; 100%								
3.1.4	Number and percentage of targeted countries with local procurements for PPE received on-time to allow for the initiation of spray operations as scheduled	Procurement Records Annually	Country	1	1; 100%								
3.1.5	Number and percentage of countries with PPE procured according to workforce composition	Procurement Records Annually	Country	1	1; 100%								
3.2	Robust Inventory Management and Logistics Systems Established												
3.2.1	Number and percentage of logistics and warehouse managers trained in vector control supply chain management	Project Training Records Annually	Country Intervention Type Sex	65	73; 112%								
3.2.2	Number and percentage of operation site warehouses where physical inventories can be verified by daily stock records	Inventory and Stock Records Annually	Country Insecticide Type	44	50; 114%								
3.2.3	Number and percentage of IRS countries that successfully completed spray operations without an insecticide stock-out	Inventory and Stock Records Annually	Country Insecticide Type	1	1; 100%								

#	Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregation(s)	Annual Targets and Results									
				Year 1		Year 2		Year 3		Year 4		Year 5	
				Target	Result	Target	Result	Target	Result	Target	Result	Target	Result
4. Innovation													
4.1	Conduct Operational Research Or Monitoring to Scale Up New Tools, Methods, and Approaches												
4.1.1	Number of operational research studies on promising new tools or new methods/approaches to existing tools that are implemented	Project Records Annually	Type of Innovation	0	0								
4.2	Create and Share Knowledge through Dissemination of Best Practices and Lessons Learned												
4.2.1	Number of innovations, best practices, and other data or lessons learned shared with other partners or international institutions for global reporting on the Vector Learning Exchange	Project Records Annually	Country Technical Area	2	0								
4.2.2	Number of individual members who use the Vector Learning Exchange	Project Records Annually	N/A	TBD	0								
4.2.3	Number of symposia and/or presentations submitted to and accepted at global conferences	Project Records Annually	Country Technical Area	2	0								
4.2.4	Number of success stories written or videos produced and shared on the PMI VectorLink project website	Project Records Annually	Country	5	1								

#	Performance Indicator	Data Source(s) and Reporting Frequency	Disaggregation(s)	Annual Targets and Results									
				Year 1		Year 2		Year 3		Year 4		Year 5	
				Target	Result	Target	Result	Target	Result	Target	Result	Target	Result
4.2.5	Number of peer-reviewed journal articles submitted and accepted	Project Records Annually	Technical Area	TBD	0 ²⁰								
4.2.6	Number of critical guidance, standards, or plans that incorporate disseminated findings/best practices	Project Records Annually	Technical Area	1	1 ²¹								
4.3	Develop and Deploy Cost-savings Approaches												
4.3.1	Number of innovative or novel approaches implemented to achieve cost savings in IRS and integrated malaria vector control programs	Project Records Annually	Country Intervention Type	1	1 ²²								
4.3.2	Number of cost-effectiveness assessments of existing approaches in the implementation of IRS and integrated malaria vector control programs	Project Records Annually	Country Intervention Type	1	1								
4.4	Cultivate Public-private Partnerships												
4.4.1	Number of private sector entities engaged with to establish public private partnerships to increase the quality and coverage of malaria vector control activities globally	Project Records Annually	Country Private Sector Organization	1	0								

²⁰ No peer-reviewed article was submitted during the 2018 IRS season.

²¹ Per the indicator definition, the Malaria Operational Plan fulfills this requirement.

²² A novel SOP transportation approach was piloted in four selected districts in 2018.

