



# PMI IRS COUNTRY PROGRAMS: 2017 COMPARATIVE COST ANALYSIS

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PMI IRS COUNTRY PROGRAMS:  
2017 COMPARATIVE  
COST ANALYSIS

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# ACRONYMS

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<b>AIRS</b>	Africa Indoor Residual Spraying
<b>CFV</b>	Control Flow Valve
<b>EC</b>	Environmental Compliance
<b>IEC</b>	Information, Education and Communication
<b>IRS</b>	Indoor Residual Spraying
<b>IT</b>	Information Technology
<b>M&amp;E</b>	Monitoring and Evaluation
<b>MOH</b>	Ministry of Health
<b>NgenIRS</b>	Next Generation IRS
<b>NMCP</b>	National Malaria Control Program
<b>OP</b>	Organophosphate
<b>PMI</b>	President's Malaria Initiative
<b>SOP</b>	Spray Operator
<b>STTA</b>	Short-term Technical Assistance
<b>USAID</b>	United States Agency for International Development
<b>WHO</b>	World Health Organization



# EXECUTIVE SUMMARY

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The President's Malaria Initiative (PMI) began implementing indoor residual spraying (IRS) programs in 2006, with a goal of reducing the incidence and prevalence of malaria. The Africa Indoor Residual Spraying (AIRS) Project, implemented from 2011-2014, along with its follow-on project, the PMI AIRS Project, implemented from 2014-2018, together constitute PMI's leading pan-African IRS initiative. This report presents the cost analysis of the expenses incurred during 2017 and compares these costs to IRS costs from 2012, 2013, 2014, 2015 and 2016.

The aim of the assessment is to:

1. Evaluate the overall level of IRS spending in each of the PMI AIRS countries, by program activity and by cost category;
2. Calculate and compare the unit costs of IRS in each country, including the cost per person protected, cost per structure sprayed, and cost per area sprayed (per 100 m<sup>2</sup>);
3. Provide cost comparisons for overall annual expenditure trends within countries over the first five years of the program.

Costing data will support PMI and host countries in the decision-making process of planning and prioritizing future investments. Findings may also help to inform local governments in the planning, funding, management, or implementation of IRS programs.

## **Costs in 2017**

Project output data, listed in Table CC1, was collected and verified by PMI AIRS M&E staff for the twelve countries with PMI-funded IRS campaigns that were implemented through the PMI AIRS Project in 2017. In total, over 17 million people were protected, ranging from approximately 517,374 people in Zimbabwe to over 3 million people in Zambia. This corresponds to about 4.6 million total structures sprayed, ranging from 156,362 structures in Senegal to 738,810 structures in Ethiopia, a total of over 380 million square meters of structures sprayed, and a total of over 1.5 million bottles of insecticide used.

The average structure size varied widely across countries, ranging from 38.2 square meters (m<sup>2</sup>) in Benin to 157.8 m<sup>2</sup> in Rwanda. The average people per structure sprayed ranged from 2.5 people in Zimbabwe and Ethiopia to 4.7 people in Zambia.

Table CC2 presents the results of the unit cost analysis. The overall unweighted average cost per person protected is \$5.73. The unweighted average cost per structure sprayed across countries is \$20.58. The unweighted average cost per 100 m<sup>2</sup> sprayed is \$25.97.

## Notable Findings in 2017

Country program expenditures were divided into six cost categories: insecticide, spray commodities, spray operations, full-time local labor, local administration, and U.S.-based labor and short-term technical assistance. Details on the types of expenditures included in each cost category can be found in the 2014 report (Johns 2015)<sup>1</sup>. The three largest cost categories were insecticide (29.9 percent of all costs), spray operations (37.7 percent of all costs), and local labor (16.5 percent of all costs), constituting an average of 84.1 percent of all costs.

### *Next Generation IRS (NgenIRS) Project*

NgenIRS copayments allowed the procurement of additional Actellic CS in eight countries (Benin, Ethiopia, Ghana, Madagascar, Mali, Tanzania, Zambia, and Zimbabwe), while enabling the complete adoption of Actellic CS in Rwanda (in place of carbamates). This allowed PMI to protect an additional 219,305 people with long lasting insecticide, on average, across the nine countries. Note that costs presented in this report are the prices paid by PMI for the insecticide in NgenIRS-supported countries and do not consider the amount of the NgenIRS subsidy.

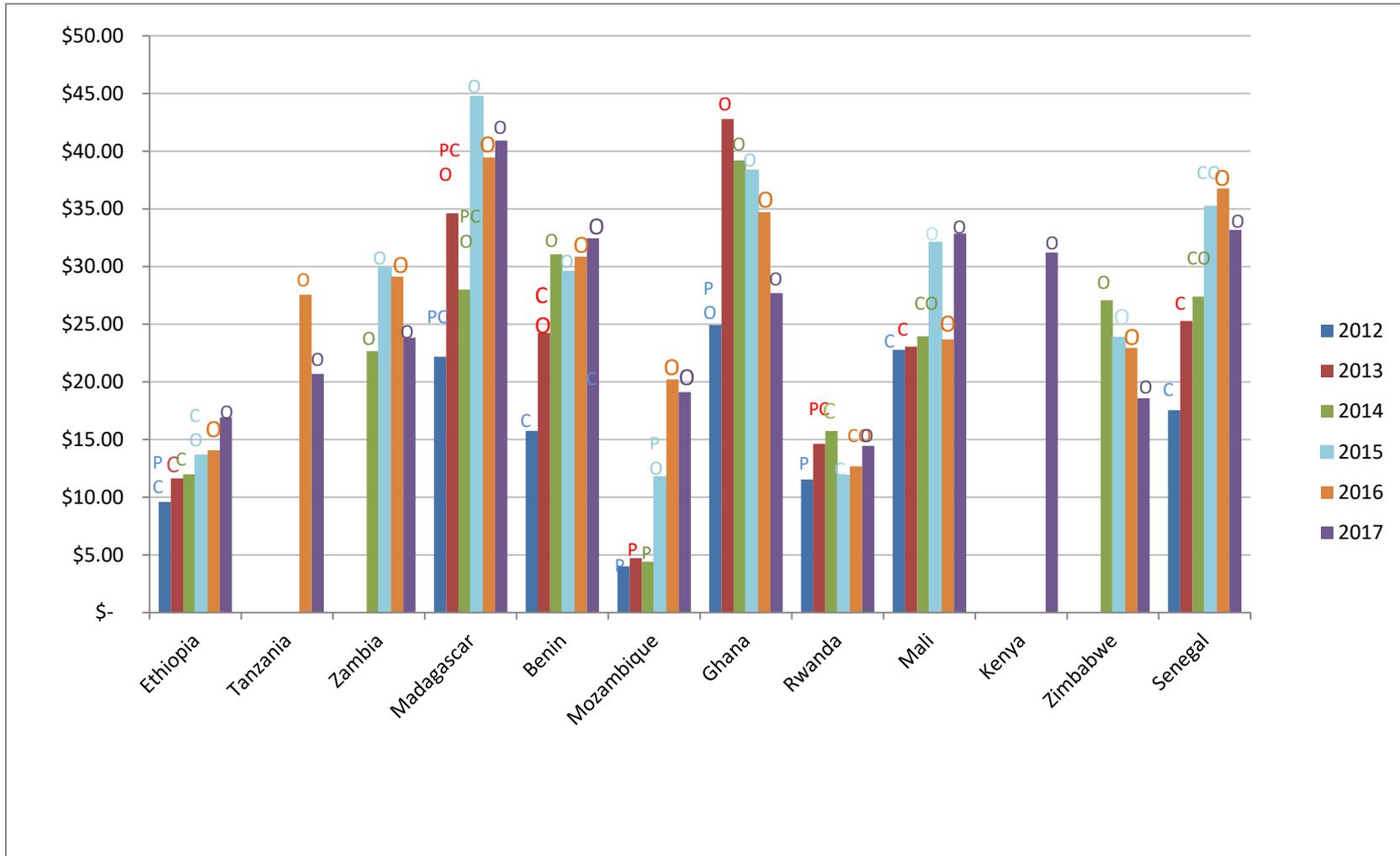
## Year-on-Year Comparison

Figure ES1 shows the unit costs for the countries included in this analysis for the years 2012 through 2017, as well as the type of insecticide used. Countries are arranged in order of the number of structures sprayed during 2017 spray campaigns, from largest to smallest.

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<sup>1</sup> Available at <http://www.pmi.gov/docs/default-source/default-document-library/implementing-partner-reports/africa-indoor-residual-spraying-project-pmi-irs-country-programs-2014-comparative-cost-analysis.pdf?sfvrsn=4>.

**FIGURE ESI: COST PER 100M<sup>2</sup> SPRAYED 2012 THROUGH 2017**





## **Country Chapters**

This report includes a more detailed and specific chapter for each IRS country program covered in this analysis. The country chapters each include a background section with relevant country context, M&E data, total program costs, and unit costs per person protected, per structure sprayed, and per area sprayed. These chapters also include a more detailed analysis of unit costs between 2016 and 2017.

## **CONCLUSIONS**

### **Program Scale**

Broadly speaking, we find, similar to previous years, that unit costs for larger size programs are lower than for smaller programs (although larger programs tend to cost more in total). This analysis uses the most standardized comparison unit cost available as there is no 'one-price-fits-all' for IRS across countries.

### **Spray Operations**

Spray operations makes up the largest cost category across the IRS programs when looking at the cost per 100 m<sup>2</sup> sprayed and in terms total expenditures. The spray operations portion of the cost per area sprayed constitutes an average of 37 percent of the total unit cost across country programs

# INTRODUCTION

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## I.1 BACKGROUND

The President's Malaria Initiative (PMI) aims to reduce the incidence and prevalence of malaria. PMI has provided IRS program support to Ministries of Health (MOHs) and National Malaria Control Programs (NMCPs) in sub-Saharan Africa since 2006. In April 2015, PMI's 2015-2020 strategy was released with specific objectives to: 1) reduce malaria mortality by one-third from 2015 levels in PMI-supported countries, achieving a greater than 80 percent reduction from PMI's original 2000 baseline levels, 2) reduce malaria morbidity in PMI-supported countries by 40 percent from 2015 levels, and 3) assist at least five PMI-supported countries to meet the World Health Organization (WHO) criteria for national or sub-national pre-elimination. The Africa Indoor Residual Spraying (AIRS) Project, implemented from 2011-2014, along with its follow-on project the PMI AIRS Project, implemented from 2014-2018, together constitute PMI's leading pan-African IRS initiative.

In 2017, the PMI AIRS Project provided 12 PMI-supported countries with full IRS operations and logistics support (Benin, Ethiopia, Ghana, Kenya, Madagascar, Mali, Mozambique, Rwanda, Senegal, Tanzania, Zambia, and Zimbabwe).

The PMI AIRS Project implements all aspects of the IRS process, including:

- Planning and forecasting IRS programming with government, community leaders, and other key stakeholders;
- Procuring insecticides and spray equipment/materials;
- Managing the supply chain of all IRS equipment and materials;
- Working with local leaders and organizations to ensure community awareness and knowledge of IRS campaign objectives, benefits, and timelines; and working with communities to provide further buy-in and further sensitization regarding malaria control for neighboring communities;
- Implementing IRS campaigns in targeted areas;
- Ensuring environmental compliance (EC) of IRS campaigns, and materials used in the campaigns;
- Monitoring and evaluating all program activities; and
- Out of the twelve (12) spray countries, eleven (11) countries (with the exception of Benin where entomological surveillance is conducted by the Center for Entomological Research of Cotonou (CREC) through a direct funding mechanism from PMI), completing entomological surveillance, and testing insecticide effectiveness.

PMI requested the Project to provide annual comparative cost analyses on the total and unit costs of the IRS country programs. This report builds upon the 2012, 2013, 2014, 2015, and 2016 findings by reporting on 2017 costs and comparing them with those of the previous years.

## 2. CROSS-COUNTRY RESULTS

### 2.1 BACKGROUND

#### Output Measures

Table CC1 presents the coverage provided by the PMI AIRS project's spray campaigns in each country. The area sprayed (number of 100 m<sup>2</sup> sprayed) was calculated by multiplying the total number of bottles of insecticide used by 250 m<sup>2</sup>, the estimate of coverage provided by each bottle, and dividing by 100 m<sup>2</sup> in order to develop a more usable unit of measure. The average size of a structure in each country was calculated by the total area sprayed divided by the number of structures sprayed. The number of people per area sprayed was calculated by dividing the total population protected by the area sprayed in terms of 100 m<sup>2</sup>, and ranged from 2.0 in Rwanda to 11.1 in Madagascar.

