



U.S. PRESIDENT'S MALARIA INITIATIVE



PMI IRS COUNTRY PROGRAMS: 2018 COMPARATIVE COST ANALYSIS

Recommended Citation: Johns, Benjamin and Altea Cico Sitruk. May 2019. *PMI IRS Country Programs: 2018 Comparative Cost Analysis*. Rockville, MD. PMI VectorLink Project, Abt Associates Inc.

Contract: AID-OAA-I-17-00008

Task Order: AID-OAA-TO-17-00027

Submitted to: United States Agency for International Development/PMI



Abt Associates Inc. | 6130 Executive Boulevard
Rockville, Maryland 20852 | T. 301.347.5000 | F. 301.913.9061
www.abtassociates.com

PMI IRS COUNTRY PROGRAMS: 2018 COMPARATIVE COST ANALYSIS

CONTENTS

Contents	v
Acronyms	xi
Executive Summary	xiii
1. Introduction	1
2. Cross-Country Results	3
2.1 Background.....	3
2.2 Total Program Expenditures	3
2.3 Unit Cost Analysis.....	4
2.4 Cost Drivers.....	5
3. NgenIRS	9
4. Year-on-Year Comparison	13
5. Benin	15
5.1 Background.....	15
5.2 Program Expenditures.....	15
5.3 Unit Cost Analysis.....	16
5.4 Comparison between the Last Two Years	16
6. Burkina Faso	18
6.1 Background.....	18
6.2 Program Expenditures.....	18
6.3 Unit Cost Analysis.....	19
7. Ethiopia	21
7.1 Background.....	21
7.2 Program Expenditures.....	21
7.3 Unit Cost Analysis.....	22
7.4 Comparison between the Last Two Years	22
8. Ghana	25
8.1 Background.....	25
8.2 Program Expenditures.....	25
8.3 Unit Cost Analysis.....	26
8.4 Comparison between the Last Two Years	26
9. Kenya	29

9.1 Background.....	29
9.2 Program Expenditures.....	29
9.3 Unit Cost Analysis.....	30
9.4 Comparison between the Last Two Years	30
10. Madagascar	33
10.1 Background	33
10.2 Program Expenditures.....	33
10.3 Unit Cost Analysis.....	34
10.4 Comparison between the Last Two Years	34
11. Malawi	37
11.1 Background	37
11.2 Program Expenditures.....	37
11.3 Unit Cost Analysis.....	38
12. Mali	39
12.1 Background	39
12.2 Program Expenditures.....	39
12.3 Unit Cost Analysis.....	40
12.4 Comparison between the Last Two Years	40
13. Mozambique	43
13.1 Background	43
13.2 Program Expenditures.....	43
13.3 Unit Cost Analysis.....	44
13.4 Comparison between the Last Two Years	44
14. Rwanda.....	47
14.1 Background	47
14.2 Program Expenditures.....	47
14.3 Unit Cost Analysis.....	48
14.4 Comparison between the Last Two Years	48
15. Tanzania.....	51
15.1 Background	51
15.2 Program Expenditures.....	51
15.3 Unit Cost Analysis.....	52
15.4 Comparison between the Last Two Years	53
16. Uganda	55
16.1 Background	55
16.2 Program Expenditures.....	55
16.3 Unit Cost Analysis.....	56
17. Zambia	57

17.1 Background	57
17.2 Program Expenditures	57
17.3 Unit Cost Analysis	58
17.4 Comparison between the Last Two Years	58
18. Zimbabwe	61
18.1 Background	61
18.2 Program Expenditures	61
18.3 Unit Cost Analysis	62
18.4 Comparison between the Last Two Years	62
References	65
Annex A: Year-on-Year Comparison of Output Measures	66
Annex B: Year-on-Year Comparison of Unit Costs	68
Annex C: Methodology	71

LIST OF TABLES

Table CC1: PMI VectorLink Project Spray Coverage in 2018, by Country	3
Table CC2: 2018 IRS Program Unit Costs	5
Table CC3: Breakdown of Fixed and Variable Costs, as Percentage of Unit Cost per Area Sprayed	6
Table CC4: Seasonal SOPs and Campaign Days	7
Table NG1: Effects of NgenIRS on Program Scale	10
Table YR1: Year-on-Year Comparison of Output Measures	13
Table YR2: Year-on-Year Comparison of Unit Costs	14
Table BN1: Benin Quick Facts	15
Table BN2: Benin IRS Program Capital and Recurrent Expenditures, by Activity and Cost Category	16
Table BN3: Benin Unit Costs	16
Table BN4: Benin IRS Program Comparison of Expenditures	16
Table BN5: Benin IRS Program Comparison of Output Measures and Unit Costs	17
Table BF1: Burkina Faso Quick Facts	18
Table BF2: Burkina Faso IRS Program Capital and Recurrent Expenditures, by Activity and Cost Category	19
Table BF3: Burkina Faso Unit Costs	19
Table ET1: Ethiopia Quick Facts	21
Table ET2: Ethiopia IRS Program Capital and Recurrent Expenditures, by Activity and Cost Category	22
Table ET3: Ethiopia Unit Costs	22
Table ET4: Ethiopia IRS Program Comparison of Expenditures	23
Table ET5: Ethiopia IRS Program Comparison of Output Measures and Unit Costs	23
Table GH1: Ghana Quick Facts	25

Table GH2: Ghana IRS Program Capital and Recurrent Expenditures, by Activity and Cost	
Category	26
Table GH3: Ghana Unit Costs.....	26
Table GH4: Ghana IRS Program Comparison of Expenditures.....	27
Table GH5: Ghana IRS Program Comparison of Output Measures and Unit Costs	28
Table KN1: Kenya Quick Facts	29
Table KN2: Kenya IRS Program Capital and Recurrent Expenditures, by Activity and Cost	
Category	30
Table KN3: Kenya Unit Costs.....	30
Table KN4: Kenya IRS Program Comparison of Expenditures.....	31
Table KN5: Kenya IRS Program Comparison of Output Measures and Unit Costs.....	31
Table MG1: Madagascar Quick Facts.....	33
Table MG2: Madagascar IRS Program Capital and Recurrent Expenditures, by Activity and	
Cost Category	34
Table MG3: Madagascar Unit Costs	34
Table MG4: Madagascar IRS Program Comparison of Expenditures	35
Table MG5: Madagascar IRS Program Comparison of Output Measures and Unit Costs	35
Table MW1: Malawi Quick Facts	37
Table MW2: Malawi IRS Program Capital and Recurrent Expenditures, by Activity and Cost	
Category	38
Table MW3: Malawi Unit Costs.....	38
Table ML1: Mali Quick Facts	39
Table ML2: Mali IRS Program Capital and Recurrent Expenditures, by Activity and Cost	
Category	40
Table ML3: Mali Unit Costs.....	40
Table ML4: Mali IRS Program Comparison of Expenditures.....	41
Table ML5: Mali IRS Program Comparison of Output Measures and Unit Costs.....	41
Table MZ1: Mozambique Quick Facts	43
Table MZ2: Mozambique IRS Program Capital and Recurrent Expenditures, by Activity and	
Cost Category	44
Table MZ3: Mozambique Unit Costs.....	44
Table MZ4: Mozambique IRS Program Comparison of Expenditures.....	45
Table MZ5: Mozambique IRS Program Comparison of Output Measures and Unit Costs.....	45
Table RW1: Rwanda Quick Facts.....	47
Table RW2: Rwanda IRS Program Capital and Recurrent Expenditures, by Activity and Cost	
Category	48
Table RW3: Rwanda Unit Costs	48
Table RW4: Rwanda IRS Program Comparison of Expenditures	49
Table RW5: Rwanda IRS Program Comparison of Output Measures and Unit Costs	49
Table TZ1: Tanzania Quick Facts.....	51
Table TZ2: Tanzania IRS Program Capital and Recurrent Expenditures, by Activity and Cost	
Category	52
Table TZ3: Tanzania Unit Costs	52
Table TZ4: Tanzania IRS Program Comparison of Expenditures	53

Table TZ5: Tanzania IRS Program Comparison of Output Measures and Unit Costs.....	54
Table UG1: Uganda Quick Facts.....	55
Table UG2: Uganda IRS Program Capital and Recurrent Expenditures, by Activity and Cost Category	56
Table UG3: Uganda Unit Costs	56
Table ZA1: Zambia Quick Facts	57
Table ZA2: Zambia IRS Program Capital and Recurrent Expenditures, by Activity and Cost Category	58
Table ZA3: Zambia Unit Costs.....	58
Table ZA4: Zambia IRS Program Comparison of Expenditures.....	59
Table ZA5: Zambia IRS Program Comparison of Output Measures and Unit Costs.....	60
Table ZW1: Zimbabwe Quick Facts	61
Table ZW2: Zimbabwe IRS Program Capital and Recurrent Expenditures, by Activity and Cost Category	62
Table ZW3: Zimbabwe Unit Costs.....	62
Table ZW4: Zimbabwe IRS Program Comparison of Expenditures.....	63
Table ZW5: Zimbabwe IRS Program Comparison of Output Measures and Unit Costs.....	63

LIST OF FIGURES

Figure ES1: Cost per 100m ² Sprayed 2012 through 2018	xv
Figure CC1: Capital and Recurrent Expenditures, by Cost Category	4

ACRONYMS

AIRS	Africa Indoor Residual Spraying
EC	Environmental Compliance
IEC	Information, Education and Communication
IRS	Indoor Residual Spraying
IT	Information Technology
M&E	Monitoring and Evaluation
NgenIRS	Next Generation IRS
NMCP	National Malaria Control Program
OP	Organophosphate
PMI	U.S. President's Malaria Initiative
SOP	Spray Operator
STTA	Short-term Technical Assistance
USAID	United States Agency for International Development
WHO	World Health Organization

EXECUTIVE SUMMARY

The U.S. 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 to 2014, the PMI AIRS Project, implemented from 2014 to 2018, and the PMI VectorLink Project, to be implemented from 2017 to 2022, together constitute PMI's pan-African IRS program. This report presents the cost analysis of the expenses incurred during 2018 and compares these costs to IRS costs from 2012, 2013, 2014, 2015, 2016, and 2017.