ANNEX G: ENVIRONMENTAL MITIGATION AND MONITORING REPORT

Mitigation Measure	Status of Mitigation Measure	Remarks
1a. Pre-contract inspection and certification of vehicles used for pesticide or spray team transport.	Conducted between September 27 and October 14, 2018. Some trucks presented for inspection did not have benches or railings, or complete documentation. Other vehicles were not roadworthy. In total 101 vehicles were inspected. 86 were hired.	After the inspections, all suitable trucks were retrofitted with benches, tents, roll cages, and handrails. Vehicles that were not roadworthy were not hired.
1b. Driver training	Trained 86 drivers between October 9, and October 12 in Katete, Mansa, Mpika, and Kasama districts.	VectorLink individually oriented all drivers who joined mid- campaign to the safeguards for Actellic 300CS and spray operator (SOP) transport.
1c. Cell phone, personal protective equipment (PPE), and spill kits on board during pesticide transportation.	All drivers were required to have cell phone and were given PPE after training. Transport vendors provided each vehicle with a first aid box and spill management kit. The project inspected 386 vehicles. 13 did not a complete spill kit, and 14 did not have a complete first aid kit.	Vendors stocked all vehicles with complete spill kits and first aid kits to last the whole spray campaign after VectorLink staff emphasized this requirement for all vehicles.
1d. Initial and 30-day pregnancy testing for female candidates for jobs with potential pesticide contact.	SOPs, washers, and store assistants took initial pregnancy tests before they were hired. The tests were done between September 8 and October 19, 2018. In some districts, a second test was conducted 30 days after the first round of tests.	Two tested positive in Kasama and these were assigned duties as packers.
1e. Health fitness testing for all SOPs	All SOPs received medical examinations (physical examinations, Hb, and blood pressure tests) before they were hired.included.	None.

Mitigation Measure	Status of Mitigation Measure	Remarks
1f. Procurement of, distribution to, and training on the use of PPE for all workers with potential pesticide contact.	Both international and local procurements were completed before trainings began. The use of PPE was demonstrated during TOTs, cascade, and storekeeper trainings, before the spray campaign began.	None.
1g. Training on mixing pesticides and the proper use and maintenance of spray pumps.	All trainings covered the correct mixing procedure for pesticides, including triple rinse of the bottles. They also covered pump mechanics for the maintenance of the pumps; 147 supervisors got this training during TOTs, and 247 team leaders did during cascade training. Out of the 1,326 houseowner and SOP performance inspections submitted, 63 instances of leaking pumps were reported.	At the beginning of the spray campaign (after training), most SOPs still could not properly clean and assemble the pumps. District coordinators and supervisors reviewed this procedure with them daily during morning mobilization and eventually the number of leaking pumps fell. Team leaders were available in the field to ensure that faulty pumps were immediately replaced or fixed.
1h. Provision of adequate facilities and supplies for end-of-day clean-up.	All 50 IRS operation sites (fixed and campsites) were located within health center premises. Eight new IRS operation sites with storerooms and soak pits were established. Two fixed soak pits in bad condition were renovated. In addition, 95 MSPs were provided before the campaign. According to the Best Management Practice (BMP) guidelines, VectorLink staff and MOH supervisors did 443 end-of-day clean-up inspections of fixed and MSPs; all operation sites inspected had wash facilities with soap and water for SOPs.	All operation bases had wash facilities with adequate water, soap, buckets, and privacy. The camping sites had temporary wash facilities that were certified prior to the start of the spray campaign. In districts without running water, washers drew and reserved water from the borehole before SOPs returned from the field, for use in end-of-day clean-up.
1i. Enforce clean-up procedures.	Pump clean-up was done in designated wash areas and supervised by the environmental compliance officer (ECO), IRS managers, district coordinators, and other PMI VectorLink staff. PMI VectorLink staff and MOH supervisors inspected 50 sites (443 total inspections) and reported 36 cases of non-compliance. 4 instances were about the same issue (covering all 7 barrels after clean-up).	Early in the campaign, team leaders did not take time to supervise the end-of-day clean-up activities. PMI VectorLink staff that visited all 29 districts addressed the issue by providing feedback and disseminating text reminders through the CommCare system.