**TABLE CC1: PMI AIRS PROJECT SPRAY COVERAGE IN 2017, BY COUNTRY**

Country	# of People Protected	# of Structures Sprayed	Area Sprayed (100 m <sup>2</sup> )	Avg. Size of Structure (m <sup>2</sup> )	# People per Area Sprayed
Benin	1,227,536	384,761	146,913	38.2	8.4
Ethiopia	1,877,154	738,810	627,295	84.9	3.0
Ghana	840,438	302,648	164,738	54.4	5.1
Kenya	906,388	212,029	176,383	83.2	5.1
Madagascar	2,008,963	487,636	189,860	38.9	11.1
Mali	823,201	227,646	200,673	88.2	4.1
Mozambique	1,711,518	381,463	513,058	134.5	3.3
Rwanda	919,735	231,258	456,020	157.8	2.0
Senegal	619,578	156,362	122,745	78.5	5.0
Tanzania	2,568,522	664,622	527,795	79.4	4.9
Zambia	3,005,676	634,371	421,928	66.5	7.1
Zimbabwe	517,374	209,055	247,870	118.6	2.1

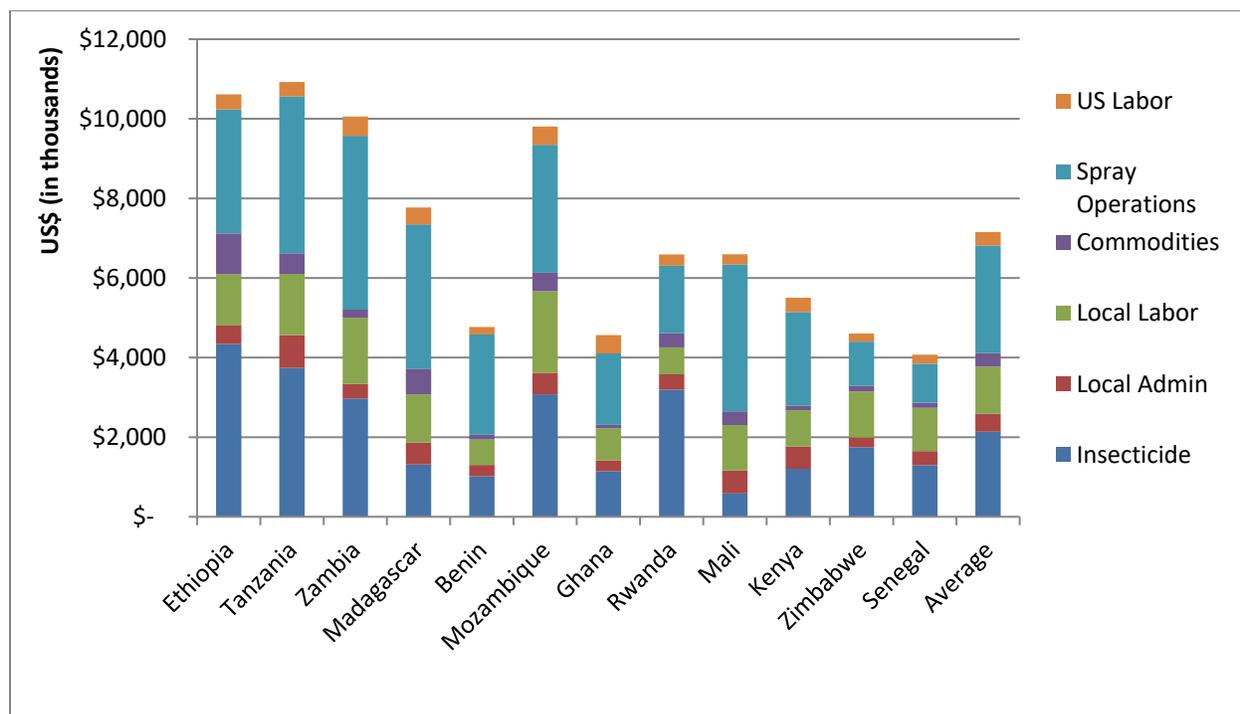
The average structure size and number of people per area sprayed both provide additional contextual understanding of a country program's spray campaign. Structure size varied widely between countries, ranging from 38.2 m<sup>2</sup> in Benin to 157.8 m<sup>2</sup> in Rwanda, over four times as large. The average size of structures sprayed across all 2017 countries was 85.3 m<sup>2</sup> (not weighting for the different number of structures sprayed

between countries). On average each bottle of insecticide covered about 3.5 structures.

## 2.2 TOTAL PROGRAM EXPENDITURES

This section presents the IRS country programs' total expenditures for 2017. Figure CC1 below includes all capital and recurrent costs of country IRS programs broken down by cost category. Countries are arranged in order of the number of structures sprayed during 2017 spray campaigns, from largest to smallest.

**FIGURE CC1: CAPITAL AND RECURRENT EXPENDITURES, BY COST CATEGORY**



Note: Costs of insecticides are reflective of the lower price paid through the NgenIRS project for project countries and include insecticides provided by other donors (such as the Global Fund).

The above figure shows that the U.S.-based labor and STTA cost category remains consistent across all country programs at an annual average of about \$340,000. Local administration, while more variable than the U.S.-based labor cost category, is also considered a fixed cost and averaged about \$454,000 across countries. These fixed costs are discussed in more detail in the cost-drivers analysis section. An average of 72 percent of total project expenditures is spent directly on spray operations, insecticide, and other commodities.

The average total program implementation expenditures across all programs are about \$7.16 million.

## 2.3 UNIT COST ANALYSIS

This section presents country IRS programs' capital and recurrent expenditures as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m<sup>2</sup>). The unit costs, shown in Table CC2, are calculated using total program expenditures and the output measures provided in Table CC1.

**TABLE CC2: 2017 IRS PROGRAM UNIT COSTS**

<b>Country</b>	<b>Cost per Person Protected</b>	<b>Cost per Structure Sprayed</b>	<b>Cost per Area Sprayed</b>
Ethiopia	\$5.55	\$14.11	\$16.62
Tanzania	\$4.25	\$16.44	\$20.70
Zambia	\$3.35	\$15.85	\$23.83
Madagascar	\$3.87	\$15.93	\$40.93
Benin	\$3.88	\$12.39	\$32.45
Mozambique	\$5.73	\$25.71	\$19.11
Ghana	\$5.43	\$15.08	\$27.70
Rwanda	\$7.17	\$28.51	\$14.46
Mali	\$8.01	\$28.97	\$32.86
Kenya	\$6.07	\$25.96	\$31.21
Zimbabwe	\$8.90	\$22.03	\$18.58
Senegal	\$6.57	\$26.04	\$33.17
<b>Average (unweighted)</b>	<b>\$5.73</b>	<b>\$20.58</b>	<b>\$25.97</b>

The average cost per structure sprayed across countries (not weighted by the number of structures sprayed in each country) was \$25.97. The cost per structure sprayed was generally lower for larger programs compared to smaller ones.

## 2.4 COST DRIVERS

This section focuses on the country IRS programs' costs per area (100 m<sup>2</sup>) sprayed, in order to assess plausible explanations ("cost drivers") for differences in unit cost across the countries. A cost driver is the activity, or unit of an activity, that is responsible for significant differences in costs between one country and another. This section explores selected cost categories separately to assess and explain the variation in unit costs. This section will also continue to categorize countries by program size.

Table CC3 provides the percentage of each cost category out of the total unit cost per area sprayed. This is the first step in determining which cost categories constitute the largest percentage of costs, and which cost categories show the most variance across countries in terms of their percentage of the total costs.

Table CC3 shows that on average, the largest cost category is spray operations, which accounts for an average of 37 percent of the unit costs. Insecticide and local labor follow as the next largest cost categories, making up an average of 29 percent and 17 percent of costs, respectively. There is variability in the cost categories between countries.

**TABLE CC3: BREAKDOWN OF FIXED AND VARIABLE COSTS, AS PERCENTAGE OF UNIT COST PER AREA SPRAYED**

Country	Fixed Costs					Variable Costs				Total Unit Cost
	Local Admin	Capital Items	US Labor	Commodities	Total Fixed Costs	Spray Operations	Insecticide	Local Labor	Total Variable Costs	
Ethiopia	4%	4%	3%	7%	18%	29%	41%	12%	82%	\$ 16.92
Tanzania	7%	2%	3%	3%	16%	36%	34%	14%	84%	\$ 20.70
Zambia	3%	2%	5%	1%	11%	43%	30%	17%	89%	\$ 23.83
Madagascar	6%	6%	5%	4%	21%	47%	17%	16%	79%	\$ 40.93
Benin	5%	4%	4%	0%	13%	52%	21%	13%	87%	\$ 32.45
Mozambique	4%	4%	5%	3%	15%	32%	31%	21%	85%	\$ 19.11
Ghana	5%	3%	10%	0%	18%	39%	25%	18%	82%	\$ 27.70
Rwanda	5%	5%	4%	3%	16%	25%	48%	10%	84%	\$ 14.46
Mali	7%	4%	4%	3%	18%	56%	9%	17%	82%	\$ 32.86
Kenya	9%	1%	7%	2%	19%	43%	22%	17%	81%	\$ 31.21
Zimbabwe	5%	3%	4%	1%	13%	24%	38%	25%	87%	\$ 18.58
Senegal	7%	4%	5%	1%	18%	24%	32%	27%	82%	\$ 33.17
Average	6%	4%	5%	2%	16%	37%	29%	17%	84%	\$ 25.97

The following sub-section provides a more in-depth cost driver analysis of spray operations.

#### 2.4.1 SPRAY OPERATIONS: PROGRAM SCALE

**TABLE CC4: SEASONAL SPRAY OPERATORS (SOPS) AND CAMPAIGN DAYS**

Country	Total # SOPs	Total # SOP Days	Avg. # Days/SOP	Avg. Daily wage of SOP	Total # Campaign days	Total Area Sprayed (# 100 m <sup>2</sup> )	Area Sprayed/SOP day	Area Sprayed/Campaign Day
Ethiopia	1,805	55,955	31	\$6.00	31	627,295	11.2	20,235
Tanzania	2,864	191,888	64	\$8.14	67	527,795	2.8	7,878
Zambia	1,797	118,602	66	\$5.10*	66	421,928	3.6	6,393
Madagascar	1,685	40,440	24	\$5.50	24	189,860	4.7	7,911
Benin	1,572	34,584	22	\$7.00	22	146,913	4.2	6,678
Mozambique	974	48,700	50	\$2.87	50	513,058	10.5	10,261
Ghana	611	18,941	31	\$8.91	31	164,738	8.7	5,314
Rwanda	1,322	26,440	20	\$7.00	20	456,020	17.2	22,801
Mali	760	26,600	35	\$5.00	35	200,673	7.5	5,734

Kenya	841	25,230	30	\$11.53	30	176,383	7.0	5,879
Zimbabwe	457	14,167	31	\$15.00	31	247,870	17.5	7,996
Senegal	645	19,350	30	\$6.00	20	122,745	6.3	6,137
<b>Average</b>	<b>1,288</b>	<b>52,451</b>	<b>36</b>	<b>\$7.34</b>	<b>36</b>	<b>318,048</b>	<b>8.4</b>	<b>9,461</b>

\*SOPs are not paid; figure represents allowance given to SOPs for meals

Table CC4 provides a detailed breakdown of the number of SOPs that worked in each country spray campaign, as well as the total and average numbers of SOP days, and the average daily wage. Also provided are the total number of campaign days, the total amount of area sprayed (in terms of 100 m<sup>2</sup>), and the average amount of area sprayed per SOP day and per campaign day (both also in terms of 100 m<sup>2</sup>). There is no noticeable correlation or trend between the number of SOPs or number of SOP days and the amount of area sprayed per SOP day. For example, two of the three programs spraying the largest area, Mozambique and Ethiopia, used different numbers of SOPs in the program spray campaigns (Mozambique below the average, while Ethiopia was above the average across countries). However, the amount of area sprayed per SOP per day was relatively close to the average amount sprayed per SOP per day in all countries for Mozambique, but well above the average in Ethiopia (although both are above average).

## 2.5 CONCLUSIONS

### Program Scale

Broadly speaking, we find, similar to previous years, that unit costs for larger sized programs are lower than for smaller programs (although larger programs tend to cost more in total). Using the most standardized comparison unit cost available, there is no 'one-price-fits-all' for IRS across countries.

There are some fixed costs for IRS programs which are not correlated to program scale, such as local administration and U.S.-based labor, which constitute an average of 6 and 5 percent (\$248,000 to \$823,00 and \$188,000 to \$482,300, respectively) of the total program costs, each.

Two of the important IRS program cost drivers, spray operations and local labor, constitute an average of 37 percent and 17 percent of the cost per area sprayed, respectively. Spray operations and local labor are both correlated with program scale (although there is a minimum level of local labor needed for any program). Programs with outlier costs in these areas are due to specific country context: geography of spray coverage area and general cost of living (prices for labor, fuel, etc.).

### Spray Operations

Spray operations is the largest cost category across the IRS programs when looking at the cost per 100 m<sup>2</sup> sprayed; it is also the largest cost category when assessing total expenditures. The spray operations portion of the cost per area sprayed constitutes an average of 37 percent of the total unit cost across country programs.

### 3. NGENIRS

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In 2017, the AIRS project benefited from the NGenIRS project, a UNITAID-funded partnership between the Innovative Vector Control Consortium, PMI and its IRS implementing partner Abt Associates Inc., Global Fund (GF), PATH/Malaria Control and Elimination Partnership in Africa and National Malaria Control Programs (NMCPs). Its objective is to accelerate and expand access and affordability of new, third generation formulations of IRS insecticides for malaria vector control to mitigate insecticide resistance. The goal of the NGenIRS project is sustainable and rational deployment of effective malaria vector control tools in insecticide resistance management programs to save lives and improve health. Through the support, nine countries on the PMI AIRS project were able to procure Actellic 300CS insecticide at a price of 15 USD per bottle instead of the market price of 23.50 USD per bottle in 2017. The effects of the cost savings are depicted in Table NG1.

The five countries that exclusively used Actellic in both 2016 and 2017 and benefited from NGenIRS for the first time in 2017 (Benin, Ghana, Madagascar, Tanzania, and Zimbabwe) had lower insecticide costs per structure sprayed in 2017 directly due to NGenIRS. Ethiopia, Mali, Rwanda, and Zambia benefited from NGenIRS both years.

**TABLE NGI: EFFECTS OF NGENIRS ON PROGRAM SCALE**

Countries Receiving NgenIRS Copayment	Number of Insecticide Bottles Used			Total Cost of Insecticide (to the PMI AIRS project)			Number of Structures Sprayed			Number of People Protected			Insecticide Cost per Structure Sprayed			Comments
	2016	2017	2017 - 2016	2016	2017	2017 - 2016	2016	2017	2017 - 2016	2016	2017	2017 - 2016	2016	2017	2017 - 2016	
<b>Benin</b>	46,617	58,765	12,148	\$1,222,450	\$1,017,823	\$(204,627)	269,179	384,761	115,582	858,113	1,227,536	369,423	\$4.54	\$2.65	\$(1.90)	Effect of Subsidy on Number of Structures Sprayed and Number of People Protected in 2017 With the insecticide subsidy that Benin received in 2017, it sprayed 115,582 additional structures and protected 369,423 additional people.
<b>Ethiopia*</b>	271,196	250,918	(20,278)	\$4,793,373	\$4,339,305	\$(454,068)	715,541	738,810	23,269	1,688,745	1,877,154	188,409	\$6.70	\$5.62	\$(1.08)	Ethiopia was able to increase its spray coverage by spraying 23,269 additional structures and protecting 188,409 more people during the 2017 spray campaign.
<b>Ghana</b>	47,133	65,895	18,762	\$1,239,766	\$1,145,787	\$(93,979)	211,283	302,648	91,365	570,871	840,438	269,567	\$5.87	\$3.79	\$(2.08)	Ghana was able to increase its spray coverage by spraying 91,365 additional structures and protecting 269,567 more people during the 2017 spray campaign.
<b>Madagascar</b>	53,212	75,944	22,732	\$1,411,034	\$1,314,331	\$(96,703)	310,426	487,636	177,210	1,257,036	2,008,963	751,927	\$4.55	\$2.70	\$(1.85)	With the insecticide subsidy that Madagascar received in 2017, it sprayed 177,210 additional structures and protected 751,927 additional people.
<b>Mali*</b>	84,571	80,269	(4,302)	\$1,552,889	\$587,762	\$(965,127)	228,672	227,646	(1,026)	788,922	823,201	34,279	\$6.79	\$2.58	\$(4.21)	With the insecticide subsidy that Mali received in 2017, it was able to protect 34,279 additional people, while lowering the insecticide cost per structure sprayed by \$4.21.
<b>Rwanda*</b>	278,563	182,408	(96,155)	\$4,232,754	\$3,191,487	\$(1,041,267)	346,917	231,258	(115,659)	1,431,410	919,735	(511,675)	\$12.20	\$13.80	\$1.60	With the insecticide copayment that Rwanda received in 2017, it used only OPs in 2017, as opposed to a combination of OPs and carbamates in 2016. Despite the increase in coverage and the use of a longer lasting insecticide, the insecticide cost per structure sprayed increased by only \$1.60.