The aim of the analysis is to:

1. Evaluate the overall level of IRS spending in each of the PMI VectorLink 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 m²);
3. Provide cost comparisons for overall annual expenditure trends within countries over the last seven years of PMI supported IRS.

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 2018

Project output data (see Table CCI in the main report), were collected and verified by PMI VectorLink monitoring and evaluation (M&E) staff for the 14 countries with PMI-funded IRS campaigns that were implemented through the PMI VectorLink Project in 2018. In 2018, the PMI VectorLink Project included three countries (Burkina Faso, Malawi, and Uganda) that were not sprayed under the auspices of the project in 2017. Additionally, 2018 saw for the first time large scale use of SumiShield 50WG, a new neonicotinoid insecticide which was listed by the World Health Organization Prequalification Team in 2017, in seven countries. In total, over 22 million people were protected, ranging from approximately 276,343 people in Zimbabwe to over 4 million people in Uganda. This corresponds to a total of about 6.0 million structures sprayed, ranging from 112,264 structures in Malawi to 1,292,309 structures in Uganda, a total of over 500 million square meters of structures sprayed, and a total of over 2.0 million units of insecticide used.

The average structure size varied widely across countries, ranging from 39.2 square meters (m²) in Benin to 190.4 m² in Rwanda. The average people per structure sprayed ranged from 2.4 people in Zimbabwe to 4.9 people in Zambia.

Table CC2 presents the results of the unit cost analysis. The overall unweighted average cost per person protected is \$5.85. The unweighted average cost per structure sprayed across countries is \$20.83. The unweighted average cost per 100 m² sprayed is \$25.53.

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 (Abbott and Johns 2014). The three largest cost categories were spray operations (34.8 percent of all costs), insecticide (32.7 percent of all costs), and local labor (16.3 percent of all costs),

constituting an average of 83.8 percent of all costs. The lowest cost categories were U.S. labor and short term technical assistance (STTA) (4.9 percent of all costs), non-insecticide commodities (4.4 percent of all costs) and local administration (6.8 percent of all costs).

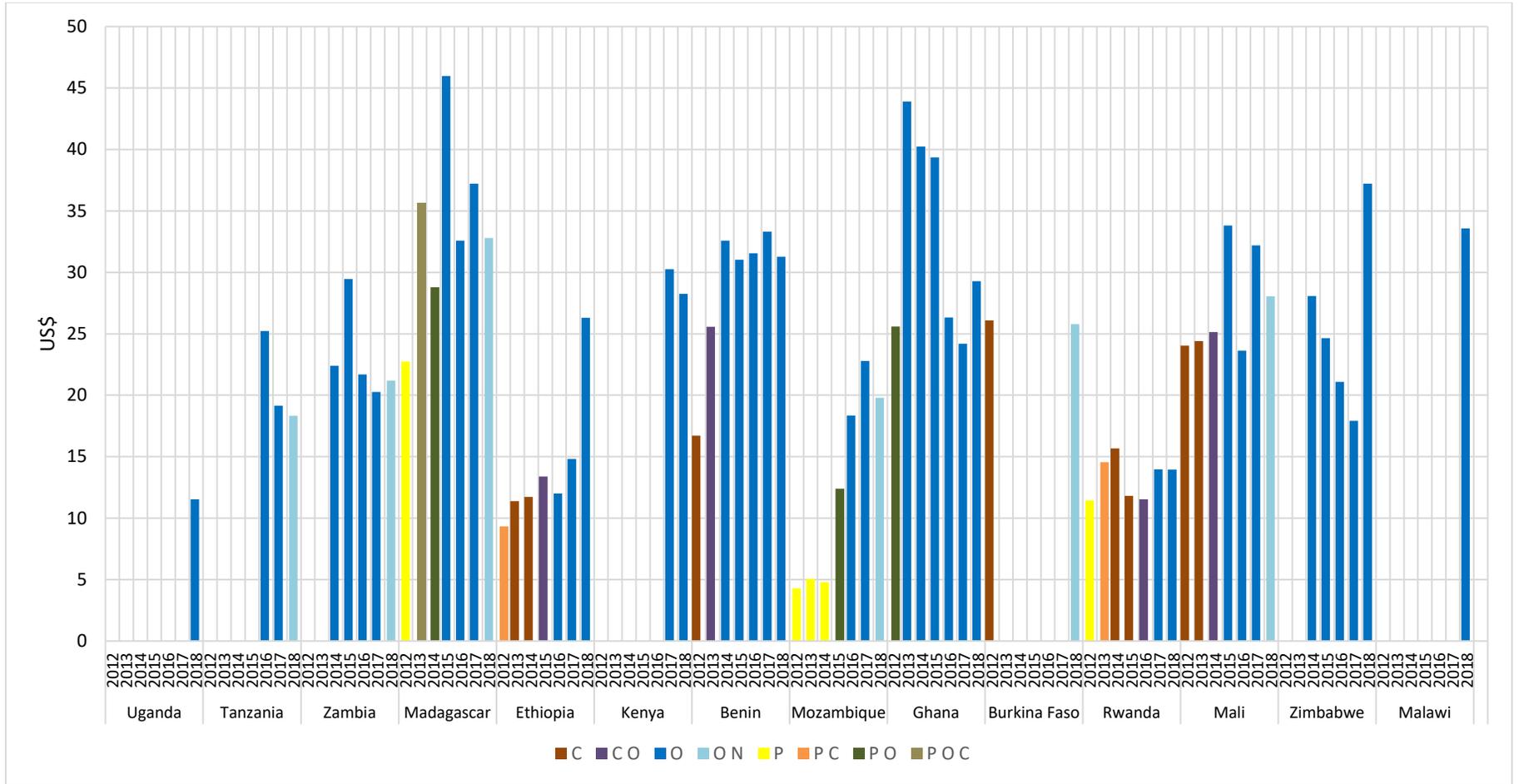
Next Generation IRS (NgenIRS) Project

Copayments from UNITAID's Next Generation IRS (NgenIRS) project kept the price of Actellic 300CS in all 14 countries at \$15 per bottle and SumiShield 50WG in six countries (Burkina Faso, Madagascar, Mali, Mozambique, Tanzania, and Zambia) at \$15 per sachet (5,000 vendor-donated SumiShield 50WG sachets were used in Ghana). 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 ESI shows the unit costs for the countries included in this analysis for the years 2012 through 2018, as well as the type of insecticide used. Countries are arranged in order of the number of structures sprayed during 2018 spray campaigns, from largest to smallest.

FIGURE ESI: COST PER 100M² SPRAYED 2012 THROUGH 2018



P: pyrethroid; C: carbamate; O: organophosphate; N: neonicotinoid

Country Chapters

This report includes a specific chapter for each IRS country program covered in the 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 an analysis of unit costs between 2017 and 2018.

CONCLUSIONS

Program Scale

Broadly speaking, we find, similar to previous years, that unit costs for larger 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 m² sprayed and in terms of total expenditures. The spray operations portion of the cost per area sprayed constitutes an average of 36.7 percent of the total unit cost across country programs.

I. INTRODUCTION

The U.S. President's Malaria Initiative (PMI) aims to reduce the incidence and prevalence of malaria. PMI has implemented indoor residual spraying (IRS) programs in collaboration with ministries of health and national malaria control programs (NMCPs) in sub-Saharan Africa since 2006. In April 2015, PMI's 2015-2020 strategy was released which outlined the following objectives: (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 to 2014, the PMI AIRS Project, implemented from 2014 to 2018, and the PMI VectorLink Project, to be implemented from 2017 to 2022, together constitute PMI's leading pan-African IRS program.

In 2018, the PMI VectorLink Project provided 14 PMI countries with full IRS operations and logistics support (Benin, Burkina Faso, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mozambique, Rwanda, Tanzania, Uganda, Zambia, and Zimbabwe).

The PMI VectorLink 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 of IRS campaigns, and materials used in the campaigns;
- Conducting monitoring and evaluation (M&E) of all program activities; and
- Completing entomological surveillance and testing insecticide effectiveness in 13 of the 14 spray countries (the exception being Benin, where entomological surveillance is conducted by the Center for Entomological Research of Cotonou (CREC) through a direct funding mechanism from PMI).

PMI asked 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, 2016, and 2017 findings by reporting on 2018 costs and comparing them with those of the previous years. Expenditures on long-lasting insecticide-treated nets are included descriptively in individual country chapters when appropriate, but, due to limited scope of activities, are not fully analyzed and are not included in costs related to IRS.

2. CROSS-COUNTRY RESULTS

2.1 BACKGROUND

2.1.1 OUTPUT MEASURES

Table CCI presents the coverage provided by the PMI VectorLink project's spray campaigns in each country. The area sprayed (number of 100 m² sprayed) was calculated by multiplying the total number of units of insecticide used by 250 m² (the estimate of coverage provided by each bottle or sachet) and dividing by 100 m² 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 m², and ranged from 2.2 in Rwanda to 10.1 in Madagascar.