Mitigation Measure	Status of Mitigation Measure	Remarks
2a. IEC campaigns to inform homeowners of responsibilities and precautions.	The project trained 4,025 community mobilizers to conduct door-to-door community mobilization and sensitization on IRS to inform homeowners what to do before, during, and after spray. All districts conducted radio programs as part of the IEC campaign.	Community mobilization was done two weeks before spraying began, and feedback or a mobilization report was presented prior to campaign launch. The mobilization report helped determine the spray schedule.
2b. Prohibition of spraying houses that are not properly prepared.	SOPs were advised not to spray in structures that were not properly prepared. PMI VectorLink and MOH staff did 1,326 homeowner preparation and SOP performance inspections. Early in the campaign, there were 12 reports of structures sprayed without adequate preparation.	In both urban and farm blocks, household preparation remains a challenge due to the large number of household items (e.g., maize) that have to be removed. This led to refusals. Pre-spray sensitization must be strengthened to improve this.
2c. Two-hour exclusion from house after spraying.	SOPs were trained to tell homeowners to keep windows and doors of sprayed structures closed for two hours, and then open them to circulate air for at least 30 minutes before cleaning floors. The ECO, district coordinators, and supervisors played a pivotal role in enforcing this requirement. As a result, all 1,326 inspections revealed SOPs had informed household owners about post-spray procedures.	None.
2d. Instruct homeowners to wash itchy skin and go to health clinic if symptoms do not subside.	Homeowners were instructed to wash their skin with plenty of water and soap if they experienced itching and to visit the nearest clinic if the itching persisted. The 1,326 inspections found 8 instances of a structure having been sprayed without the residents having been given post-spray instructions.	Most SOPs provided the required information to homeowners, but some homeowners forgot the instructions. However, these instructions were repeated by PMI VectorLink and MOH staff doing monitoring and supervision.
3a. Indoor spraying only.	The ECO, district coordinators, team leaders, and supervisors worked hard to ensure all sprayable surfaces were sprayed, including the walls, ceiling, and eaves of all sleeping spaces. Out of 1,326 inspections, two were found spraying inappropriate surfaces (floors, metal roof, outside surface of the door, glass).	The 2 instances of non-compliance occurred in the first few days of the spray campaign. The issues were addressed, and, as the campaign progressed, corrective measures were put in place to prevent such environmental compliance violations.

Mitigation Measure	Status of Mitigation Measure	Remarks
3b. Training on proper spray technique.	Team leaders and SOPs were trained on proper spray techniques during cascade trainings that were held October 23-30, 2018, in all 4 provinces. The 1,326 inspections found only four instances of SOP non-compliance.	During the first week of spraying, SOPs who were new hires were not consistent with the spray techniques and were retrained during morning mobilization to bring them up to standard with the spray technique. As the campaign progressed, spray technique was no longer an issue.
3c. Maintenance of pumps.	Prior to the deployment of SOPs each morning, team leaders and supervisors serviced all spray pumps. Out of 1,326 inspections, 63 leaking pumps were found. However, the team leaders and supervisors were always in the field to repair the defective pumps so that SOPs could quickly resume work.	None.
4a. Choose sites for disposal of liquid wastes, including mobile soak pit sites according to PMI BMPs.	Selecting the soak pit sites for liquid waste disposal was jointly done by the ECO, Zambia Environmental Management Agency (ZEMA), and MOH district representative and was supervised by the project Chief of Party in accordance with the PMI BMP. 50 fixed soak pits and 95 MSPs that were properly sited were used during the 2018 IRS campaign. Inspections of MSP sites reported no badly selected MSP sites, nor did the PSECA.	All sites selected for both fixed and mobile soak pits were suitable for the disposal of liquid waste.
4b. Construct fixed and mobile soak pits with charcoal to adsorb pesticide from rinse water.	Eight new soak pits were constructed according to BMP design. Construction was supervised by the ECO, district coordinators, and MOH district representative and had to be approved by the ZEMA. 60 MSPs filled with granulated activate charcoal (GAC) were built and installed in 14 districts where SOPs camped.	The use of MSPs reduced the costs and compliance issues associated with long distances between the fixed IRS operation site and spray sites. MSPs also expedited end-of-day clean-up. At the fixed soak pits, end-of-day clean-up was expedited by setting two sets of seven rinse barrels each to avoid congestion at the soak pit.
4c. Maintain soak pits as necessary during season.	436 fixed and mobile soak pits were well-maintained. Contaminated water drained properly into the soak pits.	None.