<b>Tanzania</b>	175,173	211,118	35,945	\$4,982,375	\$3,742,699	\$(1,239,677)	515,217	664,622	149,405	2,042,561	2,568,522	525,961	\$9.67	\$5.63	\$(4.04)	With the insecticide subsidy that Tanzania received in 2017, it sprayed 149,405 additional structures and protected 525,961 additional people.
<b>Zambia*</b>	140,018	168,771	28,753	\$2,469,973	\$2,970,959	\$500,986	559,550	634,371	74,821	2,626,718	3,005,676	378,958	\$4.41	\$4.68	\$0.27	The number of structures sprayed and the number of people protected in Zambia respectively increased by 74,821 and 378,958 in 2017.
<b>Zimbabwe</b>	105,474	99,148	(6,326)	\$2,811,510	\$1,747,064	\$(1,064,447)	229,377	209,055	(20,322)	550,475	517,374	(33,101)	\$12.26	\$8.36	\$(3.90)	The number of structures sprayed and the number of people protected in Zimbabwe decreased in 2017. However, despite this decrease in program scale, the insecticide cost per structure sprayed also decreased by \$3.90 as a result of the subsidy.

\*Benefited from NGenIRS in both 2016 and 2017.

## 4. YEAR-ON-YEAR COMPARISON

### 4.1 CHANGES IN IRS PROGRAMS FROM 2016 TO 2017

As an IRS program matures, lessons are learned, efficiencies are realized, and needs change. This section provides an overview of the major changes in countries' IRS programs across the years, focusing on changes from 2016 to 2017.

Table YR1 provides details on the changes in output measures for all country programs between 2016 and 2017. A complete table of output measures for all country programs for the period 2012-2017 is included in Annex I. Table YR2 shows the changes in unit costs between 2016 and 2017. A complete table of unit costs for all country programs for the period 2012-2017 is included in Annex II. For more information, a comprehensive discussion of the changes in each country program is provided at the end of each individual country chapter.

**TABLE YR1: YEAR-ON-YEAR COMPARISON OF OUTPUT MEASURES**

Country	People Protected			Structures Sprayed			Area Sprayed (100 m <sup>2</sup> )		
	2016	2017	Percent Change 2016-2017	2016	2017	Percent Change 2016-2017	2016	2017	Percent Change 2016-2017
Ethiopia	1,688,745	1,877,154	11%	715,541	738,810	3%	677,990	627,295	-7%
Tanzania	2,042,561	2,568,522	26%	515,217	664,622	29%	437,933	527,795	21%
Zambia	2,626,718	3,005,676	14%	559,550	634,371	13%	350,045	421,928	21%
Madagascar	1,257,036	2,008,963	60%	310,426	487,636	57%	133,030	189,860	43%
Benin	858,113	1,227,536	43%	269,179	384,761	43%	116,543	146,913	26%
Mozambique	1,929,654	1,711,518	-11%	405,597	381,463	-6%	637,380	513,058	-20%
Ghana	570,871	840,438	47%	211,283	302,648	43%	117,833	164,738	40%
Rwanda	1,431,410	919,735	-36%	346,917	231,258	-33%	634,915	456,020	-28%
Mali	788,922	823,201	4%	228,672	227,646	0%	211,428	200,673	-5%
Kenya	n/a	906,388	n/a	n/a	212,029	n/a	n/a	176,383	n/a
Zimbabwe	550,475	517,374	42%	229,377	209,055	-9%	263,685	247,870	-6%
Senegal	496,728	619,578	20%	124,757	156,362	25%	97,973	122,745	25%
<b>Average</b>	<b>1,294,658</b>	<b>1,418,840</b>	<b>29%</b>	<b>356,047</b>	<b>385,888</b>	<b>27%</b>	<b>334,432</b>	<b>316,273</b>	<b>6%</b>

In Table YR1, almost all countries, with the exception of Mali, Mozambique, and Rwanda, increased the number of people protected and structures sprayed from 2016 to 2017. Ethiopia, Mali and Zimbabwe used fewer bottles of insecticide (the basis for calculating the area sprayed), while protecting more people and/or spraying more structures between 2016 and 2017.

**TABLE YR2: YEAR-ON-YEAR COMPARISON OF UNIT COSTS**

Country	People Protected			Structures Sprayed			Area Sprayed (100 m <sup>2</sup> )		
	2016	2017	Percent Change 2016-2017	2016	2017	Percent Change 2016-2017	2016	2017	Percent Change 2016-2017
Ethiopia	\$5.65	\$5.55	-2%	\$13.33	\$14.11	6%	\$14.07	\$16.92	20%
Tanzania	\$5.91	\$4.25	-28%	\$23.42	\$16.44	-30%	\$27.56	\$20.70	-25%
Zambia	\$3.88	\$3.35	-14%	\$18.22	\$15.85	-13%	\$29.13	\$23.83	-18%
Madagascar	\$4.18	\$3.87	-7%	\$16.91	\$15.93	-6%	\$39.46	\$40.93	4%
Benin	\$4.19	\$3.88	-7%	\$13.36	\$12.39	-7%	\$30.87	\$32.45	5%
Mozambique	\$6.68	\$5.73	-14%	\$31.77	\$25.71	-19%	\$20.22	\$19.11	-5%
Ghana	\$7.17	\$5.43	-24%	\$19.36	\$15.08	-22%	\$34.71	\$27.70	-20%
Rwanda	\$5.62	\$7.17	27%	\$23.20	\$28.51	23%	\$12.68	\$14.46	14%
Mali	\$6.35	\$8.01	26%	\$21.90	\$28.97	32%	\$23.68	\$32.86	39%
Kenya	n/a	\$6.07	n/a	n/a	\$25.96	n/a	n/a	\$31.21	n/a
Zimbabwe	\$10.99	\$8.90	-19%	\$26.38	\$22.03	-16%	\$22.94	\$18.58	-19%
Senegal	\$7.25	\$6.57	-9%	\$28.88	\$26.04	-10%	\$36.78	\$33.17	-10%
<b>Average</b>	<b>\$6.17</b>	<b>\$5.73</b>	<b>-7%</b>	<b>\$21.52</b>	<b>\$20.58</b>	<b>-4%</b>	<b>\$26.55</b>	<b>\$25.99</b>	<b>-2%</b>

A detailed discussion of the changes in each country program is included in the individual country chapters.

# 5. BENIN

## 5.1 BACKGROUND

**TABLE BNI: BENIN QUICK FACTS**

	2017
Program Dates	Jan 1, 2017 – Dec 31, 2017
Number of Districts	8
# Local Staff	13
Spray Start Date	May 3, 2017
# Spray Rounds	1
Insecticides Used	Organophosphates
# Bottles Used	58,765
# People Protected	1,227,536
# Structures Sprayed	384,761
# 100 Square Meters Sprayed	146,913

## 5.2 PROGRAM EXPENDITURES

This section will present an overview of Benin IRS program expenditures in 2017. Costs are organized by activity and cost category.

**TABLE BN2: BENIN IRS PROGRAM CAPITAL AND RECURRENT EXPENDITURES, BY ACTIVITY AND COST CATEGORY**

IRS Activity	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Operations	U.S. Labor & STTA	Grand Total	% of Total
Admin		284,201	412,000			103,173	\$799,373	16.8%
Entomology			273		8,618	150	\$9,041	0.2%
Environmental Compliance			47,754		55,687	9,194	\$112,636	2.4%
Equipment Supplies				121,523			\$121,523	2.5%
IEC								0.0%
Insecticide	1,017,823						\$1,017,823	21.3%
M&E			45,662		185,882	35,990	\$267,534	5.6%

Post Spray			92,028		9,979	20,140	<b>\$122,147</b>	2.6%
Spray Campaign			20,505		1,972,284	3,807	<b>\$1,996,596</b>	41.9%
Spray Planning			22,369		283,351	15,253	<b>\$ 320,931</b>	6.7%
<b>Grand Total</b>	<b>\$1,017,823</b>	<b>\$284,201</b>	<b>\$640,591</b>	<b>\$ 121,523</b>	<b>\$ 2,515,801</b>	<b>\$187,707</b>	<b>\$ 4,767,644</b>	100.0%

Table BN2 displays the Benin IRS program total capital and recurrent expenditures from 2017. The first column lists the program activities as tracked by the PMI AIRS Project's financial systems, and the top row lists IRS program cost categories. The following figure illustrates the cost breakdown in the table.

The spray campaign is the most expensive IRS activity (41.9 percent of expenditures), followed by insecticide (21.3 percent of expenditures), and local administration (16.8 percent of expenditures). PMI AIRS Benin procured 79,968 bottles of insecticide, and used 58,765 (the cost of insecticide used is reflected in the figure above). About 64.4 percent of the total cost for administration consists of labor, both local and U.S.-based. Note that the 'U.S.-based Labor and STTA' expenditures are largely incurred under the administrative and M&E program activities (74 percent of US labor expenditures are in the two categories). Local administration, U.S. labor, and commodities costs are minimal compared to expenditures on insecticide, local labor, and spray operations.

### 5.3 UNIT COST ANALYSIS

This section presents Benin IRS as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m<sup>2</sup>).

**TABLE BN3: BENIN UNIT COSTS**

		Unit cost	
<b>Cost per</b>	<b>Person protected</b>	\$	3.88
	<b>Structure sprayed</b>	\$	12.39
	<b>100 m<sup>2</sup> sprayed</b>	\$	32.45

### 5.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the PMI AIRS Benin IRS program between 2016 and 2017, as implemented by the PMI AIRS Project. The comparison focuses on output measures, total expenditures, and unit costs.

**TABLE BN4: BENIN IRS PROGRAM COMPARISON OF EXPENDITURES**

<b>Cost Category</b>	<b>2016 (Adjusted)</b>	<b>2017</b>	<b>Percentage Change (2016 to 2017)</b>
Insecticide (used)	\$1,222,450	\$1,017,823	-17%
Local Admin	\$231,679	\$284,201	23%

Local Labor	\$692,258	\$640,591	-7%
Spray Operations	\$1,154,066	\$2,515,801	118%
Commodities	\$101,801	\$121,523	19%
U.S. Labor	\$194,878	\$187,707	-4%
<b>TOTAL</b>	<b>\$ 3,597,132</b>	<b>\$ 4,767,644</b>	<b>32.5%</b>

Table BN4, above, compares the year-on-year change in total program capital and recurrent expenditures. The total program cost increased by 32.5 percent from 2016 to 2017, reflecting the increase in the number of people protected and structures sprayed. Spray operations accounted for the largest increase in costs in relative terms (118 percent or about \$1.36 million). With the increased number of structures, transportation costs (vehicle rentals) of spray teams and supervision personnel, and salary costs associated with a higher number of seasonal workers and per diems also increased. In addition, to address the high refusal rates and spray compliance in the North Department, supervision and mobilization efforts intensified. Insecticide costs decreased by 17 percent (roughly \$205,000), reflecting a lower price paid for insecticide in 2017.

**TABLE BN5: BENIN IRS PROGRAM COMPARISON OF OUTPUT MEASURES AND UNIT COSTS**

	<b>2016</b>	<b>2017</b>	<b>Percentage Change (2016 to 2017)</b>
<b>Output Measures</b>			
People Protected	858,113	1,227,536	43.1%
Structures Sprayed	269,179	384,761	42.9%
Area Sprayed (100 m <sup>2</sup> )	116,543	146,913	26.1%
<b>Unit Costs</b>			
Per Person Protected	\$4.19	\$3.88	-7.3%
Per Structure Sprayed	\$13.19	\$12.39	-6.1%
Per Area Sprayed	\$30.87	\$32.45	5.1%

Table BN5, above, compares the year-on-year change in Benin IRS program output measures and unit costs. Overall, in 2017, the program protected more people, sprayed more structures and more area than in previous years. Because the total program costs increased less than the number of people protected and the number of structures sprayed, the unit cost per person protected decreased by 7.3 percent and the cost per structure sprayed decreased by 6.1 percent. The cost per area sprayed increased by about 5.1 percent from 2016 to 2017.

# 6. ETHIOPIA

## 6.1 BACKGROUND

**TABLE ET1: ETHIOPIA QUICK FACTS**

	2017
Program Dates	Jan 1, 2017 – Dec 31, 2017
Number of Districts	44
# Local Staff	32
Spray Start Date	June 12, 2017
# Spray Rounds	1
Insecticides Used	Organophosphates
# Bottles Used	250,918
# People Protected	1,877,154
# Structures Sprayed	738,810
# 100 Square Meters Sprayed	627,295

## 6.2 PROGRAM EXPENDITURES

This section will present an overview of Ethiopia IRS program expenditures in 2017. Costs are organized by activity and cost category.

**TABLE ET2: ETHIOPIA IRS PROGRAM CAPITAL AND RECURRENT EXPENDITURES, BY ACTIVITY AND COST CATEGORY**

IRS Activity	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Operations	U.S. Labor & STTA	Grand Total	% of Total
Admin		480,451	656,645			173,573	<b>\$1,310,669</b>	12.4%
Entomology			145,583		353,108	48,477	<b>\$547,168</b>	5.2%
Environmental Compliance			85,998		185,074	23,019	<b>\$294,091</b>	2.8%
Equipment Supplies				1,024,542			<b>\$1,024,542</b>	9.7%
IEC						23	<b>\$23</b>	0.0%
Insecticide	4,339,305						<b>\$4,339,305</b>	40.9%

M&E			51,142		20,266	47,084	<b>\$118,492</b>	1.1%
Post Spray			18,014		46,753	3,189	<b>\$67,956</b>	0.6%
Spray Campaign			241,191		1,936,987	58,586	<b>\$2,236,765</b>	21.1%
Spray Planning			75,685		576,638	20,227	<b>\$672,549</b>	6.3%
<b>Grand Total</b>	<b>\$4,339,305</b>	<b>\$480,451</b>	<b>\$1,274,258</b>	<b>\$1,024,542</b>	<b>\$3,118,826</b>	<b>\$374,178</b>	<b>\$10,611,559</b>	100%

Table ET2 displays the Ethiopia IRS program total capital and recurrent expenditures from 2017. The first column lists the program activities as tracked by the PMI AIRS project financial systems, and the top row lists IRS program cost categories.