TABLE CCI: PMI VECTORLINK PROJECT SPRAY COVERAGE IN 2018, BY COUNTRY

Country	# of People Protected	# of Structures Sprayed	Area Sprayed (100 m ²)	Avg. Size of Structure (m ²)	# People per Area Sprayed
Benin	1,321,758	400,997	157,103	39.2	8.4
Burkina Faso	766,374	258,766	133,813	51.7	5.7
Ethiopia	1,264,189	472,569	287,243	60.8	4.4
Ghana	836,376	298,701	163,860	54.9	5.1
Kenya	1,833,860	440,969	406,170	92.1	4.5
Madagascar	2,232,097	548,789	220,560	40.2	10.1
Malawi	501,324	112,264	119,358	106.3	4.2
Mali	665,581	160,723	192,463	119.7	3.5
Mozambique	1,663,078	387,413	462,068	119.3	3.6
Rwanda	894,098	214,802	408,878	190.4	2.2
Tanzania	2,840,927	744,597	587,325	78.9	4.8
Uganda	4,436,156	1,292,309	1,386,420	107.3	3.2
Zambia	2,818,176	579,490	369,958	63.8	7.6
Zimbabwe	276,343	112,805	105,675	93.7	2.6

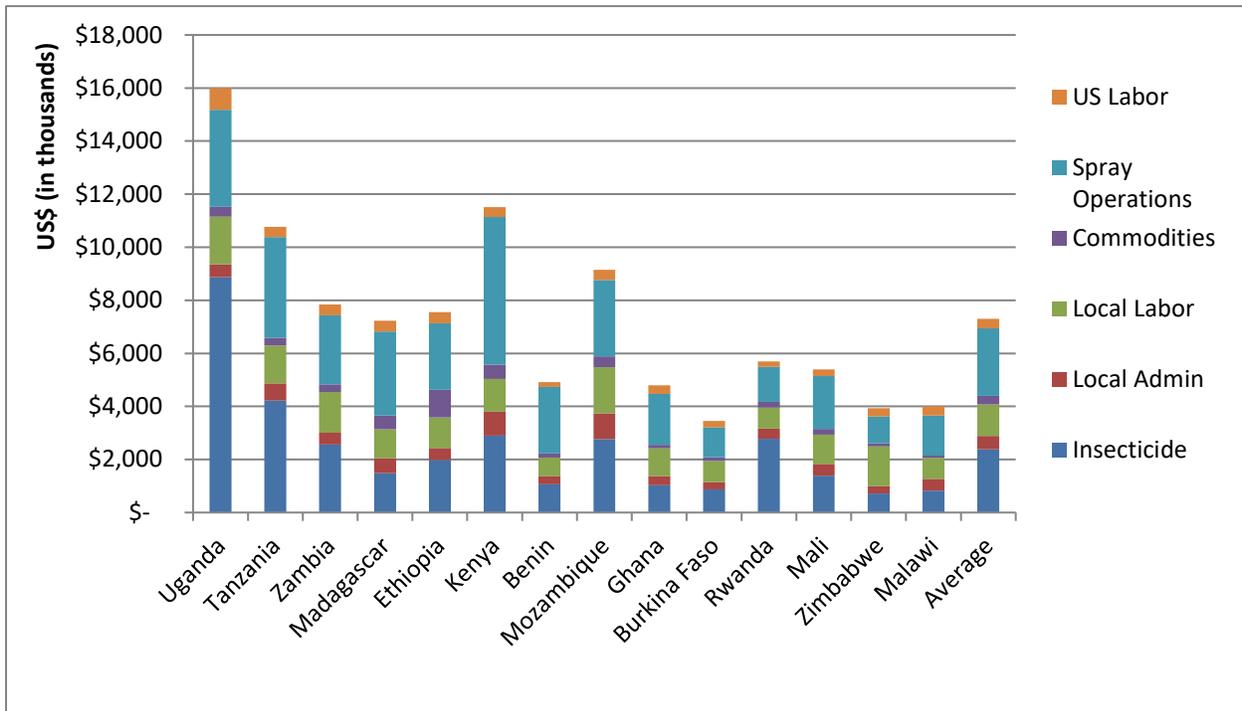
The average structure size and number of people per area sprayed both provide additional contextual understanding of a country program's spray campaign. Structure size varied widely between countries, ranging from 39.2 m² in Benin to 190.4 m² in Rwanda, more than four times as large as in Benin. The average size of structures sprayed across all 2018 countries was 87.0 m² (not weighting for the different number of structures sprayed between countries). On average each unit of insecticide covered about 3.5 structures.

2.2 TOTAL PROGRAM EXPENDITURES

This section presents the IRS country programs' total expenditures for 2018. Figure CCI 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 2018 spray campaigns, from largest to smallest.

FIGURE CCI: 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).

Certain IRS costs are fixed and fairly consistent across country programs regardless of the number of structures sprayed. This includes the U.S.-based labor and short-term technical assistance (STTA) cost category which remain consistent across all country programs at an annual average of about \$361,000. Another category is local administration (rent, utilities, TCN allowances) while more variable than the U.S.-based labor cost category, is also considered a fixed cost and averages about \$495,000 across countries. These fixed costs are discussed in more detail in the cost-drivers analysis section. An average of 84 percent of total project expenditures is spent directly on the variable costs of spray operations, insecticide, and local labor.

The average total program implementation expenditures across all programs are about \$7.3 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 m²). The unit costs, shown in Table CC2, are calculated using total program expenditures and the output measures provided in Table CCI (see preceding section).

TABLE CC2: 2018 IRS PROGRAM UNIT COSTS

Country	Cost per Person Protected	Cost per Structure Sprayed	Cost per Area Sprayed
Uganda	\$3.60	\$12.37	\$11.53
Tanzania	\$3.79	\$14.45	\$18.32
Zambia	\$2.78	\$13.53	\$21.20
Madagascar	\$3.24	\$13.18	\$32.80
Ethiopia	\$5.98	\$15.99	\$26.30
Kenya	\$6.28	\$26.11	\$28.35
Benin	\$3.72	\$12.25	\$31.27
Mozambique	\$5.50	\$23.61	\$19.80
Ghana	\$5.74	\$16.07	\$29.29
Burkina Faso	\$4.50	\$13.34	\$25.80
Rwanda	\$6.38	\$26.54	\$13.94
Mali	\$8.11	\$33.59	\$28.05
Zimbabwe	\$14.23	\$34.86	\$37.21
Malawi	\$7.99	\$35.69	\$33.57
Average (unweighted)	\$5.85	\$20.83	\$25.53

The average cost per structure sprayed across countries (not weighted by the number of structures sprayed in each country) was \$20.83. The cost per structure sprayed was generally lower for larger programs than for smaller ones.

2.4 COST DRIVERS

This section focuses on the country IRS programs' costs per area (100 m²) sprayed, in order to 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. The section will also continue to categorize countries by program size.

2.4.1 VARIABLE AND CAPITAL COSTS

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, variable costs (spray operations, insecticide, and local labor) constitute 86 percent of total costs across the countries, ranging from 77 percent of total costs in Ethiopia to 90 percent of costs in Uganda. Fixed costs (capital items, local administration, U.S. labor, and commodities) were then 14 percent of costs on average. Capital items constitute 4 percent of total costs.

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	
Uganda	2%	1%	5%	2%	10%	23%	55%	11%	90%	\$ 11.53
Tanzania	5%	3%	2%	1%	11%	36%	40%	14%	89%	\$ 17.96
Zambia	5%	3%	1%	2%	11%	34%	34%	20%	89%	\$ 20.40
Madagascar	7%	7%	1%	2%	17%	46%	22%	16%	83%	\$ 31.22
Ethiopia	6%	8%	1%	7%	23%	34%	27%	16%	77%	\$ 25.17
Kenya	7%	1%	1%	4%	14%	49%	26%	11%	86%	\$ 27.69
Benin	5%	5%	0%	0%	11%	52%	22%	15%	89%	\$ 30.26
Mozambique	9%	5%	1%	2%	18%	32%	31%	20%	82%	\$ 19.25
Ghana	7%	4%	1%	1%	13%	42%	23%	23%	87%	\$ 27.53
Burkina Faso	8%	2%	1%	3%	14%	35%	27%	24%	86%	\$ 24.20
Rwanda	5%	6%	1%	1%	13%	23%	50%	14%	87%	\$ 13.59
Mali	7%	6%	1%	1%	14%	38%	27%	21%	86%	\$ 26.92
Zimbabwe	7%	4%	1%	0%	12%	27%	20%	41%	88%	\$ 34.50
Malawi	10%	3%	1%	1%	15%	41%	22%	21%	85%	\$ 30.85
Average	7%	4%	1%	2%	14%	38%	28%	20%	86%	\$ 24.36

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

2.4.2 SPRAY OPERATIONS: PROGRAM SCALE

Table CC4 provides a detailed breakdown of the number of spray operators (SOPs) who worked in each country spray campaign, as well as the total and average numbers of SOP days, and the average daily wage. It also shows the total number of campaign days, the total amount of area sprayed (in terms of 100 m²), and the average amount of area sprayed per SOP day and per campaign day (both also in terms of 100 m²). 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, Uganda and Tanzania sprayed the most area among the countries, even though their SOPs sprayed a below-average area per day, whereas in Mozambique and Rwanda, with the third and fourth largest area sprayed, SOPs sprayed above the average area per day. Uganda, Ethiopia, Benin, and Madagascar had the lowest area sprayed per SOP per day; Benin, and Madagascar also had the smallest structure size on average. A possible explanation for differences in area sprayed per SOP per day is differences in the density of structures; however, data are not available to test this explanation. However, variation in the daily productivity of SOPs (along with the daily wages of SOPs) is a direct contributor to variation in the spray operations cost per area sprayed, and helps to explain differences in cost per area sprayed between countries.