Mitigation Measure	Status of Mitigation Measure	Remarks
4d. Inspection and certification of solid waste disposal sites before spray campaign.	The ECO, chief environmental health officer, and the PMI VectorLink operation manager inspected solid waste disposal sites before the spray campaign started.	Most dump sites in Zambia are not properly managed and thus scavenging is common. To prevent this, VectorLink washes and gives uncontaminated waste (old overalls, bags, and used mutton cloths) to deserving SOPs. Worn-out helmets, face shields and gloves will be washed, then shredded and buried at the dump site. Empty bottles will be taken to a central facility (Lusaka Cleansing Depot) to be cleaned prior to being recycled. Contaminated boxes, empty insecticide sachets, and nose masks will be incinerated by the University Teaching Hospital (UTH); uncontaminated boxes will be given to paper milling plants as raw material in paper production.
4e. Monitoring waste storage and management during campaign.	All IRS solid waste was separated into categories (paper, plastic, rubber, and cloth, and were stored in labeled refuse bags. The 161 storekeeper performance inspections conducted found no containers for empty sachets and used masks unaccounted for or not labeled.	Most storekeepers were not new to the project which made it easier for them to adhere to the PMI BMP guidelines. Additionally, the entire VectorLink Zambia management team was in the field monitoring and supervising IRS operations throughout the campaign and was able to immediately identify and correct many non-compliance issues.
4f. Monitoring disposal procedures post-campaign.	The ECO will monitor the post-spray campaign solid waste disposal. All IRS waste has been collected and transported to the Lusaka Cleansing Depot for disposal at the national dump site. UTH will incinerate contaminated wastes (such as used nose masks) by February 2019.	None.

Mitigation Measure	Status of Mitigation Measure	Remarks
5a. Maintain records of all pesticide receipts, issuance, and return of empty sachets/bottles.	Stock cards tracked pesticide going to and from the central store, with back-up ledger books at central, district, and sub-district stores. The 161 storekeeper performance inspections conducted found no instance when the sum of the stock balance on the stock card, the stock issued for the day, and the balance of empty sachets/bottles did not equal the opening balance in the ledger.	Most storekeepers had worked for previous IRS campaign/s and adhered closely to the PMI BMP guidelines. VectorLink Zambia staff were in the field to monitor and supervise IRS operations throughout the campaign which limited environmental compliance violations in IRS stock management. Issues identified were rectified immediately.
5b. Reconciliation of number of houses sprayed vs. number of sachets/bottles used.	The average number of structures sprayed per bottle of insecticide was 3.8, slightly higher than the estimated average of 3.64.	VectorLink sprays many rural areas and, in some catchment areas, households have very small structures. One bottle can therefore protect more structures.
5c. Visual examination of houses sprayed to confirm pesticide application.	Visual examination of houses sprayed was conducted by observing the traces of the sprayed chemical of the walls, ceilings, and eaves during data collection verification by supervisors, district coordinators, M&E assistants, and other PMI VectorLink staff.	None.
5d. Perform physical inventory counts during the spray season.	The ECO, district coordinators, and logistics coordinator did physical inventory counts during and after the spray season with the storekeeper performance inspection checklist. In 161 inspections, the balance on stock cards equaled the physical stock.	Most of the storekeepers were not new to the project. Therefore, they were able to correctly use stock control cards and daily insecticide usage registers and they made no errors in entries.