Insecticides represented the majority of the total costs at 40.9 percent of costs. The cost of insecticide substantially increased in 2017 due to the use of Actellic CS in all districts. Spray campaign costs and administration were the next two largest categories of costs, representing 21.1 and 12.4 percent of costs, respectively. PMI AIRS procured 305,916 bottles of organophosphate insecticides, and used 250,918 bottles. About 63 percent of the total cost for administration consists of labor, both local and U.S.-based. Local administration, U.S. labor, and commodities costs are minimal compared to expenditures on insecticide, local labor, and spray operations.

### 6.3 UNIT COST ANALYSIS

This section presents Ethiopia IRS as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m<sup>2</sup>).

**TABLE ET3: ETHIOPIA UNIT COSTS**

	Unit costs	
<b>Person protected</b>	\$	5.65
<b>Cost per Structure sprayed</b>	\$	14.36
<b>100 m<sup>2</sup> sprayed</b>	\$	16.92

### 6.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Ethiopia IRS program between 2016 and 2017, as implemented by the PMI AIRS project. The comparison focuses on output measures, total expenditures, and unit costs.

**TABLE ET4: ETHIOPIA IRS PROGRAM COMPARISON OF EXPENDITURES**

Cost Category	2016 (Adjusted)	2017	Percentage Change (2016 to 2017)
Insecticide	4,793,373	4,339,305	-9.5%
Local Admin	312,443	480,451	53.8%

Local Labor	1,056,533	1,274,258	20.6%
Spray Operations	2,474,890	3,118,826	26.0%
Commodities	558,819	1,024,542	83.3%
U.S. Labor	342,312	374,178	9.3%
<b>TOTAL</b>	<b>\$ 9,538,370</b>	<b>\$ 10,611,559</b>	<b>11.3%</b>

Table ET4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost increased by 11.3 percent from 2016 to 2017, representing an increase in the total annual cost of about \$1,073,190. In terms of the total increase between 2016 and 2017, spray operations represented the majority of the increase (\$643,936), reflecting the larger scale of the program in 2017.

When the insecticide is excluded from the year-on-year comparison, costs were 32.2 percent greater in 2017 than in 2016, reflecting the effect of the NGenIRS subsidy in containing costs. Insecticide costs decreased by about \$454,000 between the years, while costs in all other categories increased. The increase in program scale in 2017 led to an increase in the cost of spray operations, commodities and transportation to the spray sites. Furthermore, higher costs in 2017 are explained by an increase in the number of local staff from 22 in 2016 to 31 in 2017 and the expansion of project districts from 36 to 44 during the same time period.

**TABLE ET5: ETHIOPIA IRS PROGRAM COMPARISON OF OUTPUT MEASURES AND UNIT COSTS**

	<b>2016</b>	<b>2017</b>	<b>Percentage Change (2016 to 2017)</b>
<b>Output Measures</b>			
People Protected	1,688,745	1,877,154	11.2%
Structures Sprayed	715,541	738,810	3.3%
Area Sprayed (100 m <sup>2</sup> )	677,990	627,295	-7.5%
<b>Unit Costs</b>			
Per Person Protected	\$ 5.65	\$5.65	0.1%
Per Structure Sprayed	\$ 13.33	\$14.36	7.7%
Per Area Sprayed	\$ 14.07	\$16.92	20.2%

Table ET5 compares the year-on-year change in Ethiopia IRS program output measures and unit costs. In 2017, the program achieved higher coverage in terms of people protected and structures sprayed. Between 2016 and 2017, the number of people protected increased 11.2 percent and the number of structures increased 3.3 percent. Area sprayed decreased by 7.5 percent.

Unit costs were higher per person protected, structure sprayed, and area sprayed in 2017 than 2016. These increases are explained by the creation of ten new operation sites, and the increased number of local staff hired and additional spray equipment

purchased to accommodate the increased number of spray districts. Furthermore, structures were smaller in size in the new districts compared to the existing districts.

# 7. GHANA

## 7.1 BACKGROUND

**TABLE GHI: GHANA QUICK FACTS**

	2017
Program Dates	Jan 1, 2017 – Dec 31, 2017
Number of Districts	7
# Local Staff	27
Spray Start Date	April 25, 2017
# Spray Rounds	1
Insecticides Used	Organophosphates
# Bottles Used	65,895
# People Protected	840,438
# Structures Sprayed	302,648
# 100 Square Meters Sprayed	164,738

## 7.2 PROGRAM EXPENDITURES

This section will present an overview of Ghana IRS program expenditures in 2017. Costs are organized by activity and cost category.

**TABLE GH2: GHANA IRS PROGRAM CAPITAL AND RECURRENT EXPENDITURES, BY ACTIVITY AND COST CATEGORY**

IRS Activity	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Operations	U.S. Labor & STTA	Grand Total	% of Total
Admin		274,595	417,742			305,849	\$998,186	21.9%
Entomology			118,669		351,705	36,760	\$507,134	11.1%
Environmental Compliance			38,164		36,688	11,676	\$86,528	1.9%
Equipment Supplies				82,751			\$82,751	1.8%
IEC			22,673		203,552	7,290	\$233,515	5.1%
Insecticide	1,145,787						\$1,145,787	25.1%
M&E			40,863		37,414	46,191	\$124,468	2.7%

Post Spray			83,049		51,634	26,655	<b>\$161,338</b>	3.5%
Spray Campaign			29,547	7,813	1,074,230	4,971	<b>\$1,116,561</b>	24.5%
Spray Planning			49,886		37,478	19,921	<b>\$107,284</b>	2.4%
<b>Grand Total</b>	<b>\$1,145,787</b>	<b>\$274,595</b>	<b>\$800,594</b>	<b>\$90,564</b>	<b>\$1,792,700</b>	<b>\$459,314</b>	<b>\$ 4,563,554</b>	100.0%

Table GH2 displays the Ghana IRS program total capital and recurrent expenditures from 2017. The first column lists the program activities as tracked by the PMI AIRS project financial systems, and the top row lists IRS program cost categories.

Costs for insecticides, administration, and the spray campaign constitute over 71 percent of costs (25.1, 21.9 and 24.5 percent of total costs, respectively). PMI AIRS procured 67,584 bottles of Actellic CS, and used 65,895 bottles; the cost for the latter is included here. About 73 percent of the total cost for administration consists of labor, both local and U.S.-based. Local administration, U.S. labor, and commodities costs are minimal compared to expenditures on insecticide, local labor, and spray operations.

### 7.3 UNIT COST ANALYSIS

This section presents Ghana IRS expenditures as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m<sup>2</sup>).

**TABLE GH3: GHANA UNIT COSTS**

Unit costs	
<b>Person protected</b>	\$ 5.43
<b>Cost per Structure sprayed</b>	\$ 15.08
<b>100 m<sup>2</sup> sprayed</b>	\$ 27.70

### 7.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Ghana IRS program between 2016 and 2017, as implemented by the PMI AIRS project. The comparison focuses on output measures, total expenditures, and unit costs. 2016 expenditures, excluding insecticides, have been adjusted to real 2017 U.S. dollars to allow for a more accurate comparison.

**TABLE GH4: GHANA IRS PROGRAM COMPARISON OF EXPENDITURES**

<b>Cost Category</b>	<b>2016 (Adjusted)</b>	<b>2017</b>	<b>Percentage Change (2016 to 2017)</b>
Insecticide	\$1,239,766	\$1,145,787	-7.6%
Local Admin	\$253,178	\$274,595	8.5%
Local Labor	\$885,389	\$800,594	-9.6%

Spray Operations	\$1,301,220	\$1,792,700	37.8%
Commodities	\$113,419	\$90,564	-20.2%
U.S. Labor	\$297,447	\$459,314	54.4%
<b>TOTAL</b>	<b>\$4,090,419</b>	<b>\$4,563,554</b>	<b>11.6%</b>

Table GH4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost increased by over 11 percent from 2016 to 2017, representing an increase in the total annual cost of about \$473,135. Costs decreased for (i) insecticide by over \$94,000, (ii) local labor by almost \$85,000, and (iii) spray commodities by almost \$23,000. Cost increased for the same period for local administration (8.5 percent increase of over \$21,000), spray operations (37.8 percent increase of over \$491,000), and U.S. labor (54.4 percent increase of almost \$162,000). The increased costs of U.S. labor largely reflect the staff changes in the home office backstopping team in 2017.

**TABLE GH5: GHANA IRS PROGRAM COMPARISON OF OUTPUT MEASURES AND UNIT COSTS**

	2016	2017	Percentage Change (2016 to 2017)
<b>Output Measures</b>			
People Protected	570,871	840,438	47.2%
Structures Sprayed	211,283	302,648	43.2%
Area Sprayed (100 m <sup>2</sup> )	117,833	164,738	39.8%
<b>Unit Costs</b>			
Per Person Protected	\$ 7.17	\$5.43	-24.2%
Per Structure Sprayed	\$ 19.36	\$ 15.08	-22.1%
Per Area Sprayed	\$ 37.82	\$ 27.70	-20.2%

Table GH5 compares the year-on-year change in Ghana IRS program output measures and unit costs. In 2017, the program protected 47.2 more people, sprayed 43.2 percent more structures, and 39.8 percent more area than in 2016.

Because the number of people protected increased by 47.2 percent from 2016 to 2017, but total costs increased by only 11.6 percent, the cost per person protected decreased from \$7.17 to \$5.43 (24.2 percent) across the two years. The smaller increase in total costs from 2016 to 2017 compared to the increase in the number of structures sprayed also resulted in lower costs per structure sprayed in 2017 than in 2016. The increase in the area sprayed and the relatively smaller increase in total costs also resulted in a lower cost per area sprayed in 2017 than in 2016.

# 8. KENYA

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## 8.1 BACKGROUND

**TABLE KNI: KENYA QUICK FACTS**

	2017
Program Dates	Oct 1, 2016 – Sep 30, 2017
Number of Sub-counties	6
# Local Staff	20
Spray Start Date	February 13, 2017
# Spray Rounds	1
Insecticides Used	Organophosphates
# Bottles Used	70,553
# People Protected	906,388
# Structures Sprayed	212,029
# 100 Square Meters Sprayed*	176,383

\* Reverse calculation using number of insecticide bottles used during campaign multiplied by the average of 250 m<sup>2</sup> estimated to be sprayed by one bottle and divided by the number of structures sprayed.

Note that 2017 was the first year of IRS implementation under the PMI AIRS project, and thus a year-on-year comparison is not possible.

## 8.2 PROGRAM EXPENDITURES

This section presents an overview of Kenya IRS program expenditures in 2017. Costs are organized by activity and cost category.

**TABLE KN2: KENYA IRS PROGRAM CAPITAL AND RECURRENT EXPENDITURES, BY ACTIVITY AND COST CATEGORY**

<b>IRS Activity</b>	<b>Insecticide</b>	<b>Local Admin</b>	<b>Local Labor</b>	<b>Spray Commodities</b>	<b>Spray Operations</b>	<b>U.S. Labor &amp; STTA</b>	<b>Grand Total</b>	<b>% of Total</b>
Admin		555,525	325,945			190,762	<b>\$1,072,232</b>	19.5%
Entomology			146,891		321,793	58,072	<b>\$526,756</b>	9.6%
Environmental Compliance			43,432		31,167	29,718	<b>\$104,317</b>	1.9%
Equipment Supplies				113,481			<b>\$113,481</b>	2.1%
IEC			73,942		85,308	7,082	<b>\$166,333</b>	3.0%
Insecticide	1,206,372						<b>\$1,206,372</b>	21.9%
M&E			88,169		26,406	44,053	<b>\$158,628</b>	2.9%
Post Spray			42,367		45,301	5,673	<b>\$93,341</b>	1.7%
Spray Campaign			24,848		1,470,720	3,135	<b>\$1,498,703</b>	27.2%
Spray Planning			170,348		372,185	22,107	<b>\$564,640</b>	10.3%
<b>Grand Total</b>	<b>\$1,206,372</b>	<b>\$555,525</b>	<b>\$915,940</b>	<b>\$113,481</b>	<b>\$2,352,881</b>	<b>\$360,603</b>	<b>\$5,504,802</b>	<b>100.0%</b>

Table KN2 displays the Kenya IRS program total capital and recurrent expenditures from 2017. The first column lists the program activities as tracked by the PMI AIRS Project's financial systems, and the top row lists IRS program cost categories.

The spray campaign is the most expensive IRS activity (27.2 percent of expenditures), followed by insecticide (21.9 percent of expenditures) and administration (19.5 percent of expenditures). PMI AIRS procured 91,584 bottles of organophosphate insecticide, and used about 70,553 bottles (costs reflect the insecticides used). About 48 percent of the total cost for administration consists of labor, both local and U.S.-based. Local administration, U.S. labor, and commodities costs are minimal compared to expenditures on insecticide, local labor, and spray operations.

### 8.3 UNIT COST ANALYSIS

This section presents Kenya IRS expenditures as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m<sup>2</sup>).

**TABLE KN3: KENYA UNIT COSTS**

	<b>Unit costs</b>	
<b>Person protected</b>	\$	6.07
<b>Cost per Structure sprayed</b>	\$	25.96
<b>100 m<sup>2</sup> sprayed</b>	\$	31.21

# 9. MADAGASCAR

## 9.1 BACKGROUND

**TABLE MGI: MADAGASCAR QUICK FACTS**

	2017
Program Dates	January 1, 2017 – December 31, 2017
Number of Districts	8
# Local Staff	32
Spray Start Date	
<i>East Coast</i>	Sep 4, 2017
<i>Southeast</i>	Jul 24, 2017
# Spray Rounds	1
Insecticides Used	Organophosphates
# Bottles Used	75,944
# People Protected	2,008,963
# Structures Sprayed	487,636
# 100 Square Meters Sprayed	189,860

## 9.2 PROGRAM EXPENDITURES

This section will present an overview of Madagascar IRS program expenditures in 2017. Costs are organized by activity and cost category.

**TABLE MG2: MADAGASCAR IRS PROGRAM CAPITAL AND RECURRENT EXPENDITURES, BY ACTIVITY AND COST CATEGORY**

IRS Activity	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Operations	U.S. Labor & STTA	Grand Total	% of Total
Admin		553,175	685,137			138,788	<b>\$1,377,099</b>	17.7%
Entomology			225,447		359,385	141,495	<b>\$726,326</b>	9.3%
Environmental Compliance			26,750		161,482	27,438	<b>\$215,670</b>	2.8%
Equipment Supplies				643,044			<b>\$643,044</b>	8.3%
IEC			19,621		156,052	4,973	<b>\$180,645</b>	2.3%

Insecticide	1,314,331						<b>\$1,314,331</b>	16.9%
M&E			38,410		119,883	31,580	<b>\$189,874</b>	2.4%
Post Spray			50,646		50,438	14,728	<b>\$115,812</b>	1.5%
Spray Campaign			45,707		1,771,175	10,151	<b>\$1,827,032</b>	23.5%
Spray Planning			118,365		1,009,399	52,839	<b>\$1,180,603</b>	15.2%
<b>Grand Total</b>	<b>\$1,314,331</b>	<b>\$553,175</b>	<b>\$1,210,082</b>	<b>\$643,044</b>	<b>\$3,627,813</b>	<b>\$421,990</b>	<b>\$7,770,436</b>	100.0%

Table MG2 displays the Madagascar IRS program total capital and recurrent expenditures from 2017. The first column lists the program activities as tracked by the PMI AIRS Project's financial systems, and the top row lists IRS program cost categories.