TABLE CC4: SEASONAL 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 ²)	Area Sprayed/ SOP Day	Area Sprayed/ Campaign Day
Uganda	6,256	271,925	43	\$3.25	74*	1,386,420	5.1	55,457
Tanzania	3,191	76,581	24	\$9.20	68*	587,325	7.7	8,637
Zambia	1,286	38,580	30	\$4.58 ⁺	30	369,958	9.6	12,332
Madagascar	1,934	46,416	24	\$5.50	24	220,560	4.8	9,190
Ethiopia	1,378	82,680	60	\$7.00	60	287,243	3.5	4,787
Kenya	1,696	61,056	36	\$6.83	36	406,170	6.7	11,283
Benin	1,583	33,243	21	\$7.00	21	157,103	4.7	7,481
Mozambique	1,120	39,200	35	\$2.81	35	462,068	11.8	13,202
Ghana	602	18,146	30	\$7.44	31	163,860	9.0	5,286
Burkina Faso	749	22,470	30	\$6.34	30	133,813	6.0	4,460
Rwanda	1,710	34,200	20	\$7.00	20	408,878	12.0	20,444
Mali	626	21,284	34	\$5.36	34	192,463	9.0	5,661
Zimbabwe	224	8,288	37	\$15.00	37	105,675	12.8	2,856
Malawi	396	12,672	32	\$5.60	32	119,358	9.4	3,730
Average	1,625	54,767	33	\$6.64	38	357,206	8.0	11,772

*The campaign was split into different times and in different geographic locations, so SOPs were recruited separate in different locations; thus, the average number of days per SOP is less than the total number of campaign days because most / all of the SOPs did not work the full campaign.

⁺SOPs are not paid; figure represents allowance given to SOPs for meals.

3. NGENIRS

In 2018, the VectorLink 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, PATH/Malaria Control and Elimination Partnership in Africa, and 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 NgenIRS project, all PMI VectorLink Project countries were able to procure Actellic 300CS insecticide at a price of \$15.00 per bottle instead of the market price of \$23.50 per bottle in 2018. Further six countries (Burkina Faso, Madagascar, Mali, Mozambique, Tanzania, and Zambia) benefited from co-payments for SumiShield 50WG insecticide, at a price of \$15.00 per sachet, and vendor-donated SumiShield 50WG was used in Ghana. However, all the countries assessed with data for 2017 and 2018 had an NgenIRS subsidy in 2017, so the year-on-year impact of the subsidy is not readily tractable. Insecticide usage and costs for the two years are depicted in Table NG1.

TABLE NGI: EFFECTS OF NGENIRS ON PROGRAM SCALE

Countries Receiving NgenIRS Copayment*	Number of Insecticide Units Used			Total Cost of Insecticide (to the PMI VectorLink project)			Number of Structures Sprayed			Number of People Protected			Insecticide Cost per Structure Sprayed			Comments
	2017	2018	2018 – 2017	2017	2018	2018 – 2017	2017	2018	2018 – 2017	2017	2018	2018 – 2017	2017	2018	2018 – 2017	
Benin	58,765	62,841	4,076	1,017,823	1,060,118	42,295	384,761	400,997	16,236	1,227,536	1,321,758	94,222	\$2.65	\$2.64	(0.00)	
Burkina Faso		53,525			872,354			258,766			766,374			\$3.37		Mix of Actellic 800CS and SumiShield 50WG
Ethiopia	250,918	114,897	(136,021)	4,339,305	1,975,237	(2,364,068)	738,810	472,569	(266,241)	1,877,154	1,264,189	(612,965)	\$5.87	\$4.18	(1.69)	
Ghana	65,895	65,544	(351)	1,145,787	1,028,897	(116,891)	302,648	298,701	(3,947)	840,438	836,376	(4,062)	\$3.79	\$3.44	(0.34)	VectorLink purchased Actellic 300CS; Vendor donated SumiShield 50WG
Kenya	70,553	162,468	91,915	1,206,372	2,899,824	1,693,452	212,029	440,969	228,940	906,388	1,833,860	927,472	\$5.69	\$6.58	0.89	
Madagascar	75,944	88,224	12,280	1,314,331	1,481,633	167,303	487,636	548,789	61,153	2,008,963	2,232,097	223,134	\$2.70	\$2.70	0.00	Mix of Actellic 800CS and SumiShield 50WG
Malawi		47,743			824,537			112,264			501,324			\$7.34		
Mali	80,269	76,985	(3,284)	1,468,859	1,388,739	(80,120)	227,646	160,723	(66,923)	823,201	665,581	(157,620)	\$6.45	\$8.64	2.19	Mix of Actellic 800CS and SumiShield 50WG
Mozambique	205,223	184,827	(20,396)	3,078,345	2,772,405	(305,940)	381,463	387,413	5,950	1,711,518	1,663,078	(48,440)	\$8.07	\$7.16	(0.91)	Insecticide procured by NMCP with subsidies. Mix of Actellic 800CS and SumiShield 50WG.
Rwanda	182,408	163,551	(18,857)	3,191,487	2,781,842	(409,645)	231,258	214,802	(16,456)	919,735	894,098	(25,637)	\$13.80	\$12.95	(0.85)	
Tanzania	211,118	234,930	23,812	3,742,699	4,222,167	479,468	664,622	744,597	79,975	2,568,522	2,840,927	272,405	\$5.63	\$5.67	0.04	Global Fund procured insecticide for Zanzibar. Mix of Actellic 800CS and

Countries Receiving NgenIRS Copayment*	Number of Insecticide Units Used			Total Cost of Insecticide (to the PMI VectorLink project)			Number of Structures Sprayed			Number of People Protected			Insecticide Cost per Structure Sprayed			Comments
	2017	2018	2018 – 2017	2017	2018	2018 – 2017	2017	2018	2018 – 2017	2017	2018	2018 – 2017	2017	2018	2018 – 2017	
																SumiShield 50WG.
Uganda		554,568			8,871,598			1,292,309			4,436,156			\$6.86		
Zambia	168,771	147,983	(20,788)	2,970,959	2,561,377	(409,582)	634,371	579,490	(54,881)	3,005,676	2,818,176	(187,500)	\$4.68	\$4.42	(0.26)	Mix of Actellic 800CS and SumiShield 50WG
Zimbabwe	99,148	42,270	(56,878)	1,747,064	719,396	(1,027,667)	209,055	112,805	(96,250)	517,374	276,343	(241,031)	\$8.36	\$6.38	(1.98)	

*All countries benefited from the NgenIRS co-payment in both 2017 (if there was spraying under PMI AIRS) and 2018.

4. YEAR-ON-YEAR COMPARISON

This section provides an overview of the major changes in countries' IRS programs across the years, focusing on changes from 2017 to 2018.

Table YR1 provides details on the changes in output measures for all country programs between 2017 and 2018. A complete table of output measures for all country programs for the period 2012-2018 is included in Annex A. Table YR2 shows the changes in unit costs between 2017 and 2018. A complete table of unit costs for all country programs for the period 2012-2018 is included in Annex B. For more information, a comprehensive discussion of the changes in each country program is provided at the end of each individual country chapter (if applicable for that country).

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

Country	People Protected			Structures Sprayed			Area Sprayed (100 m ²)		
	2017	2018	Percent Change 2017-2018	2017	2018	Percent Change 2017-2018	2017	2018	Percent Change 2017-2018
Uganda	NA	4,436,156	NA	NA	1,292,309	NA	NA	1,386,420	NA
Tanzania	2,568,522	2,840,927	11%	664,622	744,597	12%	549,095	587,325	7%
Zambia	3,005,676	2,818,176	-6%	634,371	579,490	-9%	421,928	369,958	-12%
Madagascar	2,008,963	2,232,097	11%	487,636	548,789	13%	189,860	220,560	16%
Ethiopia	1,877,154	1,264,189	-33%	738,810	472,569	-36%	627,295	287,243	-54%
Kenya	906,388	1,833,860	102%	212,029	440,969	108%	176,383	406,170	130%
Benin	1,227,536	1,321,758	8%	384,761	400,997	4%	146,913	157,103	7%
Mozambique	1,711,518	1,663,078	-3%	381,463	387,413	2%	513,058	462,068	-10%
Ghana	840,438	836,376	0%	302,648	298,701	-1%	164,738	163,860	-1%
Burkina Faso	NA	766,374	NA	NA	258,766	NA	NA	133,813	NA
Rwanda	919,735	894,098	-3%	231,258	214,802	-7%	456,020	408,878	-10%
Mali	823,201	665,581	-19%	227,646	160,723	-29%	200,673	192,463	-4%
Zimbabwe	517,374	276,343	-47%	209,055	112,805	-46%	247,870	105,675	-57%
Malawi	NA	501,324	NA	NA	112,264	NA	NA	119,358	NA
Average	1,171,893	1,596,453	36%	319,593	430,371	35%	263,845	357,206	35%

NA: Data are not available

As Table YR1 shows, four countries, Tanzania, Madagascar, Kenya, and Benin, increased the number of people protected, and they, along with Mozambique, also increased the number of structures sprayed from 2017 to 2018. Tanzania, Madagascar, Kenya, and Benin also used more units of insecticide (the basis for calculating the area sprayed) between 2017 and 2018.

Unit costs decreased from 2017 to 2018 in Tanzania, Madagascar, Benin, and Mozambique (Table YR2). Unit costs increased in Ethiopia, Ghana, Rwanda, and Zimbabwe, and were mixed in Zambia, Kenya, and Mali.