ANNEX H: INSECTICIDE USAGE

Province	District	Structures Sprayed	Bottles Used	Avg Sprayed Structures per Bottle	Avg Bottles per SOP per Day	Structures Sprayed per Day per SOP
Eastern	Chadiza	21,485	5,639	3.8	3.5	13.2
	Katete	33,855	8,359	4.1	3.3	13.3
	Sinda	32,277	6,906	4.7	3.1	14.3
	Total	87,617	20,904	4.2	3.3	13.6
Muchinga	Chama	21,256	4,329	4.9	2.6	12.6
	Chinsali	19,642	5,251	3.7	3.7	13.8
	Isoka	12,572	3,068	4.1	3.1	12.7
	Mafinga	11,148	2,343	4.8	2.8	13.3
	Mpika	24,514	5,748	4.3	3.2	13.7
	Nakonde	20,890	5,244	4.0	3.5	14.0
	Shiwang'andu	9,148	2,198	4.2	3.3	13.7
	Total	119,170	28,181	4.2	3.2	13.4

Province	District	Structures Sprayed	Bottles Used	Avg Sprayed Structures per Bottle	Avg Bottles per SOP per Day	Structures Sprayed per Day per SOP
Northern	Chilubi	16,826	4,561	3.7	3.9	14.6
	Kaputa	12,830	3,837	3.3	3.9	13.0
	Kasama	42,348	10,791	3.9	3.2	12.7
	Luwingu	16,848	4,752	3.5	3.2	11.5
	Mbala	13,873	3,390	4.1	2.9	11.9
	Mporokoso	12,589	3,277	3.8	3.2	12.4
	Mungwi	24,645	6,756	3.6	3.2	11.6
	Nsama	9,013	2,290	3.9	3.2	12.4
	Senga	10,662	2,636	4.0	2.9	11.7
	Total	159,634	42,290	3.8	3.3	12.4
Luapula	Chembe	5,533	1,470	3.8	3.2	12.0
	Chiengi	44,211	12,087	3.7	3.8	13.8
	Chipili	4,821	1,206	4.0	3.3	13.3
	Kawambwa	23,526	5,964	3.9	3.4	13.3
	Mansa	30,298	7,780	3.9	3.4	13.3
	Milenge	5,198	1,296	4.0	2.8	11.2
	Mwansabombwe	9,234	2,114	4.4	2.8	12.4
	Mwense	22,607	6,431	3.5	3.3	11.5
	Nchelenge	28,327	7,688	3.7	3.1	11.5
	Samfya	39,294	10,572	3.7	3.4	12.6
	Total	213,069	56,608	3.8	3.4	12.7
Total		579,490	147,983	3.9	3.3	12.8

ANNEX I: INSECTICIDE DISTRIBUTION TO GRZ DISTRICTS

District	Number of Bottles of Actellic CS300	Structures to be Sprayed
Lusaka Province		
Lusaka	1,405	5,620
Kafue	1,000	4,000
Sub Total	2,405	9,620
Copperbelt Province		
Ndola	1,000	4000
Masaiti	500	2000
Mpongwe	800	3200
Lufwanyama	100	400
Kitwe	1658	6,632
Luanshya	100	400
Mufulira	1,000	4000
Chingola	200	800
Chililabombwe	200	800
Kallushi	800	3200
Sub Total	6,358	25432

District	Number of Bottles of Actellic CS300	Structures to be Sprayed
Central Province		
Kabwe	520	2,080
Chisamba	500	2,000
Chibombo	74	296
Kapiriponshi	555	2,220
Sub Total	1,649	6,300
North Western Province		
Zambezi	2,500	10,000
Solwezi	1,000	4,000
Manyinga	600	2,400
Kabompo	900	3,600
Mfumbwe	1,000	4,000
Sub Total	6,000	24,000
Eastern Province		
Lundazi	2,177	8,708
Grand Total	18,589	74,356