Administration and spray campaign costs were the two most expensive IRS activities (constituting 17.7 percent and 23.5 percent of expenditures, respectively), followed closely by insecticide costs (16.9 percent of expenditures). PMI AIRS Madagascar procured 94,896 bottles of Actellic CS, and used 75,944 organophosphate bottles, the costs of the latter are reflected here. About 60 percent of the total cost for administration consists of labor, both local and U.S.-based. Local administration, U.S. labor, and commodities costs are minimal compared to expenditures on insecticide, local labor, and spray operations.

### 9.3 UNIT COST ANALYSIS

This section presents Madagascar IRS expenditures as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m<sup>2</sup>).

**TABLE MG3: MADAGASCAR UNIT COSTS**

	Unit costs	
<b>Person protected</b>	\$	3.87
<b>Cost per Structure sprayed</b>	\$	15.93
<b>100 m<sup>2</sup> sprayed</b>	\$	40.93

### 9.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the PMI AIRS Madagascar IRS program between 2016 and 2017, as implemented by the project. The comparison focuses on output measures, total expenditures, and unit costs.

**TABLE MG4: MADAGASCAR IRS PROGRAM COMPARISON OF EXPENDITURES**

Cost Category	2016 (Adjusted)	2017	Percentage Change (2016 to 2017)
Insecticide	\$1,411,034	\$1,314,331	-6.9%

Local Admin	\$359,109	\$553,175	54.0%
Local Labor	\$798,666	\$1,210,082	51.5%
Spray Operations	\$1,990,325	\$3,627,813	82.3%
Commodities	\$342,497	\$643,044	87.8%
U.S. Labor	\$347,851	\$421,990	21.3%
<b>TOTAL</b>	<b>\$5,249,481</b>	<b>\$7,770,436</b>	<b>48%</b>

Table MG4, above, compares the year-on-year change in total program capital and recurrent expenditures. The total program cost increased by 48 percent from 2016 to 2017. Spray operations costs increased by about \$1,637,000 (82.3 percent), commodity costs increased by about \$300,000 (87.8 percent), while insecticide costs decreased by almost \$97,000 (6.9 percent) from 2016 to 2017, reflecting the effect of the NGenIRS subsidy in containing costs despite an increase in program scale. Costs increased in all other categories from 2016 to 2017.

**TABLE MG5: MADAGASCAR IRS PROGRAM COMPARISON OF OUTPUT MEASURES AND UNIT COSTS**

	<b>2016</b>	<b>2017</b>	<b>Percentage Change (2016 to 2017)</b>
<b>Output Measures</b>			
People Protected	1,257,036	2,008,963	59.8%
Structures Sprayed	310,426	487,636	57.1%
Area Sprayed (100 m <sup>2</sup> )	133,030	189,860	42.7%
<b>Unit Costs</b>			
Per Person Protected	\$4.18	\$3.87	-7.4%
Per Structure Sprayed	\$16.91	\$15.93	-5.8%
Per Area Sprayed	\$39.46	\$40.93	3.7%

Table MG5 compares the year-on-year change in Madagascar IRS program output measures and unit costs. Overall, in 2017, the program sprayed the most structures, protected the most people, and sprayed the largest amount of area of the two years presented. The number of structures sprayed increased by 57.1 percent from 2016 to 2017, and the number of people protected increased by 59.8 percent over the same period. Additionally, the area sprayed increased by 42.7 percent. Total program costs increased by 48 percent, while the number of structures sprayed increased by 57.1 percent between 2016 and 2017. Thus, the cost per structure sprayed decreased by 5.8 percent between the two years. The increase in the number of people protected (59.8 percent) was larger than the increase in the program costs between 2016 and 2017, indicating that the cost per person protected decreased by 7.4 percent between the two years. The cost per area sprayed increased from \$39.46 in 2016 to \$40.93 in 2017, an increase of 3.7 percent.

# 10. MALI

## 10.1 BACKGROUND

**TABLE MLI: MALI QUICK FACTS**

	2017
Program Dates	Jan 1, 2017 – Dec 31, 2017
Number of Districts	4
# Local Staff	22
Spray Start Date	July 24, 2017
# Spray Rounds	1
Insecticides Used	Organophosphates
# Bottles Used	80,269
# People Protected	<b>823,201</b>
# Structures Sprayed	<b>227,646</b>
# 100 Square Meters Sprayed	<b>200,673</b>

## 10.2 PROGRAM EXPENDITURES

This section will present an overview of Mali IRS program expenditures in 2017. Costs are organized by activity and cost category.

**TABLE ML2: MALI IRS PROGRAM CAPITAL AND RECURRENT EXPENDITURES, BY ACTIVITY AND COST CATEGORY**

IRS Activity	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Operations	U.S. Labor & STTA	Grand Total	% of Total
Admin		575,441	895,624			150,172	<b>\$1,621,236</b>	24.6%
Entomology			150,651		562,915	34,402	<b>\$747,968</b>	11.3%
Environmental Compliance			32,972		111,336	27,538	<b>\$171,846</b>	2.6%
Equipment Supplies				342,910			<b>\$342,910</b>	5.2%
IEC					1,282,517		<b>\$1,282,517</b>	19.4%
Insecticide	587,762						<b>\$587,762</b>	8.9%

M&E			64,415		270,825	28,724	<b>\$363,964</b>	5.5%
Post Spray					42,005		<b>\$42,005</b>	0.6%
Spray Campaign					1,021,729	134	<b>\$1,021,863</b>	15.5%
Spray Planning					397,147	14,808	<b>\$411,955</b>	6.2%
<b>Grand Total</b>	<b>\$587,762</b>	<b>\$575,441</b>	<b>\$1,143,663</b>	<b>\$342,910</b>	<b>\$3,688,474</b>	<b>\$255,777</b>	<b>\$6,594,027</b>	100.0%

Table ML2 displays the Mali IRS program total capital and recurrent expenditures from 2017. The first column lists the program activities as tracked by the PMI AIRS project financial systems, and the top row lists IRS program cost categories.

Administration is the most expensive IRS activity (24.6 percent of expenditures), followed by information, education, and communication (IEC) (19.4 percent of expenditures) and spray campaign activities (15.5 percent of expenditures). PMI AIRS procured 111,792 bottles of Actellic CS and used 80,269 bottles. About 65 percent of the total cost for administration consists of labor, both local and U.S.-based. Note that the 'U.S.-based Labor and STTA' expenditures are largely incurred under the administrative, entomology, and environmental compliance program activities (83 percent of US labor expenditures are in the three categories). Local administration, U.S. labor, and commodities costs are minimal compared to expenditures on insecticide, local labor, and spray operations.

### 10.3 UNIT COST ANALYSIS

This section presents Mali IRS expenditures as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m<sup>2</sup>).

**TABLE ML3: MALI UNIT COSTS**

		Unit costs	
	<b>Person protected</b>	\$	8.01
<b>Cost per</b>	<b>Structure sprayed</b>	\$	28.97
	<b>100 m<sup>2</sup> sprayed</b>	\$	32.86

### 10.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Mali IRS program between 2016 and 2017, as implemented by the PMI AIRS project. The comparison focuses on output measures, total expenditures, and unit costs.

**TABLE ML4: MALI IRS PROGRAM COMPARISON OF EXPENDITURES**

<b>Cost Category</b>	<b>2016 (Adjusted)</b>	<b>2017</b>	<b>Percentage Change (2016 to 2017)</b>
Insecticide	\$1,552,889	\$587,762	-62.2%
Local Admin	\$429,735	\$575,441	33.9%
Local Labor	\$992,683	\$1,143,663	15.2%
Spray Operations	\$1,534,358	\$3,688,474	140.4%
Commodities	\$193,822	\$342,910	76.9%
U.S. Labor	\$303,553	\$255,777	-15.7%
<b>TOTAL</b>	<b>\$5,007,039</b>	<b>\$6,594,027</b>	<b>31.7%</b>

Table ML4, above, compares the year-on-year change in total program capital and recurrent expenditures. The total program cost increased by 31.7 percent from 2016 to 2017. Costs declined for U.S. labor by 15.7 percent (about \$48,000), and for insecticide by 62.2 percent (about \$965,000). Costs increased in real and nominal terms for all other categories. Spray operations costs increased by 140.4 percent or about \$2,154,000. The difference in the cost can be explained mainly by the relocation of the intervention zone. Mopti and Bankass (sprayed in 2017) are about 600 km and 700 km from Bamako, while Koulikoro and Baroueli (sprayed in 2016) are only 60 and 200 km away. In addition to the establishment of 44 new operations sites, these long distances in 2017 led to increased transport costs (vehicle rental and fuel), lengthened the duration of field missions, and increased accommodation needs. For example, if a supervision visit to Koulikoro took 3 days in 2016, it took at least 6 days to do the same work in Bankass in 2017.

**TABLE ML5: MALI IRS PROGRAM COMPARISON OF OUTPUT MEASURES AND UNIT COSTS**

	<b>2016</b>	<b>2017</b>	<b>Percentage Change (2016 to 2017)</b>
<b>Output Measures</b>			
People Protected	788,922	823,201	4.3%
Structures Sprayed	228,672	227,646	-0.4%
Area Sprayed (100 m <sup>2</sup> )	211,428	200,673	-5.1%
<b>Unit Costs</b>			
Per Person Protected	\$6.35	\$8.01	26.2%
Per Structure Sprayed	\$21.90	\$28.97	32.3%
Per Area Sprayed	\$23.68	\$32.86	38.8%

Table ML5 compares the year-on-year change in Mali IRS program output measures and unit costs. In 2017, the program protected 4.3 percent more people, but sprayed 0.4 percent less structures and 5.1 percent less area than in 2016. Given that the total expenditures increased significantly from 2016 to 2017, while the three outputs either increased at a smaller rate or decreased, the unit costs were higher in 2017 than in 2016 due to the relocation of the intervention zone explained above. For the cost per person protected and per structure sprayed, unit costs increased by 26.2 percent and 32.3 percent respectively from 2016 to 2017, while cost per 100 m<sup>2</sup> sprayed increased by 38.8 percent.

# II. MOZAMBIQUE

## II.1 BACKGROUND

**TABLE MZI: MOZAMBIQUE QUICK FACTS**

	2017
Program Dates	April 1, 2017 – March 31, 2017
Number of Districts	7
# Local Staff	33
Spray Start Date	October 17, 2017
# Spray Rounds	1
Insecticides Used	Organophosphates
# Bottles Used	205,223
# People Protected	1,711,518
# Structures Sprayed	381,463
# 100 Square Meters Sprayed	513,058

## II.2 PROGRAM EXPENDITURES

This section presents an overview of Mozambique IRS program expenditures in 2017. Costs are organized by activity and cost category.

**TABLE MZ2: MOZAMBIQUE IRS PROGRAM CAPITAL AND RECURRENT EXPENDITURES, BY ACTIVITY AND COST CATEGORY**

IRS Activity	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Operations	U.S. Labor & STTA	Grand Total	% of Total
Admin		539,046	836,037			251,387	<b>\$1,626,471</b>	16.6%
Entomology			147,733		290,018	33,820	<b>\$471,570</b>	4.8%
Environmental Compliance			80,649		43,542	13,768	<b>\$137,958</b>	1.4%
Equipment Supplies			299	463,719		125	<b>\$464,143</b>	4.7%
IEC			107,952		222,383	6,130	<b>\$336,465</b>	3.4%

Insecticide*	3,078,345						<b>\$3,078,345</b>	31.4%
M&E			145,728		215,902	44,277	<b>\$405,907</b>	4.1%
Post Spray			151,872		92,574	15,255	<b>\$259,701</b>	2.6%
Spray Campaign			164,008		1,693,043	14,419	<b>\$1,871,469</b>	19.1%
Spray Planning			415,106		658,620	80,926	<b>\$1,154,652</b>	11.8%
<b>Grand Total</b>	<b>\$3,078,345</b>	<b>\$539,046</b>	<b>\$2,049,384</b>	<b>\$463,719</b>	<b>\$3,216,082</b>	<b>\$460,106</b>	<b>\$9,806,683</b>	100.0%

\*Includes estimated cost of organophosphate insecticides procured by the Global Fund based on the unit price of \$15 paid by the Global Fund.

Table MZ2 displays the Mozambique IRS program total capital and recurrent expenditures from 2017. The first column lists the program activities as tracked by the PMI AIRS project's financial systems, and the top row lists IRS program cost categories.

Insecticides and the spray campaign are the two most expensive IRS activities (31.4 percent and 19.1 percent of expenditures, respectively), followed by the local administration (16.6 percent of expenditures). PMI AIRS Mozambique received an insecticide donation of 326,688 bottles of organophosphate class insecticides and used 205,223 bottles. About 67 percent of the total cost for administration consists of labor, both local and U.S.-based. Local administration, U.S. labor, and commodities costs are minimal compared to expenditures on local labor and spray operations.

### 11.3 UNIT COST ANALYSIS

This section presents Mozambique IRS expenditures as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m<sup>2</sup>).

**TABLE MZ3: MOZAMBIQUE UNIT COSTS**

		Unit costs
<b>Cost per</b>	<b>Person protected</b>	\$ 5.73
	<b>Structure sprayed</b>	\$ 25.71
	<b>100 m<sup>2</sup> sprayed</b>	\$ 19.11

### 11.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the PMI AIRS Mozambique IRS program between 2016 and 2017, as implemented by the PMI AIRS Project.