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

Country	People Protected			Structures Sprayed			Area Sprayed (100 m ²)		
	2017	2018	Percent Change 2017-2018	2017	2018	Percent Change 2017-2018	2017	2018	Percent Change 2017-2018
Uganda	NA	\$3.60	NA	NA	\$12.37	NA	NA	\$11.53	NA
Tanzania	\$4.09	\$3.79	-7%	\$15.82	\$14.45	-9%	\$19.15	\$18.32	-4%
Zambia	\$2.84	\$2.78	-2%	\$13.48	\$13.53	0%	\$20.26	\$21.20	5%
Madagascar	\$3.52	\$3.24	-8%	\$14.49	\$13.18	-9%	\$37.23	\$32.80	-12%
Ethiopia	\$4.95	\$5.98	21%	\$12.59	\$15.99	27%	\$14.82	\$26.30	77%
Kenya	\$5.89	\$6.28	7%	\$25.18	\$26.11	4%	\$30.26	\$28.35	-6%
Benin	\$3.99	\$3.72	-7%	\$12.72	\$12.25	-4%	\$33.32	\$31.27	-6%
Mozambique	\$6.83	\$5.50	-19%	\$30.64	\$23.61	-23%	\$22.78	\$19.80	-13%
Ghana	\$4.74	\$5.74	21%	\$13.16	\$16.07	22%	\$24.19	\$29.29	21%
Burkina Faso	NA	\$4.50	NA	NA	\$13.34	NA	NA	\$25.80	NA
Rwanda	\$6.93	\$6.38	-8%	\$27.54	\$26.54	-4%	\$13.97	\$13.94	-0.2%
Mali	\$7.85	\$8.11	3%	\$28.38	\$33.59	18%	\$32.20	\$28.05	-13%
Zimbabwe	\$8.59	\$14.23	66%	\$21.26	\$34.86	64%	\$17.93	\$37.21	108%
Malawi	NA	\$7.99	NA	NA	\$35.69	NA	NA	\$33.57	NA
Average	\$5.47	\$5.85	7%	\$19.57	\$20.83	6%	\$24.19	\$25.53	6%

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

	2018
Program Dates	Jan 1, 2018– Dec 31, 2018
Number of Districts	8
# Local Staff	15
Spray Start Date	Apr 30, 2018 in Zone 1 May 10, 2018 in Zone 2
Insecticides Used	Organophosphates
# Units of Insecticide Used	62,841
# People Protected	1,321,758
# Structures Sprayed	400,997
# 100 Square Meters Sprayed*	157,103

* Reverse calculation using number of insecticide units used during campaign multiplied by the average of 250 m² estimated to be sprayed by one unit and divided by the number of structures sprayed.

5.2 PROGRAM EXPENDITURES

This section will present an overview of Benin IRS program expenditures in 2018. Costs are organized by activity and cost category.

Table BN2 displays the Benin IRS program total capital and recurrent expenditures from 2018. The first column lists the program activities as tracked by the PMI VectorLink Project's financial systems, and the top row lists IRS program cost categories.

The spray campaign is the most expensive IRS activity (29.7 percent of expenditures), followed by insecticide (21.6 percent of expenditures), and spray planning (20.6 percent of expenditures). PMI VectorLink Benin procured 37,908 units of insecticide, and used 62,841 (the cost of insecticide used is reflected in Table BN2). About 66.1 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 (78 percent of U.S. 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.

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		300,953	491,856			96,107	\$888,915	18.1%
Entomology					53,195	671	\$53,866	1.1%
Environmental Compliance			23,211		42,765	15,487	\$81,464	1.7%
Equipment Supplies			3,439	162,662		728	\$166,829	3.4%
IEC							\$0	0.0%
Insecticide	1,060,118						\$1,060,118	21.6%
M&E			44,387		55,818	42,464	\$142,668	2.9%
Post Spray			33,915		11,543	5,861	\$51,319	1.0%
Spray Campaign			24,973		1,428,770	3,363	\$1,457,106	29.7%
Spray Planning			84,082		912,642	13,196	\$1,009,920	20.6%
Grand Total	\$1,060,118	\$300,953	\$705,863	\$162,662	\$2,504,732	\$177,877	\$4,912,205	100.0%

Note: IEC: information, education and communication

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 m²).

TABLE BN3: BENIN UNIT COSTS

	Unit Cost
Cost per Person protected	\$ 3.72
Cost per Structure sprayed	\$ 12.25
Cost per 100 m ² sprayed	\$ 31.27

5.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the PMI VectorLink Benin IRS program between 2017 and 2018, as implemented by the PMI VectorLink Project. The comparison focuses on output measures, total expenditures, and unit costs.

Table BN4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost increased by 0.4 percent from 2017 to 2018, reflecting the increase in the number of people protected and structures sprayed. Commodities accounted for the largest increase in costs in relative terms (29 percent or about \$37,015) to account for replacement of damaged/worn-out materials. Insecticide costs increased by 4 percent (roughly \$42,300).

TABLE BN4: BENIN IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2017 (Adjusted)	2018	Percentage Change 2017-2018
Insecticide (used)	\$1,017,823	\$1,060,118	4%
Local Admin	\$293,845	\$300,953	2%
Local Labor	\$662,330	\$705,863	7%
Spray Operations	\$2,601,178	\$2,504,732	-4%
Commodities	\$125,647	\$162,662	29%
U.S. Labor	\$194,077	\$177,877	-8%
TOTAL	\$4,894,901	\$4,912,205	0.4%

Table BN5 compares the year-on-year change in Benin IRS program output measures and unit costs. Overall, in 2018, the program protected more people, sprayed more structures and more area than in 2017.

Because the number of people protected increased by 7.7 percent from 2017 to 2018, but total costs increased by only 0.4 percent, the cost per person protected decreased from \$3.99 to \$3.72 (6.8 percent) across the two years. The smaller increase in total costs from 2017 to 2018 compared to the increase in the number of structures sprayed also resulted in lower costs per structure sprayed in 2018 than in 2017. The increase in the area sprayed and the relatively smaller increase in total costs also resulted in a lower cost per area sprayed in 2018 than in 2017.

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

	2017	2018	Percentage Change 2017-2018
Output Measures			
People Protected	1,227,536	1,321,758	7.7%
Structures Sprayed	384,761	400,997	4.2%
Area Sprayed (100 m ²)	146,913	157,103	6.9%
Unit Costs			
Per Person Protected	\$3.99	\$3.72	-6.8%
Per Structure Sprayed	\$12.72	\$12.25	-3.7%
Per Area Sprayed	\$33.32	\$31.27	-6.2%

6. BURKINA FASO

6.1 BACKGROUND

TABLE BF1: BURKINA FASO QUICK FACTS

	2018
Program Dates	Jan 1, 2018–Dec 31, 2018
Number of Districts	3
# Local Staff	12
Spray Start Date	Jun 5, 2018
Insecticides Used	Organophosphates Neonicotinoids
# Units of Insecticide Used	29,098 OP 24,427 N
# People Protected	766,374
# Structures Sprayed	258,766
# 100 Square Meters Sprayed*	133,813

* Reverse calculation using number of insecticide units used during campaign multiplied by the average of 250 m² estimated to be sprayed by one unit and divided by the number of structures sprayed.

Note that 2018 was the first year of IRS implementation under the PMI VectorLink project, and thus a year-on-year comparison is not possible.

6.2 PROGRAM EXPENDITURES

This section presents an overview of Burkina Faso IRS program expenditures in 2018. Costs are organized by activity and cost category.

Table BF2 displays the Burkina Faso IRS program total capital and recurrent expenditures from 2018. The first column lists the program activities as tracked by the PMI VectorLink Project’s financial systems, and the top row lists IRS program cost categories.

Administration is the most expensive IRS activity (28.2 percent of expenditures), followed by insecticide (25.5 percent of expenditures) and the spray campaign (13.1 percent of expenditures). PMI VectorLink procured 44,462 bottles of organophosphate and 33,843 sachets of neonicotinoid insecticides, and used about 29,098 bottles of organophosphates and 24,427 sachets of neonicotinoids (costs reflect the insecticides used). About 71.6 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.

TABLE BF2: BURKINA FASO 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		276,439	558,300			138,445	\$973,184	28.2%
Entomology			10,610		231,297	16,270	\$258,177	7.5%
Environmental Compliance			45,041		27,324	34,356	\$106,721	3.1%
Equipment Supplies			16,169	148,884		130	\$165,182	4.8%
IEC			24,768		3,377	4,110	\$32,255	0.9%
Insecticide	872,354		9,165			64	\$881,583	25.5%
M&E			20,840		22,460	38,333	\$81,633	2.4%
Post Spray			16,897		50,417	243	\$67,558	2.0%
Spray Campaign			32,208		418,068	1,354	\$451,630	13.1%
Spray Planning			52,640		377,464	4,217	\$434,321	12.6%
Grand Total	\$872,354	\$276,439	\$786,639	\$148,884	\$1,130,407	\$237,523	\$3,452,245	100.0%

6.3 UNIT COST ANALYSIS

This section presents Burkina Faso IRS expenditures as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m²).

TABLE BF3: BURKINA FASO UNIT COSTS

	Unit Costs
Person protected	\$ 4.50
Cost per Structure sprayed	\$ 13.34
100 m ² sprayed	\$ 25.80

7. ETHIOPIA

7.1 BACKGROUND

TABLE ET1: ETHIOPIA QUICK FACTS

	2018
Program Dates	Jan 1, 2018–Dec 31, 2018
Number of Districts	44
# Local Staff	31
Spray Start Date	May 21, 2018
Insecticides Used	Organophosphates
# Units of Insecticide Used	114,897
# People Protected	1,264,189
# Structures Sprayed	472,569
# 100 Square Meters Sprayed*	287,243

* Reverse calculation using number of insecticide units used during campaign multiplied by the average of 250 m² estimated to be sprayed by one unit and divided by the number of structures sprayed.

7.2 PROGRAM EXPENDITURES

This section will present an overview of Ethiopia IRS program expenditures in 2018. Costs are organized by activity and cost category.

Table ET2 displays the Ethiopia IRS program total capital and recurrent expenditures from 2018. The first column lists the program activities as tracked by the PMI VectorLink Project's financial systems, and the top row lists IRS program cost categories.