ANNEX J: SOP TRANSPORTATION OPTIMIZATION PILOT

INTRODUCTION

Indoor residual spraying (IRS) innovative operations approaches aim to maximize efficiency without compromising effectiveness of the intervention. The approach described here, which was first implemented in Tanzania, aims at reducing operations costs by reducing SOP transportation costs while also preventing increased costs associated with setting up sub-sites as in traditional community-based IRS. For SOP transportation optimization, spray teams use bicycles rather than motor vehicles in the final days of spray operations, when their travel from the operation site to the spray site is not more than 10 km. The use of bicycles saves funds that otherwise would have gone into hiring vehicles, a major cost driver in IRS. In the 2018 spray season, VectorLink Zambia piloted an approach where SOPs used bicycles for the final seven days of the 30-day campaign. The team selected Mpika (Muchinga), Luwingu (Northern), and Mwanabombwe (Luapula) for the pilot because the terrain in those areas is mostly flat and thus suitable for bicycle use. All prospective spray operators (SOPs) and team leaders in the selected districts were informed during the recruitment phase and ability to provide and ride a bicycle was a prerequisite for their recruitment. VectorLink paid SOPs a daily bicycle maintenance allowance of 20 kwacha per person for the seven-day period.

KEY FINDINGS

- A total of 100 bicycles were used during the pilot across the three districts—11, 30, and 59 bicycles in Mpika, Mwanabombwe, and Luwingu districts, respectively
- Spray teams were able to arrange to have bicycles except at two operation sites in Mpika where they failed to do so in a timely manner.
- Because the spray calendar was not followed in Mpika, two of the three hired vehicles continued throughout the campaign to mop up the farthest areas where coverage was below 85 percent.
- Recruitment criteria that required personnel to be able to ride a bicycle simplified implementation.
- The bicycle allowance of 20 ZMK allocated to the spray personnel per day boosted their morale and encouraged them to work harder.
- Use of bicycles simplified deployment of SOPs each day because they did not have to wait for a vehicle that might be delayed in picking them up.
- Use of bicycles expedited movement between households and/or communities in communities where houses are widely dispersed.
- Bicycles could negotiate roads that were inaccessible to vehicles.
- Use of bicycles made it easier to do mop-up because the district vehicle usually was not available for these unforeseen and therefore unscheduled activities.

The table below shows the summary of the cost analysis of use of vehicles versus use of bicycles to transport spray personnel.

Table 15: Cost Analysis of SOP Transportation Optimization Pilot

District	Use of Vehicle throughout Campaign								Use of Bicycle during Last 7 Days of Campaign				Cost Savings
	Days	No. of Vehicles	Vehicle Hire/Day (ZMW)	Total Cost of Vehicle Hire/Day (ZMW)	Fuel/Day (L)	Fuel/L (ZMW)	Total Cost of Fuel/Day	Total Cost for Period (ZMW)	Days	No. of Bicycles	Bicycle Allow./Day (ZMW)	Total Cost (ZMW)	Total Cost Saved (ZMW)
Luwingu	7	3	650	1,950	30	14.65	1,318.5	22,880	7	59	20	8,260	14,620
Mpika*	5	1	650	650	30	14.65	439.5	5,448	5	11	20	1,100	4,348
Mwansabombwe	7	2	550	1,100	30	14.65	879	13,853	7	30	20	4,200	9,653
Total	19	6	1850	3,700	90	14.65	2,637	42,180	19	100	20	13,560	28,620
Total Cost Saved (Vehicles against Bicycles)													28,620 ZMW

*In Mpika, the pilot was not properly implemented.

CHALLENGES

- Failure by district-level staff in Mpika to adhere to the operational design led to a failed pilot at two operation sites, Mpika Boma and Kanchibiya. Other challenges also affected the overall campaign in Mpika, such as early rainfall and many unattended households due to caterpillar harvesting season. These obstacles could have also affected the roll-out of the pilot.
- For spray team members who did not arrange for bicycles early enough, the cost of hiring increased during the rainy season because there was increased demand by users for transport to their farms. In some cases, the cost went as high as 40 ZMW.
- SOPs were not provided with rain suits/coats, and this disrupted spraying.
- Bicycle breakdowns led to reduced daily spray coverage by SOPs.

CONCLUSION

The adoption of bicycles during a portion of the IRS campaign reduce the cost of transportation for spray teams and saved the project 28,620 ZMW across the three districts. The project should consider scaling up this approach in 2019 to districts where the terrain is conducive to bicycle transportation.