**TABLE MZ4: MOZAMBIQUE IRS PROGRAM COMPARISON OF EXPENDITURES**

<b>Cost Category</b>	<b>2016 (Adjusted)</b>	<b>2017</b>	<b>Percentage Change (2016 to 2017)</b>
Insecticide	\$6,737,319	\$3,078,345	-54.3%
Local Admin	\$584,806	\$539,046	-7.8%

Local Labor	\$1,918,904	\$2,049,384	6.8%
Spray Operations	\$2,815,692	\$3,216,082	14.2%
Commodities	\$354,802	\$463,719	30.7%
U.S. Labor	\$473,552	\$460,106	-2.8%
<b>TOTAL</b>	<b>\$12,885,076</b>	<b>\$9,806,683</b>	<b>-23.9%</b>

Table MZ4, above, compares the year-on-year change in total program capital and recurrent expenditures. The total program cost decreased by 23.9 percent from 2016 to 2017. The largest increase in costs in absolute terms was for spray operations, which increased by over \$400,000 (14.2 percent increase) compared to 2016. In 2017, the increase in spray operations costs was driven by (1) an increase in daily wages for some cadres of seasonal workers<sup>2</sup> and the introduction of an IEC assistant position and its associated costs, (2) an increase in the number of hired and trained seasonal workers and associated costs<sup>3</sup>, (3) spraying in a new district, (Maganja da Costa), which lead to additional costs associated with setting up operation sites such as renovation of structures at provincial health directorate, warehouse rental and soak pit constructions, (4) a longer spray campaign in 2017 than in 2016<sup>4</sup>, and (5) a one-month long short-term technical assistance by the Kenya Operations Manager to provide additional operational and logistical support to the Chief of Party and Operations Manager during the spray campaign. The costs of commodities increased over 30 percent from 2016 to 2017 (about \$109,000). In 2017, the AIRS project had to purchase additional materials for the 2017 spray campaign as the remaining stock from the 2016 spray campaign was not enough to cover the 2017 campaign needs. The cost of local labor also increased by 6.8 percent (about \$130,000). In 2016, the project had two positions with dual roles: an IT specialist/database manager and a warehouse and logistics manager. In 2017, the project created two new positions splitting the dual roles and hired a database manager and logistics manager. Costs decreased between 2016 and 2017 for insecticide by over 54 percent, or over \$3,659,000. This decrease was due to the 19.5 percent decrease in area sprayed, as well as to the decrease in insecticide unit costs resulting from the UNITAID copayment on the Global Fund-procured Actellic in 2017. Local administration and U.S. labor costs also decreased by 7.8 percent and 2.8 percent, respectively.

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<sup>2</sup> In 2017, PMI AIRS Mozambique increased the daily wages for spray operators, team leaders, brigade supervisors, guards, store keepers and mobilizers.

<sup>3</sup> In 2016 and 2017, we hired 2,385 and 3,705 people and trained 2,888 and 4,333 people respectively.

<sup>4</sup> In 2016, the spray campaign was 44 days while in 2017 it was 50 days

**TABLE MZ5: MOZAMBIQUE IRS PROGRAM COMPARISON OF OUTPUT MEASURES AND UNIT COSTS**

	2016	2017	Percentage Change (2016 to 2017)
<b>Output Measures</b>			
People Protected	1,929,654	1,711,518	-11.3%
Structures Sprayed	405,597	381,463	-6.0%
Area Sprayed (100 m <sup>2</sup> )	637,380	513,058	-19.5%
<b>Unit Costs</b>			
Per Person Protected	\$6.68	\$5.73	-14.2%
Per Structure Sprayed	\$31.77	\$25.71	-19.1%
Per Area Sprayed	\$20.22	\$19.11	-5.4%

Table MZ5 compares the year-on-year change in Mozambique IRS program output measures and unit costs. Overall, in 2017, the program sprayed fewer structures and protected fewer people, and sprayed less area than in 2016. Because the decrease in program size was lower than the decrease in total expenditures from 2016 to 2017, the unit costs decreased across all categories of output measures by 5.4 percent to 19.1 percent.

# 12. RWANDA

## 12.1 BACKGROUND

**TABLE RW1: RWANDA QUICK FACTS**

	2017
Program Dates	Jan 1, 2017 – Dec 31, 2017
Number of Districts	3
# Local Staff	16
Spray Start Date	September 17, 2017
# Spray Rounds	1
Insecticides Used	Organophosphates
# Bottles Used	182,408
# People Protected	919,735
# Structures Sprayed	231,258
# 100 Square Meters Sprayed	456,020

## 12.2 PROGRAM EXPENDITURES

This section presents an overview of Rwanda IRS program expenditures in 2017. Costs are organized by activity and cost category.

**TABLE RW2: RWANDA IRS PROGRAM CAPITAL AND RECURRENT EXPENDITURES, BY ACTIVITY AND COST CATEGORY**

IRS Activity	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Operations	U.S. Labor & STTA	Grand Total	% of Total
Admin		390,913	374,340			109,202	<b>\$874,455</b>	13.3%
Entomology			33,016		545,630	16,552	<b>\$595,198</b>	9.0%
Environmental Compliance			45,697		3,855	75,351	<b>\$124,903</b>	1.9%
Equipment Supplies				357,180			<b>\$357,180</b>	5.4%
IEC					7,971		<b>\$7,971</b>	0.1%
Insecticide	3,191,487						<b>\$3,191,487</b>	48.4%
M&E			49,416		3,789	37,449	<b>\$90,654</b>	1.4%

Post Spray					9,762		\$9,762	0.1%
Spray Campaign					849,055	5,084	\$854,140	13.0%
Spray Planning			171,264		273,514	41,913	\$486,691	7.4%
<b>Grand Total</b>	<b>\$3,191,487</b>	<b>\$390,913</b>	<b>\$673,732</b>	<b>\$357,180</b>	<b>\$1,693,577</b>	<b>\$285,551</b>	<b>\$6,592,441</b>	100.0%

Table RW2 displays the Rwanda IRS program total capital and recurrent expenditures from 2017. The first column lists the program activities as tracked by the PMI AIRS project financial systems, and the top row lists IRS program cost categories.

Insecticides represented 48.4 percent of costs. Administration and spray campaign costs were the next two most expensive activities, representing 13.3 and 13 percent of costs, respectively. The Project procured 159,468 bottles of organophosphate, and used 182,408 bottles; the costs above reflect the cost of insecticide used. About 55 percent of the total cost for administration consists of labor, both local and U.S.-based. Local administration, U.S. labor, and commodities costs are minimal compared to expenditures on insecticide, local labor, and spray operations.

### 12.3 UNIT COST ANALYSIS

This section presents Rwanda IRS expenditures as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m<sup>2</sup>).

**TABLE RW3: RWANDA UNIT COSTS**

		Unit costs
<b>Person protected</b>	\$	7.17
<b>Cost per Structure sprayed</b>	\$	28.51
<b>100 m<sup>2</sup> sprayed</b>	\$	14.46

### 12.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Rwanda IRS program between 2016 and 2017, as implemented by the PMI AIRS project. The comparison focuses on output measures, total expenditures, and unit costs.

**TABLE RW4: RWANDA IRS PROGRAM COMPARISON OF EXPENDITURES**

<b>Cost Category</b>	<b>2016 (Adjusted)</b>	<b>2017</b>	<b>Percentage Change (2016 to 2017)</b>
Insecticide	\$ 4,232,754	\$ 3,191,487	-24.6%
Local Admin	\$ 288,467	\$ 390,913	35.5%
Local Labor	\$ 701,843	\$ 673,732	-4.0%

Spray Operations	\$ 2,335,507	\$ 1,693,577	-27.5%
Commodities	\$ 237,100	\$ 357,180	50.6%
U.S. Labor	\$ 252,599	\$ 285,551	13.1%
<b>TOTAL</b>	<b>\$ 8,048,270</b>	<b>\$ 6,592,441</b>	<b>-4.1%</b>

Table RW4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost decreased by 4.1 percent from 2016 to 2017, representing a decrease in the total annual cost of almost \$1,456,000. Insecticide costs decreased by 24.6 percent (about \$1,041,000), while spray operations costs decreased by 27.5 percent (almost \$642,000), reflecting the decrease in program scale from 2016 to 2017. Costs increased for local administration by about \$102,000 for commodities by about \$120,000 and for U.S. labor by about \$33,000. These increases can be explained by the implementation of electronic data collection that increased monitoring and evaluation labor costs, as well as by the procurement of new coveralls, boots and spray pumps.

**TABLE RW5: RWANDA IRS PROGRAM COMPARISON OF OUTPUT MEASURES AND UNIT COSTS**

	2016	2017	Percentage Change (2016 to 2017)
<b>Output Measures</b>			
People Protected	1,431,410	919,735	-35.7%
Structures Sprayed	346,917	231,258	-33.3%
Area Sprayed (100 m <sup>2</sup> )	634,915	456,020	-28.2%
<b>Unit Costs</b>			
Per Person Protected	\$5.62	\$7.17	27.5%
Per Structure Sprayed	\$23.20	\$28.51	22.9%
Per Area Sprayed	\$12.68	\$14.46	14.0%

Table RW5 compares the year-on-year change in PMI AIRS Rwanda program output measures and unit costs. In 2017, the program achieved lower coverage on all three indicators used in Table RW4 than in 2016. Between 2016 and 2017, the number of people protected decreased 35.7 percent, the number of structures decreased 33.3 percent, and the area sprayed decreased by 28.2 percent. Given that the decrease in total expenditures was lower than the decrease in coverage, the unit costs increased by 27.5 percent for cost per person protected, 22.9 percent for cost per structure sprayed, and 14 percent for cost per area sprayed.

# 13. SENEGAL

## 13.1 BACKGROUND

**TABLE SNI: SENEGAL QUICK FACTS**

	2017
Program Dates	Jan 1, 2017 – Dec 31, 2017
Number of Districts	4
# Local Staff	17
Spray Start Date	June 30, 2017
# Spray Rounds	1
Insecticides Used	Organophosphates
# Bottles Used	49,098
# People Protected	619,578
# Structures Sprayed	156,362
# 100 Square Meters Sprayed*	122,745

\* Reverse calculation using number of insecticide bottles used during campaign multiplied by the average of 250 m<sup>2</sup> estimated to be sprayed by one bottle and divided by the number of structures sprayed.

## 13.2 PROGRAM EXPENDITURES

This section presents an overview of Senegal IRS program expenditures in 2017. Costs are organized by activity and cost category.

**TABLE SN2: SENEGAL IRS PROGRAM CAPITAL AND RECURRENT EXPENDITURES, BY ACTIVITY AND COST CATEGORY**

IRS Activity	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Operations	U.S. Labor & STTA	Grand Total	% of Total
Admin		355,284	599,200			120,155	\$1,074,639	26.4%
Entomology			64,785		303,359	26,631	\$394,775	9.7%
Environmental Compliance			72,954		19,128	14,418	\$106,500	2.6%
Equipment Supplies			7,807	129,142		74	\$137,024	3.4%
IEC			41,450		19,760	6,048	\$67,259	1.7%
Insecticide	1,296,631		3,009			20	\$1,299,661	31.9%

M&E			62,640		33,061	13,632	<b>\$109,334</b>	2.7%
Post Spray			58,987		25,522	11,812	<b>\$96,321</b>	2.4%
Spray Campaign			28,569		345,468	3,267	<b>\$377,303</b>	9.3%
Spray Planning			145,486		232,284	30,917	<b>\$408,688</b>	10.0%
<b>Grand Total</b>	<b>\$1,296,631</b>	<b>\$355,284</b>	<b>\$1,084,889</b>	<b>\$129,142</b>	<b>\$978,582</b>	<b>\$226,974</b>	<b>\$4,071,502</b>	100.0%

Table SN2 displays the Senegal IRS program total capital and recurrent expenditures from 2017. The first column lists the program activities as tracked by the PMI AIRS Project's financial systems, and the top row lists IRS program cost categories.

Insecticide is the most expensive IRS activity (31.9 percent of expenditures), followed by administration (26.4 percent of expenditures), and spray planning activities (10 percent of expenditures). PMI AIRS procured 54,395 bottles of organophosphate class insecticide, and used about 49,098 bottles (costs reflect the insecticides used). About 67 percent of the total cost for administration consists of labor, both local and U.S.-based. Local administration, U.S. labor, and commodities costs are minimal compared to expenditures on insecticide, local labor, and spray operations.

### 13.3 UNIT COST ANALYSIS

This section presents Senegal IRS expenditures as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m<sup>2</sup>).

**TABLE SN3: SENEGAL UNIT COSTS**

		Unit costs
<b>Person protected</b>	\$	6.57
<b>Cost per Structure sprayed</b>	\$	26.04
<b>100 m<sup>2</sup> sprayed</b>	\$	33.17

### 13.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Senegal IRS program between 2016 and 2017, as implemented by the PMI AIRS project. The comparison focuses on output measures, total expenditures, and unit costs.

**TABLE SN4: SENEGAL IRS PROGRAM COMPARISON OF EXPENDITURES**

Cost Category	2016 (Adjusted)	2017	Percentage Change (2016 to 2017)
Insecticide	1,036,482	1,296,631	25.1%
Local Admin	345,567	355,284	2.8%
Local Labor	1,151,624	1,084,889	-5.8%

Spray Operations	673,383	978,582	45.3%
Commodities	113,923	129,142	13.4%
U.S. Labor	282,270	226,974	-19.6%
<b>TOTAL</b>	<b>\$ 3,603,249</b>	<b>\$ 4,071,502</b>	<b>13.0%</b>

Table SN4, above, compares the year-on-year change in total program capital and recurrent expenditures. The total program cost increased by 13.0 percent from 2016 to 2017, representing an increase in the total annual cost of about \$468,000. Reductions in costs from 2016 to 2017 were seen in local labor and U.S. labor (5.8 percent and 19.6 percent, respectively).

The costs of insecticides used increased 25.1 percent from 2016 to 2017, reflecting the increased coverage in 2017. Local administration, spray operations, and commodities also increased by 2.8 percent, 45.3 percent, and 13.4 percent, respectively, from 2016 to 2017.

**TABLE SN5: SENEGAL IRS PROGRAM COMPARISON OF OUTPUT MEASURES AND UNIT COSTS**

	2016	2017	Percentage Change (2016 to 2017)
<b>Output Measures</b>			
People Protected	496,728	619,578	24.7%
Structures Sprayed	124,757	156,362	25.3%
Area Sprayed (100 m <sup>2</sup> )	97,973	122,745	25.3%
<b>Unit Costs</b>			
Per Person Protected	\$7.25	\$6.57	-9.4%
Per Structure Sprayed	\$28.88	\$26.04	-9.8%
Per Area Sprayed	\$36.78	\$33.17	-9.8%

Table SN5, above, compares the year-on-year change in Senegal IRS program output measures and unit costs. In 2017, the program had higher coverage metrics than in 2016. The number of people protected increased by 24.7 percent from 2016 to 2017, while the number of structures sprayed and area sprayed increased by 25.3 percent each over the same period. Because the increase in program size was larger than the increase in total expenditures, unit costs decreased from 2016 to 2017. The cost per person protected decreased by about 9.4 percent, while costs per structure sprayed and area sprayed decreased on the order of 9.8 percent, each, from 2016 to 2017.