Insecticides represented the majority of the total costs at 26.1 percent of costs. Spray campaign costs and administration were the next two largest categories of costs, representing 24.3 and 16.0 percent of costs, respectively. PMI VectorLink procured 141,412 bottles of organophosphate insecticides, and used 114,897 bottles. About 62 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.

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		454,911	604,930			148,709	\$1,208,550	16.0%
Entomology			116,016		260,398	108,691	\$485,105	6.4%
Environmental Compliance			75,397		45,929	24,553	\$145,880	1.9%
Equipment Supplies				1,045,424			\$1,045,424	13.8%
IEC							\$0	0.0%
Insecticide	1,975,237						\$1,975,237	26.1%
M&E			50,919		65,348	22,599	\$138,866	1.8%
Post Spray			22,504		44,320	1,905	\$68,729	0.9%
Spray Campaign			250,302		1,492,752	95,437	\$1,838,492	24.3%
Spray Planning			35,061		599,312	14,480	\$648,854	8.6%
Grand Total	\$1,975,237	\$454,911	\$1,155,130	\$1,045,424	\$2,508,060	\$416,374	\$7,555,136	100%

7.3 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 m²).

TABLE ET3: ETHIOPIA UNIT COSTS

	Unit Costs
Person protected	\$ 5.98
Cost per Structure sprayed	\$ 15.99
100 m ² sprayed	\$ 26.30

7.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Ethiopia IRS program between 2017 and 2018, as implemented by the PMI VectorLink project. The comparison focuses on output measures, total expenditures, and unit costs.

Table ET4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost decreased by 18.7 percent from 2017 to 2018, representing a decrease in the total annual cost of about \$1,743,157. The total decrease between 2017 and 2018 was entirely due to a decrease of \$2,364,068 (54.5 percent) in insecticide costs, reflecting the smaller scale of the program in 2018.

TABLE ET4: ETHIOPIA IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2017 (Adjusted)	2018	Percentage Change 2017-2018
Insecticide	4,339,305	1,975,237	-54.5%
Local Admin	379,856	454,911	19.8%
Local Labor	1,007,458	1,155,130	14.7%
Spray Operations	2,465,815	2,508,060	1.7%
Commodities	810,026	1,045,424	29.1%
U.S. Labor	295,833	416,374	40.7%
TOTAL	\$9,298,293	\$7,555,136	-18.7%

When the insecticide is excluded from the year-on-year comparison, costs were 12.5 percent greater in 2018 than in 2017. Costs in local admin, local labor and spray operations increased due to inflation and currency exchange rate fluctuations. Commodities costs increased by 29.1 percent (approximately \$235,400), while local administration, local labor, and U.S. labor costs increased by 19.8 percent (\$75,055), 14.7 percent (\$147,673), and 40.7 percent (\$120,540), respectively. These higher costs in 2018 are explained by the project needing to set up 34 new districts for IRS (soak pits, stores, tents, etc.), and increased STTA from the home office (four trips in 2018 compared with two trips in 2017) and increased home office support in all technical areas due to changes in the districts sprayed.

Table ET5 compares the year-on-year change in Ethiopia IRS program output measures and unit costs. In 2018, the program achieved lower coverage in terms of people protected and structures sprayed. Between 2017 and 2018, the number of people protected decreased 32.7 percent and the number of structures decreased 36.0 percent. Area sprayed decreased by 54.2 percent.

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

	2017	2018	Percentage Change 2017-2018
Output Measures			
People Protected	1,877,154	1,264,189	-32.7%
Structures Sprayed	738,810	472,569	-36.0%
Area Sprayed (100 m ²)	627,295	287,243	-54.2%
Unit Costs			
Per Person Protected	\$4.95	\$5.98	20.6%
Per Structure Sprayed	\$12.59	\$15.99	27.0%
Per Area Sprayed	\$14.82	\$26.30	77.4%

Unit costs were higher per person protected, structure sprayed, and area sprayed in 2018 than 2017. These increases are explained by the decrease in population density in the areas PMI instructed VectorLink to spray in 2018 (compared to 2017) and increased distances between target communities (resulting in more time spent traveling, fewer structures reach per SOP day), and the cost of setting up operations (soak pits, stores, etc.) in 34 new districts.

8. GHANA

8.1 BACKGROUND

TABLE GHI: GHANA QUICK FACTS

	2018
Program Dates	Jan 1, 2018– Dec 31, 2018
Number of Districts	7
# Local Staff	27
Spray Start Date	Apr 24, 2018
Insecticides Used	Organophosphates (6 districts) and neoniconoid (1 district)
# Units of Insecticide Used	65,544 (60,929 OP 4,615 N)
# People Protected	836,376
# Structures Sprayed	298,701
# 100 Square Meters Sprayed*	163,860

* Reverse calculation using number of insecticide units used during campaign multiplied by the average of 250 m² estimated to be sprayed by one unit and divided by the number of structures sprayed.

8.2 PROGRAM EXPENDITURES

This section will present an overview of Ghana IRS program expenditures in 2018. Costs are organized by activity and cost category.

Table GH2 displays the Ghana IRS program total capital and recurrent expenditures from 2018. The first column lists the program activities as tracked by the PMI VectorLink Project’s financial systems, and the top row lists IRS program cost categories.

Costs for insecticides, administration, and the spray campaign constitute over 66 percent of costs (21.4, 23.6 and 21.5 percent of total costs, respectively). PMI VectorLink procured 67,560 bottles of organophosphate insecticide and received a donation of 5,000 sachets of neonicotinoid insecticide and used 60,929 bottles and 4,615 sachets, respectively; the cost for insecticide used is included here. About 69 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.

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		353,957	612,178			168,596	\$1,134,731	23.6%
Entomology			152,314		460,439	34,168	\$646,921	13.5%
Environmental Compliance			45,718		34,575	12,750	\$93,043	1.9%
Equipment Supplies				118,577			\$118,577	2.5%
IEC			29,453		272,384	6,041	\$307,879	6.4%
Insecticide*	1,028,897						\$1,028,897	21.4%
M&E			45,230		67,178	54,691	\$167,099	3.5%
Post Spray			79,904		43,963	22,236	\$146,104	3.0%
Spray Campaign			35,405	7,707	982,935	3,858	\$1,029,904	21.5%
Spray Planning			40,768		56,363	29,000	\$126,131	2.6%
Grand Total	\$1,028,897	\$353,957	\$1,040,972	\$126,283	\$1,917,836	\$331,341	\$4,799,286	100.0%

*Includes estimated price of SumiShield 50WG donated by the vendor, at the NgenIRS subsidized rate. Since both OP bottles and SumiShield 50WG sachets have a subsidized cost of \$15, the cost for SumiShield 50WG was estimated using the cost for OP. Costs for insecticide used born by PMI were \$956,451.

8.3 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 m²).

TABLE GH3: GHANA UNIT COSTS

	Unit costs
Person protected	\$ 5.74
Cost per Structure sprayed	\$ 16.07
100 m ² sprayed	\$ 29.29

8.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Ghana IRS program between 2017 and 2018, as implemented by the PMI VectorLink Project. The comparison focuses on output measures, total expenditures, and unit costs. 2017 expenditures, excluding insecticides, have been adjusted to real 2018 U.S. dollars to allow for a more accurate comparison.

Table GH4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost increased by over 20 percent from 2017 to 2018, representing an increase in the total annual cost of about \$815,006. Costs decreased for (1) insecticide by over \$116,800, and (2) U.S. labor by over \$50,000. Cost increased for the same period for local administration (55.2 percent increase of over \$125,000), local labor (56.6 percent increase of over \$376,000), spray operations (28.8 percent increase of almost \$429,000), and commodities (67.9 percent increase of over \$51,000). The increased costs largely reflect (1) salaries and allowance for expatriate and third-country nationals staff with change in staff from AIRS to VectorLink, (2) motorcycles, replacement IT equipment, and permanent IRS household number plates purchases, (3) leadership training and VectorLink boot camp (4) new subcontractors under VectorLink, BAO Systems for VectorLink Collect implementation and Digital Globe for mapping (5) increased number of sentinel sites from 15 to 20 and associated costs, (6) increased number of days for some trainings e.g., spray training of trainers and SOP training increased from 5 to 7 days and 170 more seasonal staff hired in 2018, and (f) more radio announcements and programming and IRS IEC materials for distribution.

TABLE GH4: GHANA IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2017 (Adjusted)	2018	Percentage Change 2017-2018
Insecticide	\$1,145,787	\$1,028,897	-10.2%
Local Admin	\$228,054	\$353,957	55.2%
Local Labor	\$664,902	\$1,040,972	56.6%
Spray Operations	\$1,488,857	\$1,917,836	28.8%
Commodities	\$75,214	\$126,283	67.9%
U.S. Labor	\$381,465	\$331,341	-13.1%
TOTAL	\$3,984,280	\$4,799,286	20.5%

Table GH5 compares the year-on-year change in Ghana IRS program output measures and unit costs. In 2018, the program protected 0.5 percent less people, sprayed 1.3 percent less structures, and 0.5 less area than in 2017.

Because the number of people protected decreased by 0.5 percent from 2017 to 2018, but total costs increased by 22.1 percent, the cost per person protected increased from \$4.74 to \$5.74 (21.0 percent) across the two years. The increase in total costs from 2017 to 2018 compared to the decrease in the number of structures sprayed also resulted in higher costs per structure sprayed in 2018 than in 2017. The decrease in the area sprayed and the increase in total costs also resulted in a higher cost per area sprayed in 2018 than in 2017.