# 14. TANZANIA

## 14.1 BACKGROUND

**TABLE TZI: TANZANIA QUICK FACTS**

	2017
Program Dates	Oct 1, 2016 – Sep 30, 2017
Number of Districts	18
# Local Staff	35
Spray Start Date	
<i>Mainland (Kagera/Geita)</i>	January 25, 2017
<i>Zanzibar</i>	February 14, 2017
<i>Mainland (Mwanza/Mara)</i>	March 8, 2017
# Spray Rounds	1
Insecticides Used	Organophosphates
# Bottles Used	219,638
# People Protected	2,568,522
# Structures Sprayed	664,622
# 100 Square Meters Sprayed*	549,095

\* Reverse calculation using number of insecticide bottles used during campaign multiplied by the average of 250 m<sup>2</sup> estimated to be sprayed by one bottle and divided by the number of structures sprayed.

## 14.2 PROGRAM EXPENDITURES

This section presents an overview of Tanzania IRS program expenditures in 2017. Costs are organized by activity and cost category.

**TABLE TZ2: TANZANIA IRS PROGRAM CAPITAL AND RECURRENT EXPENDITURES, BY ACTIVITY AND COST CATEGORY**

IRS Activity	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Operations	U.S. Labor & STTA	Grand Total	% of Total
Admin		822,854	835,448			206,645	\$1,864,947	17.1%
Entomology			80,665		672,708	17,508	\$770,880	7.1%
Environmental Compliance			89,323		66,970	22,813	\$179,106	1.6%
Equipment Supplies			13,540	513,949		6,521	\$534,011	4.9%
IEC							\$-	0.0%
Insecticide	3,742,699		566			120	\$3,743,385	34.3%
M&E			47,760		15,675	26,426	\$89,861	0.8%
Post Spray			96,544		77,259	17,140	\$190,943	1.7%
Spray Campaign			108,859		2,198,430	16,305	\$2,323,595	21.3%
Spray Planning			266,726		914,631	46,274	\$1,227,631	11.2%
<b>Grand Total</b>	<b>\$3,742,699</b>	<b>\$822,854</b>	<b>\$1,539,432</b>	<b>\$513,949</b>	<b>\$3,945,673</b>	<b>\$359,750</b>	<b>\$10,924,358</b>	<b>100.0%</b>

Table TZ2 displays the Tanzania IRS program total capital and recurrent expenditures from 2017. The first column lists the program activities as tracked by the PMI AIRS Project's financial systems, and the top row lists IRS program cost categories.

Insecticide is the most expensive IRS activity (34.3 percent of expenditures), followed by the spray campaign activities (21.3 percent of expenditures) and administration (16.8 percent of expenditures). PMI AIRS procured 196,558 bottles of organophosphate insecticide, and used about 211,118 bottles (costs reflect the insecticides used). About 56 percent of the total cost for administration consists of labor, both local and U.S.-based. Local administration, U.S. labor, and commodities costs are minimal compared to expenditures on insecticide, local labor, and spray operations.

### 14.3 UNIT COST ANALYSIS

This section presents Tanzania IRS expenditures as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m<sup>2</sup>).

**TABLE TZ3: TANZANIA UNIT COSTS**

	Unit costs	
Person protected	\$	4.25
Cost per Structure sprayed	\$	16.44
100 m <sup>2</sup> sprayed	\$	19.90

## 14.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Tanzania IRS program between 2016 and 2017, as implemented by the PMI AIRS project. The comparison focuses on output measures, total expenditures, and unit costs.

**TABLE TZ4: TANZANIA IRS PROGRAM COMPARISON OF EXPENDITURES**

<b>Cost Category</b>	<b>2016 (Adjusted)</b>	<b>2017</b>	<b>Percentage Change (2016 to 2017)</b>
Insecticide	\$4,982,375	\$3,742,699	-25%
Local Admin	\$939,771	\$822,854	-12%
Local Labor	\$1,470,668	\$1,539,432	5%
Spray Operations	\$3,903,079	\$3,945,673	1%
Commodities	\$363,706	\$513,949	41%
U.S. Labor	\$408,255	\$359,750	-12%
<b>TOTAL</b>	<b>\$12,067,855</b>	<b>\$11,075,400</b>	<b>-9.5%</b>

Table TZ4, above, compares the year-on-year change in total program capital and recurrent expenditures. The total program cost decreased by 9.5 percent from 2016 to 2017, representing a decrease in the total annual cost of about \$1,144,000.

The costs of insecticides used decreased 25 percent from 2016 to 2017, reflecting the fact that Tanzania benefited from the NGenIRS subsidy in 2017. Local administration and U.S. labor costs also decreased by 12 percent, each, from 2016 to 2017. Increases were seen in the costs of local labor (about 5 percent), spray operations (about 1 percent), and commodities (41 percent). In order to replenish the spray materials stock, and given the increased number of structures to be sprayed, additional spray materials had to be purchased. Obsolete materials were also replaced with new procurement.

**TABLE TZ5: TANZANIA IRS PROGRAM COMPARISON OF OUTPUT MEASURES AND UNIT COSTS**

	<b>2016</b>	<b>2017</b>	<b>Percentage Change (2016 to 2017)</b>
<b>Output Measures</b>			
People Protected	2,042,561	2,568,522	25.8%
Structures Sprayed	515,217	664,622	29.0%
Area Sprayed (100 m <sup>2</sup> )	437,933	549,095	25.4%

<b>Unit Costs</b>			
Per Person Protected	\$5.91	\$4.25	-28.0%
Per Structure Sprayed	\$23.42	\$16.44	-29.8%
Per Area Sprayed	\$27.56	\$19.90	-27.8%

Table TZ5, above, compares the year-on-year change in Tanzania IRS program output measures and unit costs. In 2017, the program had higher coverage metrics than in 2016. The number of people protected increased by 25.8 percent from 2016 to 2017, and the number of structures sprayed and area sprayed increased by 29 percent and 25.4 percent, respectively. Because the program size increased while total expenditures decreased, unit costs decreased from 2016 to 2017. The cost per person protected decreased by about 28 percent, while costs per structure sprayed and area sprayed decreased on the order of 29.8 percent and 27.8 percent, respectively, from 2016 to 2017.

# 15. ZAMBIA

## 15.1 BACKGROUND

**TABLE ZAI: ZAMBIA QUICK FACTS**

	2017
Program Dates	March 1, 2017 – Feb 28, 2018
Number of Districts	36
# Local Staff	44
Spray Start Date	October 2, 2017
# Spray Rounds	1
Insecticides Used	Organophosphates
# Bottles Used	168,771
# People Protected	3,005,676
# Structures Sprayed	634,371
# 100 Square Meters Sprayed	421,928

## 15.2 PROGRAM EXPENDITURES

This section presents an overview of Zambia IRS program expenditures in 2017. Costs are organized by activity and cost category.

**TABLE ZA2: ZAMBIA IRS PROGRAM CAPITAL AND RECURRENT EXPENDITURES, BY ACTIVITY AND COST CATEGORY**

IRS Activity	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Operations	U.S. Labor & STTA	Grand Total	% of Total
Admin		365,379	880,903			216,316	\$1,462,597	14.5%
Entomology			170,142		295,685	43,165	\$508,992	5.1%
Environmental Compliance			45,664		119,132	23,541	\$188,337	1.9%
Equipment Supplies				206,345			\$206,345	2.1%
IEC					199,634		\$199,634	2.0%
Insecticide	2,970,959						\$2,970,959	29.5%
M&E			66,526		179,067	55,580	\$301,173	3.0%

Post Spray			89,345		51,792	32,048	<b>\$173,186</b>	1.7%	
Spray Campaign			93,460		2,179,560	39,636	<b>\$2,312,655</b>	23.0%	
Spray Planning			316,856		1,343,515	72,032	<b>\$1,732,404</b>	17.2%	
<b>Grand Total</b>	<b>\$2,970,959</b>	<b>\$365,379</b>	<b>\$1,662,896</b>	<b>\$206,345</b>	<b>\$4,368,384</b>	<b>\$482,318</b>	<b>\$10,056,282</b>	100.0%	

Table ZA2 displays the Zambia IRS program total capital (including disposition) and recurrent expenditures from 2017. The first column lists the program activities as tracked by the PMI AIRS Project's financial systems, and the top row lists IRS program cost categories.

Insecticides and spray campaign costs are the two most expensive IRS activities (29.5 percent and 23 percent of expenditures, respectively), followed by spray planning (17.2 percent of expenditures). PMI AIRS Zambia procured 162,150 bottles of organophosphate insecticide; 168,771 bottles were used. About 75 percent of the total cost for administration consists of labor, both local and U.S.-based. Local administration, U.S. labor, and commodities costs were less than expenditures on insecticide, local labor, and spray operations.

### 15.3 UNIT COST ANALYSIS

This section presents Zambia IRS expenditures as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m<sup>2</sup>).

**TABLE ZA3: ZAMBIA UNIT COSTS**

	Unit costs	
<b>Person protected</b>	\$	3.35
<b>Cost per Structure sprayed</b>	\$	15.85
<b>100 m<sup>2</sup> sprayed</b>	\$	23.83

### 15.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Zambia IRS program for 2016 and 2017, as implemented by the PMI AIRS project. The comparison focuses on output measures, total expenditures, and unit costs.

**TABLE ZA4: ZAMBIA IRS PROGRAM COMPARISON OF EXPENDITURES**

<b>Cost Category</b>	<b>2016 (Adjusted)</b>	<b>2017</b>	<b>Percentage Change (2016 to 2017)</b>
Insecticide	\$2,469,973	\$2,970,959	20.3%
Local Admin	\$457,466	\$365,379	-20.1%
Local Labor	\$1,764,998	\$1,662,896	-5.8%

Spray Operations	\$4,717,298	\$4,368,384	-7.4%
Commodities	\$293,408	\$206,345	-29.7%
U.S. Labor	\$493,112	\$482,318	-2.2%
<b>TOTAL</b>	<b>\$10,196,255</b>	<b>\$10,056,282</b>	<b>-1.4%</b>

Table ZA4, above, compares the year-on-year change in total program capital and recurrent expenditures. The total program cost decreased by 1.4 percent from 2016 to 2017, representing a decrease in the total annual cost of about \$141,000.

The largest cost decrease in absolute terms was for spray operations, which decreased by about \$349,000 from 2016 to 2017 (a 7.4 percent decrease), accounting for over 54 percent of the decreased cost between the two years. Local administration costs decreased by 20.1 percent (about \$92,000) and local labor costs decreased by \$102,102 (5.8 percent) from 2016 to 2017. Commodities and U.S. labor costs also decreased by 29.7 percent and 2.2 percent, respectively, over the same time period. Insecticide costs increased by 20.3 percent (about \$501,000), reflecting the increase in coverage from 2016 to 2017.

**TABLE ZA5: ZAMBIA IRS PROGRAM COMPARISON OF OUTPUT MEASURES AND UNIT COSTS**

	2016	2017	Percentage Change (2016 to 2017)
<b>Output Measures</b>			
People Protected	2,626,718	3,005,676	14.4%
Structures Sprayed	559,550	634,371	13.4%
Area Sprayed (100 m <sup>2</sup> )	350,045	421,928	20.5%
<b>Unit Costs</b>			
Per Person Protected	\$3.88	\$3.35	-13.8%
Per Structure Sprayed	\$18.22	\$15.85	-13.0%
Per Area Sprayed	\$29.13	\$23.83	-18.2%

Table ZA5, above, compares the year-on-year change in Zambia IRS program output measures and unit costs. In 2017, the program had higher output metrics across the three categories considered, with increases in program outputs of over 14 percent and 13 percent compared to 2016 for the number of people protected and structures sprayed, respectively, and over 20 percent greater area sprayed. While the program size increased between 13 percent and 20 percent across the different outputs, total expenditures decreased by 1.4 percent. Thus, unit costs decreased from 2016 to 2017 by 13 percent to over 18 percent across the three output metrics.

# 16. ZIMBABWE

## 16.1 BACKGROUND

**TABLE ZWI: ZIMBABWE QUICK FACTS**

	2017
Program Dates	March 1, 2017 – Feb 28, 2018
Number of Districts	4
# Local Staff	13
Spray Start Date	October 23, 2017
# Spray Rounds	1
Insecticides Used	Organophosphates
# Bottles Used	99,148
# People Protected	517,374
# Structures Sprayed	209,055
# 100 Square Meters Sprayed	247,870

## 16.2 PROGRAM EXPENDITURES

This section presents an overview of Zimbabwe IRS program expenditures in 2017. Costs are organized by activity and cost category.

**TABLE ZW2: ZIMBABWE IRS PROGRAM CAPITAL AND RECURRENT EXPENDITURES, BY ACTIVITY AND COST CATEGORY**

IRS Activity	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Operations	U.S. Labor & STTA	Grand Total	% of Total
Admin		244,436	699,505			114,607	\$1,058,547	23.0%
Entomology		2,151	299,004		167,805	31,191	\$500,151	10.9%
Environmental Compliance		1,817	109,887		18,465	40,520	\$170,689	3.7%
Equipment Supplies				142,080			\$142,080	3.1%
IEC					1,816		\$1,816	0.0%
Insecticide	1,747,064						\$1,747,064	37.9%

M&E						11,183	<b>\$11,183</b>	0.2%
Post Spray					42,097		<b>\$42,097</b>	0.9%
Spray Campaign			41,958		836,023	5,666	<b>\$883,648</b>	19.2%
Spray Planning					47,564		<b>\$47,564</b>	1.0%
<b>Grand Total</b>	<b>\$1,747,064</b>	<b>\$248,404</b>	<b>\$1,150,354</b>	<b>\$142,080</b>	<b>\$1,113,772</b>	<b>\$203,166</b>	<b>\$4,604,839</b>	<b>100.0%</b>

Table ZW2 displays the Zimbabwe IRS program total capital (including requisition) and recurrent expenditures from 2017. The first column lists the program activities as tracked by the PMI AIRS project's financial systems, and the top row lists IRS program cost categories.

Insecticides and administration are the two most expensive IRS activities (37.9 percent and 23 percent of expenditures, respectively), followed by spray campaign (19.2 percent of expenditures). PMI AIRS Zimbabwe procured 93,000 bottles of organophosphate insecticide; 99,148 bottles were used (reflected in figure above). About 77 percent of the total cost for administration consists of labor, both local and U.S.-based. Local administration, U.S. labor, and commodities costs are minimal compared to expenditures on insecticide, local labor, and spray operations.

### 16.3 UNIT COST ANALYSIS

This section presents Zimbabwe IRS expenditures as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m<sup>2</sup>).