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

	2017	2018	Percentage Change 2017-2018
Output Measures			
People Protected	840,438	836,376	-0.5%
Structures Sprayed	302,648	298,701	-1.3%
Area Sprayed (100 m ²)	164,738	163,860	-0.5%
Unit Costs			
Per Person Protected	\$4.74	\$5.74	21.0%
Per Structure Sprayed	\$13.16	\$16.07	22.0%
Per Area Sprayed	\$24.19	\$29.29	21.1%

9. KENYA

9.1 BACKGROUND

TABLE KNI: KENYA QUICK FACTS

	2018
Program Dates	Oct 1, 2017–Sep 30, 2018*
Number of Sub-counties	14
# Local Staff	24
Spray Start Date	Feb 12, 2018
Insecticides Used	Organophosphates
# Units of Insecticide Used	162,468
# People Protected	1,833,860
# Structures Sprayed	440,969
# 100 Square Meters Sprayed ⁺	406,170

*These dates were used for the costing analysis to be comparable with previous years' analyses so that all costs, year on year, are included in the report.

⁺ Reverse calculation using number of insecticide units used during campaign multiplied by the average of 250 m² estimated to be sprayed by one unit and divided by the number of structures sprayed.

9.2 PROGRAM EXPENDITURES

This section presents an overview of Kenya IRS program expenditures in 2018. Costs are organized by activity and cost category.

Table KN2 displays the Kenya IRS program total capital and recurrent expenditures from 2018. The first column lists the program activities as tracked by the PMI VectorLink Project's financial systems, and the top row lists IRS program cost categories.

The spray campaign is the most expensive IRS activity (27.7 percent of expenditures), followed by insecticide (25.2 percent of expenditures) and spray planning (14.3 percent of expenditures). PMI AIRS procured 115,400 bottles of organophosphate insecticide, and used about 162,468 bottles including insecticide stock remaining from previous years' spray campaigns. Insecticide costs reflect total insecticides used. About 43 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.

TABLE KN2: KENYA 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		899,193	521,347			156,289	\$1,576,829	13.7%
Entomology			191,340		468,720	68,764	\$728,825	6.3%
Environmental Compliance			49,335		56,268	41,819	\$147,423	1.3%
Equipment Supplies				538,711			\$538,711	4.7%
IEC			59,038		91,920	4,743	\$155,702	1.4%
Insecticide	2,899,824						\$2,899,824	25.2%
M&E			115,026		124,481	68,788	\$308,295	2.7%
Post Spray			62,857		245,155	9,450	\$317,462	2.8%
Spray Campaign			66,756		3,115,615	12,607	\$3,194,977	27.7%
Spray Planning			170,010		1,458,668	18,980	\$1,647,658	14.3%
Grand Total	\$2,899,824	\$899,193	\$1,235,710	\$538,711	\$5,560,826	\$381,441	\$11,515,704	100.0%

9.3 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 m²).

TABLE KN3: KENYA UNIT COSTS

Unit costs	
Person protected	\$ 6.28
Cost per Structure sprayed	\$ 26.11
100 m ² sprayed	\$ 28.35

9.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Kenya IRS program between 2017 and 2018, as implemented by the PMI AIRS Project (Kenya transitions from PMI AIRS to VectorLink on July 1, after the campaign). The comparison focuses on output measures, total expenditures, and unit costs. 2017 expenditures, excluding insecticides, have been adjusted to real 2018 U.S. dollars to allow for a more accurate comparison.

Table KN4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost increased by almost 115 percent from 2017 to 2018, representing an increase in the total annual cost of about \$6,177,851. Costs increased for all categories over this period. The increased costs largely reflect the more than twofold increase in program scale in 2018. In 2018, the program added Homa Bay County for IRS.

TABLE KN4: KENYA IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2017 (Adjusted)	2018	Percentage Change 2017-2018
Insecticide	\$1,206,372	\$2,899,824	140.4%
Local Admin	\$533,948	\$899,193	68.4%
Local Labor	\$880,366	\$1,235,710	40.4%
Spray Operations	\$2,261,496	\$5,560,826	145.9%
Commodities	\$109,074	\$538,711	393.9%
U.S. Labor	\$346,598	\$381,441	10.1%
TOTAL	\$5,337,853	\$11,515,704	115.7%

Table KN5 compares the year-on-year change in Kenya IRS program output measures and unit costs. In 2018, the program protected 102.3 percent more people, sprayed 108 percent more structures, and 130.3 percent more area than in 2017.

Because the number of people protected increased by 102.3 percent from 2017 to 2018, but total costs increased by 115.7 percent, the cost per person protected increased from \$5.89 to \$6.28 (6.6 percent) across the two years. The larger increase in total costs from 2017 to 2018 compared to the increase in the number of structures sprayed also resulted in higher costs per structure sprayed in 2018 than in 2017. The increase in the area sprayed and the relatively smaller increase in total costs resulted in a lower cost per area sprayed in 2018 than in 2017.

TABLE KN5: KENYA IRS PROGRAM COMPARISON OF OUTPUT MEASURES AND UNIT COSTS

	2017	2018	Percentage Change 2017-2018
Output Measures			
People Protected	906,388	1,833,860	102.3%
Structures Sprayed	212,029	440,969	108.0%
Area Sprayed (100 m ²)	176,383	406,170	130.3%
Unit Costs			
Per Person Protected	\$5.89	\$6.28	6.6%
Per Structure Sprayed	\$25.18	\$26.11	3.7%
Per Area Sprayed	\$30.26	\$28.35	-6.3%

10. MADAGASCAR

10.1 BACKGROUND

TABLE MGI: MADAGASCAR QUICK FACTS

	2018
Program Dates	Jan 1, 2018–Dec 31, 2018
Number of Districts	9
# Local Staff	33
Spray Start Date	
<i>East Coast</i>	Sep 3, 2018
<i>Southeast</i>	Jul 23, 2018
<i>Southwest</i>	Sep 17, 2018
Insecticides Used	Organophosphates Neonicotinoids
# Units of Insecticide Used	88,224 (69,417 OP 18,807 N)
# People Protected	2,232,097
# Structures Sprayed	548,789
# 100 Square Meters Sprayed*	220,560

* Reverse calculation using number of insecticide units used during campaign multiplied by the average of 250 m² estimated to be sprayed by one unit and divided by the number of structures sprayed.

10.2 PROGRAM EXPENDITURES

This section will present an overview of Madagascar IRS program expenditures in 2018. Costs are organized by activity and cost category.

Table MG2 displays the Madagascar IRS program total capital and recurrent expenditures from 2018. The first column lists the program activities as tracked by the PMI VectorLink Project’s financial systems, and the top row lists IRS program cost categories.

An additional \$31,028 was spent on activities related to long-lasting insecticide-treated nets; this cost is not included in the table.

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	-	561,881	612,719	-	-	197,235	\$1,371,835	19.0%
Entomology	-	-	212,913	-	322,714	112,183	\$647,810	9.0%
Environmental Compliance	-	-	26,233	-	186,250	21,594	\$234,078	3.2%
Equipment Supplies	-	-	1,561	508,840	-	245	\$510,646	7.1%
IEC	-	-	20,113	-	347,294	4,071	\$371,478	5.1%
Insecticide	1,481,633	-	-	-	-	-	\$1,481,633	20.5%
M&E	-	-	41,326	-	168,350	39,206	\$248,882	3.4%
Post Spray	-	-	21,180	-	13,671	6,962	\$41,814	0.6%
Spray Campaign	-	-	37,683	-	1,799,821	8,907	\$1,846,411	25.5%
Spray Planning	-	-	124,066	-	331,446	24,511	\$480,022	6.6%
Grand Total	\$1,481,633	\$561,881	\$1,097,794	\$508,840	\$3,169,547	\$414,912	\$7,234,609	100.0%

Insecticides and the spray campaign were the two most expensive IRS activities (constituting 20.5 percent and 25.5 percent of expenditures, respectively), followed closely by administration (19.0 percent of expenditures). PMI VectorLink Madagascar procured 9,312 bottles of organophosphate insecticide and 18,827 sachets of neonicotinoid insecticide, and used 69,417 organophosphate bottles and 18,807 neonicotinoid sachets. The costs of insecticides used are reflected here. About 59 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.

10.3 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 m²).

TABLE MG3: MADAGASCAR UNIT COSTS

Unit Costs	
Person protected	\$ 3.24
Cost per Structure sprayed	\$ 13.18
100 m ² sprayed	\$ 32.80

10.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the PMI VectorLink Madagascar IRS program between 2017 and 2018, as implemented by the project. The comparison focuses on output measures, total expenditures, and unit costs.

Table MG4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost increased by 2.4 percent from 2017 to 2018. Insecticide costs increased by about \$167,303 (12.7 percent), local administrative costs increased by almost \$69,000 (14.0 percent), while

commodities costs decreased by about \$64,000 (11.2 percent) from 2017 to 2018. U.S. labor costs and local labor costs also increased by 10.3 percent (increased support to the in-country team from home office level as well as yearly salary increases) and 1.8 percent (due to yearly salary increases), respectively, from 2017 to 2018.

TABLE MG4: MADAGASCAR IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2017 (Adjusted)	2018	Percentage Change 2017-2018
Insecticide	\$1,314,331	\$1,481,633	12.7%
Local Admin	\$492,965	\$561,881	14.0%
Local Labor	\$1,078,373	\$1,097,794	1.8%
Spray Operations	\$3,232,950	\$3,169,547	-2.0%
Commodities	\$573,053	\$508,840	-11.2%
U.S. Labor	\$376,060	\$414,912	10.3%
TOTAL	\$7,067,731	\$7,234,609	2.4%

Table MG5 compares the year-on-year change in Madagascar IRS program output measures and unit costs. Overall, in 2018, 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 12.5 percent from 2017 to 2018, and the number of people protected increased by 11.1 percent over the same period. Additionally, the area sprayed increased by 16.2 percent.