**TABLE ZW3: ZIMBABWE UNIT COSTS**

Unit costs	
<b>Person protected</b>	\$ 8.90
<b>Cost per Structure sprayed</b>	\$ 22.03
<b>100 m<sup>2</sup> sprayed</b>	\$ 18.58

### 16.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Zimbabwe IRS program for 2016 and 2017, as implemented by the PMI AIRS project. The comparison focuses on output measures, total expenditures, and unit costs.

**TABLE ZW4: ZIMBABWE IRS PROGRAM COMPARISON OF EXPENDITURES**

<b>Cost Category</b>	<b>2016 (Adjusted)</b>	<b>2017</b>	<b>Percentage Change (2016 to 2017)</b>
Insecticide	\$2,811,510	\$1,747,064	-37.9%

Local Admin	\$271,091	\$248,404	-8.4%
Local Labor	\$1,253,550	\$1,150,354	-8.2%
Spray Operations	\$1,300,417	\$1,113,772	-14.4%
Commodities	\$158,567	\$142,080	-10.4%
U.S. Labor	\$254,871	\$203,166	-20.3%
<b>TOTAL</b>	<b>\$6,050,006</b>	<b>\$4,604,839</b>	<b>-23.9%</b>

Table ZW4, above, compares the year-on-year change in total program capital and recurrent expenditures. The total program cost decreased by 23.9 percent from 2016 to 2017, representing a decrease in the total annual cost of over \$1.44 million. Reductions in costs were seen across all cost categories, with the largest decreases seen, in absolute terms, in insecticide costs (37.9 percent or over \$1.06 million) and spray operations costs (14.4 percent or almost \$187,000). Costs of local labor and U.S. labor also decreased by 8.2 percent and 20.3 percent, respectively, while the cost of local administration decreased by 8.4 percent. These cost decreases are reflective of the decrease in program scale from 2016 to 2017.

**TABLE ZW5: ZIMBABWE IRS PROGRAM COMPARISON OF OUTPUT MEASURES AND UNIT COSTS**

	2016	2017	Percentage Change (2016 to 2017)
<b>Output Measures</b>			
People Protected	550,475	517,374	-6.0%
Structures Sprayed	229,377	209,055	-8.9%
Area Sprayed (100 m <sup>2</sup> )	263,685	247,870	-6.0%
<b>Unit Costs</b>			
Per Person Protected	\$10.99	\$8.90	-19.0%
Per Structure Sprayed	\$26.38	\$22.03	-16.5%
Per Area Sprayed	\$22.94	\$18.58	-19.0%

Table ZW5, above, compares the year-on-year change in Zimbabwe IRS program output measures and unit costs. In 2017, the program had lower output metrics across the three categories considered, with decreases of 6 percent in the number of people protected, 8.9 percent in the number of structures sprayed, and 6 percent in the area sprayed, compared to 2016. Because the decrease in program size was smaller than the decrease in total expenditures, unit costs decreased from 2016 to 2017 by between 16 percent and 19 percent across the three output metrics.

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# ANNEX I: YEAR-ON-YEAR COMPARISON OF OUTPUT MEASURES

Country	People Protected							Structures Sprayed							Area Sprayed (100 m <sup>2</sup> )						
	2012	2013	2014	2015	2016	2017	Percent Change 2016-2017	2012	2013	2014	2015	2016	2017	Percent Change 2016-2017	2012	2013	2014	2015	2016	2017	Percent Change 2016-2017
Ethiopia	1,506,273	1,629,958	1,647,099	1,655,997	1,688,745	1,877,154	11%	547,421	635,528	667,236	704,945	715,541	738,810	3%	524,334	617,442	624,764	641,994	677,990	627,295	-7%
Tanzania					2,042,561	2,568,522	26%					515,217	664,622	29%					437,933	527,795	21%
Zambia			2,000,824	2,544,290	2,626,718	3,005,676	14%			409,544	519,598	559,550	634,371	13%			281,508	341,630	350,045	421,928	21%
Madagascar	1,781,990	1,588,138	1,307,384	1,016,841	1,257,036	2,008,963	60%	371,391	343,470	274,533	247,902	310,426	487,636	57%	221,418	198,985	229,240	113,493	133,030	189,860	43%
Benin	762,146	694,729	789,883	802,597	858,113	1,227,536	43%	206,295	228,951	254,072	252,706	269,179	384,761	43%	192,968	125,605	110,505	114,160	116,543	146,913	26%
Mozambique	2,716,176	2,181,896	2,327,815	1,631,058	1,929,654	1,711,518	-11%	536,558	414,232	445,118	337,433	405,597	381,463	-6%	974,470	822,735	914,518	649,370	637,380	513,058	-20%
Ghana	941,240	534,060	570,572	553,954	570,871	840,438	47%	355,278	197,655	205,230	205,935	211,283	302,648	43%	193,220	108,210	112,370	113,285	117,833	164,738	40%
Rwanda	1,025,181	1,479,342	1,217,837	1,406,520	1,431,410	919,735	-36%	236,610	345,862	297,005	343,131	346,917	231,258	-33%	332,522	529,940	482,958	578,390	634,915	456,020	-28%
Mali	762,146	850,104	836,568	494,205	788,922	823,201	4%	206,295	228,985	228,123	133,527	228,672	227,646	0%	192,968	233,588	224,868	146,180	211,428	200,673	-5%
Kenya						906,388	n/a						212,029	n/a						176,383	n/a
Zimbabwe			334,746	365,425	550,475	517,374	42%			147,949	162,127	229,377	209,055	-9%			167,600	183,315	263,685	247,870	-6%
Senegal	1,095,093	690,029	708,999	514,833	496,728	619,578	20%	306,916	207,116	204,159	130,170	124,757	156,362	25%	267,185	162,623	150,465	98,010	97,973	122,745	25%
Average	1,323,781	1,206,032	1,174,173	1,098,572	1,294,658	1,418,840	29%	345,846	325,225	313,297	303,747	356,047	385,888	27%	362,386	349,891	329,879	297,983	334,432	316,273	6%

## ANNEX II: YEAR-ON-YEAR COMPARISON OF UNIT COSTS

Country	People Protected							Structures Sprayed							Area Sprayed (100 m <sup>2</sup> )						
	2012	2013	2014	2015	2016	2017	Percent Change 2016-2017	2012	2013	2014	2015	2016	2017	Percent Change 2016-2017	2012	2013	2014	2015	2016	2017	Percent Change 2016-2017
Ethiopia	\$3.34	\$4.41	\$4.55	\$5.29	\$5.65	\$5.55	-2%	\$9.20	\$11.30	\$11.23	\$12.42	\$13.33	\$14.11	6%	\$9.60	\$11.63	\$12.00	\$13.63	\$14.07	\$16.92	20%
Tanzania					\$5.91	\$4.25	-28%					\$23.42	\$16.44	-30%					\$27.56	\$20.70	-25%
Zambia			\$3.19	\$4.02	\$3.88	\$3.35	-14%			\$15.58	\$19.69	\$18.22	\$15.85	-13%			\$22.67	\$29.94	\$29.13	\$23.83	-18%
Madagascar	\$2.76	\$4.34	\$4.91	\$4.99	\$4.18	\$3.87	-7%	\$13.22	\$20.05	\$23.38	\$20.48	\$16.91	\$15.93	-6%	\$22.18	\$34.61	\$28.00	\$44.74	\$39.46	\$40.93	4%
Benin	\$3.99	\$4.38	\$4.34	\$4.20	\$4.19	\$3.88	-7%	\$14.74	\$13.30	\$13.51	\$13.36	\$13.36	\$12.39	-7%	\$15.76	\$24.25	\$31.06	\$29.56	\$30.87	\$32.45	5%
Mozambique	\$1.44	\$1.78	\$1.73	\$4.68	\$6.68	\$5.73	-14%	\$7.29	\$9.37	\$9.04	\$22.61	\$31.77	\$25.71	-19%	\$4.01	\$4.72	\$4.40	\$11.75	\$20.22	\$19.11	-5%
Ghana	\$5.12	\$8.67	\$7.72	\$7.84	\$7.17	\$5.43	-24%	\$13.56	\$23.43	\$21.46	\$21.09	\$19.36	\$15.08	-22%	\$24.93	\$42.79	\$39.20	\$38.34	\$34.71	\$27.70	-20%
Rwanda	\$3.74	\$5.24	\$6.25	\$4.89	\$5.62	\$7.17	27%	\$16.22	\$22.41	\$25.61	\$20.03	\$23.20	\$28.51	23%	\$11.54	\$14.63	\$15.75	\$11.88	\$12.68	\$14.46	14%
Mali	\$5.77	\$6.34	\$6.44	\$9.49	\$6.35	\$8.01	26%	\$21.30	\$23.52	\$23.62	\$35.12	\$21.90	\$28.97	32%	\$22.77	\$23.06	\$23.96	\$32.08	\$23.68	\$32.86	39%
Kenya						\$6.07	n/a						\$25.96	n/a						\$31.21	n/a
Zimbabwe			\$13.56	\$11.96	\$10.99	\$8.90	-19%			\$30.68	\$26.96	\$26.38	\$22.03	-16%			\$27.08	\$23.84	\$22.94	\$18.58	-19%
Senegal	\$4.28	\$5.96	\$5.82	\$6.70	\$7.25	\$6.57	-9%	\$15.27	\$19.85	\$20.20	\$26.50	\$28.88	\$26.04	-10%	\$17.54	\$25.29	\$27.40	\$35.19	\$36.78	\$33.17	-10%
<b>Average</b>	<b>\$3.80</b>	<b>\$5.14</b>	<b>\$5.85</b>	<b>\$6.41</b>	<b>\$6.17</b>	<b>\$5.73</b>	<b>-7%</b>	<b>\$13.85</b>	<b>\$17.90</b>	<b>\$19.43</b>	<b>\$21.83</b>	<b>\$21.52</b>	<b>\$20.58</b>	<b>-4%</b>	<b>\$16.04</b>	<b>\$22.62</b>	<b>\$23.15</b>	<b>\$27.10</b>	<b>\$25.99</b>	<b>\$26.33</b>	<b>-2%</b>

# ANNEX III: METHODOLOGY

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## OBJECTIVE

This report presents and compares the findings of a cost analysis of the expenses that were incurred during the last six years of IRS program implementation in eleven PMI countries, using a methodology that can be repeated on an annual basis. The purpose of the assessment is to evaluate the unit costs and the overall level of spending, by program activity and by cost category, in each of these countries.

The analysis separates capital expenditure items (used throughout full project implementation), and recurrent expenditure items (for each year of program implementation). The analysis also includes the cost of items inherited from previous IRS programs, as provided in each country's disposition inventory, as well as the cost of insecticides provided by local governments (where possible) in order to reflect the full cost of program implementation. These categories are defined in detail in the 2014 report (Johns 2015).

Conducted annually over the course of the project, the analyses will provide cost comparisons for overall annual expenditure trends within and across countries.

## TARGET AUDIENCE

The results and findings of the cost analysis will be used by PMI and host countries to make informed decisions about how and at what funding level to invest in IRS in the future. The findings will also be used by Project staff for program management, and may be shared with PMI's government partners and other key stakeholders to inform them of specific costs of implementing an IRS program in their respective countries. PMI also intends to share findings broadly with global partners and post the analysis on its publicly available website.

## APPROACH

Through a collaborative process with PMI, project technical, monitoring and evaluation (M&E), financial, and operational staff, the costing team:

1. *Collected project expenditures and output measures.* Financial data were collected from Abt Associates' internal financial tracking systems for the past four years. Information collected was augmented and verified through staff interviews. Program output and operational data were collected from the AIRS M&E systems.
2. *Categorized all financial expenditures according to the methodology framework.* The costing framework used in this analysis includes: (1) capital and recurrent costs, (2) technical program activities, and (3) cost categories. All capital costs are annualized for this report. All costs are reported in 2017 in U.S. dollars; costs from previous years are adjusted for inflation.

The methodology used for the analyses presented in this report is generally the same as used for the reports from 2012, 2013, 2014, 2015, and 2016 (Abbott 2013, Abbott 2014, Johns 2015, Johns 2016, Cico 2017). In this report, all insecticide costs reflect the cost of the insecticide used, rather than the expenditures for insecticide procurement (as was done in the 2015 report, but not done in reports prior to 2015). Insecticide costs are estimated based on the unit cost of insecticides procured, with the unit costs incurred in procurement then applied to the amount of insecticide used.

In keeping with the methodology used in the 2014 report, the useful life of capital items reflects a six-year timeframe for implementation. Items with an expected useful life of less than six years (boots, overalls, and other personal protective equipment) were not changed. Further, in the year-to-year comparisons, we did not apply inflation to insecticide costs. Insecticides are internationally available goods; when assessing the price of insecticides across the past four years, price changes do not appear to be

correlated with the inflation rates in individual countries. We do adjust all other cost inputs for inflation, as described below and done in previous years' reports.

For a detailed description of the methodology and assumptions used, as well as limitations, please refer to the 2014 report (Johns 2015)<sup>5</sup>.

This comparative costing analysis covers IRS implementation in 2012, 2013, 2014, 2015, and 2016. However, the dates of each program year (the period of program implementation) vary by country. The specific program dates for each country program can be found in the respective country chapter.

## LIMITATIONS

Limitations in available data influence the results. In-kind contributions by host governments may be provided (e.g., supervision or information, education, and communication material), but this is generally unknown and varies by government and spray campaign; therefore, they have not been included in this report.

Comparing unit costs across countries poses limitations in conclusive results as well. It is important to note that variations between countries, unrelated to the IRS program structure or implementation, can account for differences in cost. Country differences include geography and breadth of spray coverage areas, average size of structures, and number malaria transmission seasons. In addition, differences in country input prices may cause variations in unit costs that are not attributable to program efficiency.

As in past reports, we use the area sprayed as the unit for comparing costs across countries. This unit allows for a standardized metric to compare the relative efficiency of country programs that is not influenced by differences in the size of structures or the number of people per structure across countries. However, the true area sprayed is not measured routinely in PMI AIRS country programs. Rather, we estimate the area sprayed based on the amount of insecticide used. Thus, there still remains the possibility for differences in the efficiency of insecticide use between countries (due to differing spray equipment, etc.) that affect the comparisons. Further, the efficacy of use may change over time; for example, there may be higher efficiency in terms of flow rate when spray pumps are equipped with a control flow valve (CFV), such as those that come standard on Goizper pumps. Thus, some degree of inaccuracy in the comparisons is possible, and should be kept in mind when reading the results.

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<sup>5</sup> Available at <http://www.pmi.gov/docs/default-source/default-document-library/implementing-partner-reports/africa-indoor-residual-spraying-project-pmi-irs-country-programs-2014-comparative-cost-analysis.pdf?sfvrsn=4>.