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

	2017	2018	Percentage Change 2017-2018
Output Measures			
People Protected	2,008,963	2,232,097	11.1%
Structures Sprayed	487,636	548,789	12.5%
Area Sprayed (100 m ²)	189,860	220,560	16.2%
Unit Costs			
Per Person Protected	\$3.52	\$3.24	-7.9%
Per Structure Sprayed	\$14.49	\$13.18	-9.0%
Per Area Sprayed	\$37.23	\$32.80	-11.9%

Total program costs increased by 2.4 percent, while the number of structures sprayed increased by 12.5 percent between 2017 and 2018. Thus, the cost per structure sprayed decreased by 9.0 percent between the two years. The increase in the number of people protected (11.1 percent) was larger than the increase in the program costs between 2017 and 2018, indicating that the cost per person protected decreased by 7.9 percent between the two years. The cost per area sprayed decreased from \$37.23 in 2017 to \$32.80 in 2018, a decrease of 11.9 percent.

II. MALAWI

II.1 BACKGROUND

TABLE MW1: MALAWI QUICK FACTS

	2018
Program Dates	Apr 1, 2018–Mar 31, 2019
Number of Districts	1
# Local Staff	18
Spray Start Date	Oct 2, 2018
Insecticides Used	Organophosphates
# Units of Insecticide Used	47,743
# People Protected	501,324
# Structures Sprayed	112,264
# 100 Square Meters Sprayed*	119,358

* Reverse calculation using number of insecticide units used during campaign multiplied by the average of 250 m² estimated to be sprayed by one unit and divided by the number of structures sprayed.

Note that 2018 was the first year of IRS implementation under the PMI VectorLink project, and thus a year-on-year comparison is not possible.

II.2 PROGRAM EXPENDITURES

This section presents an overview of Malawi IRS program expenditures in 2018. Costs are organized by activity and cost category.

Table MW2 displays the Malawi IRS program total capital and recurrent expenditures from 2018. The first column lists the program activities as tracked by the PMI VectorLink Project's financial systems, and the top row lists IRS program cost categories.

Administration is the most expensive IRS activity (27.8 percent of expenditures), followed by insecticide (20.6 percent of expenditures) and the spray campaign (18.4 percent of expenditures). Administration cost drivers in Malawi include site office labor for finance and administration staff, foreign allowance shipping, moving and housing costs for two TCN staff, and burden on these costs. PMI VectorLink procured 54,768 bottles of organophosphate insecticide, and used 47,743 bottles (costs reflect the insecticides used). About 62 percent of the total cost for administration consists of labor, both local and U.S.-based. Expenditures on insecticide, local labor, and spray operations are about 78 percent of costs, with local administration, U.S. labor, and commodities costs composing the remaining 22 percent of costs.

TABLE MW2: MALAWI 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		418,792	478,638			215,801	\$1,113,232	27.8%
Entomology		21,014	100,144		275,313	6,658	\$403,129	10.1%
Environmental Compliance			23,205		46,930	53,059	\$123,194	3.1%
Equipment Supplies				89,957			\$89,957	2.2%
IEC			23,383		37,988	4,081	\$65,452	1.6%
Insecticide	824,537						\$824,537	20.6%
M&E		7,240	47,011		95,815	50,968	\$201,034	5.0%
Post Spray			409		39,094	22	\$39,526	1.0%
Spray Campaign			10,202		724,203	1,923	\$736,328	18.4%
Spray Planning			104,775		282,590	22,726	\$410,090	10.2%
Grand Total	\$824,537	\$447,046	\$787,768	\$89,957	\$1,501,933	\$355,239	\$4,006,479	100.0%

11.3 UNIT COST ANALYSIS

This section presents Malawi IRS expenditures as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m²).

TABLE MW3: MALAWI UNIT COSTS

	Unit Costs	
Person protected	\$	7.99
Cost per Structure sprayed	\$	35.69
100 m² sprayed	\$	33.57

Malawi saw the highest cost per 100 m² sprayed among all countries sprayed in 2018 because of small program size (it sprayed the fewest structures of all countries) meaning that fixed costs were spread over fewer structures / less areas, and due to some higher costs for starting the program.

12. MALI

12.1 BACKGROUND

TABLE MLI: MALI QUICK FACTS

	2018
Program Dates	Jan 1, 2018–Dec 31, 2018
Number of Districts	4
# Local Staff	22
Spray Start Date	Aug 20, 2018
Insecticides Used	Organophosphates Neonicotinoids
# Units of Insecticide Used	76,985 (42,412 OP 34,573 N)
# People Protected	665,581
# Structures Sprayed	160,723
# 100 Square Meters Sprayed*	192,463

* Reverse calculation using number of insecticide units used during campaign multiplied by the average of 250 m² estimated to be sprayed by one unit and divided by the number of structures sprayed.

12.2 PROGRAM EXPENDITURES

This section will present an overview of Mali IRS program expenditures in 2018. Costs are organized by activity and cost category.

Table ML2 displays the Mali IRS program total capital and recurrent expenditures from 2018. The first column lists the program activities as tracked by the PMI VectorLink Project’s financial systems, and the top row lists IRS program cost categories.

Administration is the most expensive IRS activity (26.7 percent of expenditures), followed by insecticides (25.6 percent of expenditures) and spray campaign activities (13.5 percent of expenditures). Administration cost drivers in Mali largely consist of site office labor, foreign allowance shipping, moving and housing costs for two TCN staff, and burden on these costs. PMI VectorLink procured 34,573 sachets of neonicotinoid insecticide and used 42,412 bottles of organophosphate insecticide (no organophosphate insecticide was purchased in 2018) and 34,573 sachets of SumiShield 50WG. About 69 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 (88 percent of U.S. 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.

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		441,204	833,902			161,201	\$1,436,307	26.7%
Entomology			169,968		345,292	38,588	\$553,849	10.3%
Environmental Compliance			30,053		110,067	22,710	\$162,829	3.0%
Equipment Supplies				220,804			\$220,804	4.1%
IEC					113,058		\$113,058	2.1%
Insecticide	1,388,739						\$1,388,739	25.6%
M&E			67,647		65,877	29,806	\$163,329	3.0%
Post Spray					69,024		\$69,024	1.3%
Spray Campaign					729,981		\$729,981	13.5%
Spray Planning					561,264		\$561,264	10.4%
Grand Total	\$1,388,739	\$441,204	\$1,101,569	\$220,804	\$1,994,563	\$252,305	\$5,399,184	100.0%

12.3 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 m²).

TABLE ML3: MALI UNIT COSTS

Unit Costs	
Person protected	\$ 8.11
Cost per Structure sprayed	\$ 33.59
100 m ² sprayed	\$ 28.05

12.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Mali IRS program between 2017 and 2018, as implemented by the PMI VectorLink project. The comparison focuses on output measures, total expenditures, and unit costs.

Table ML4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost decreased by 16.4 percent from 2017 to 2018. Costs decreased in real and nominal terms for all other categories. Spray operations costs decreased by 23.3 percent or about \$605,729. The decrease in costs can be explained by the decrease in program scale between 2017 and 2018.

TABLE ML4: MALI IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2017 (Adjusted)	2018	Percentage Change 2017-2018
Insecticide*	\$1,468,859	\$1,388,739	-5.5%
Local Admin	\$593,825	\$441,204	-25.7%
Local Labor	\$1,180,201	\$1,101,569	-6.7%
Spray Operations	\$2,600,292	\$1,994,563	-23.3%
Commodities	\$353,866	\$220,804	-37.6%
U.S. Labor	\$263,949	\$252,305	-4.4%
TOTAL	\$6,460,991	\$5,399,184	-16.4%

*In the 2017 report, some insecticide costs were incorrectly classified as spray operations costs; these costs have been adjusted for this report.

Table ML5 compares the year-on-year change in Mali IRS program output measures and unit costs. In 2018, the program protected 19.1 percent less people, and sprayed 29.4 percent less structures and 4.1 percent less area than in 2017. Given that the percentage decrease from 2017 to 2018 in total expenditures was less (in absolute terms) than the percentage decrease in people protected and structures sprayed, the unit costs per person protected and per structure sprayed were higher in 2018 than in 2017. However, the total 100 m² sprayed was more similar between 2017 and 2018 than were costs, indicating that the cost per area sprayed decreased by about 12.9 percent. According to the current structure definition in Mali, a structure is counted as sprayed even if only one room is sprayed. In multi-unit structures, the number of individual units that accepted IRS increased between 2017 and 2018. However the building is considered one sprayed structure regardless of how many rooms are sprayed and in 2018 we sprayed more rooms per structure than in 2017. This accounts for the increase costs for insecticide per structure sprayed as well as the overall increase in unit costs per structure, but decrease in area sprayed.

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

	2017	2018	Percentage Change 2017-2018
Output Measures			
People Protected	823,201	665,581	-19.1%
Structures Sprayed	227,646	160,723	-29.4%
Area Sprayed (100 m ²)	200,673	192,463	-4.1%
Unit Costs			
Per Person Protected	\$7.85	\$8.11	3.4%
Per Structure Sprayed	\$28.38	\$33.59	18.4%
Per Area Sprayed	\$32.20	\$28.05	-12.9%

13. MOZAMBIQUE

13.1 BACKGROUND

TABLE MZI: MOZAMBIQUE QUICK FACTS

	2018
Program Dates	Mar 1, 2018– Feb 28, 2019
Number of Districts	6
# Local Staff	29
Spray Start Date	Oct 16, 2018
Insecticides Used	Organophosphat es Neonicotinoids
# Units of Insecticide Used	184,827 (112,364 OP 72,463 N)
# People Protected	1,663,078
# Structures Sprayed	387,413
# 100 Square Meters Sprayed*	462,068

* Reverse calculation using number of insecticide units used during campaign multiplied by the average of 250 m² estimated to be sprayed by one unit and divided by the number of structures sprayed.

13.2 PROGRAM EXPENDITURES

This section presents an overview of Mozambique IRS program expenditures in 2018. Costs are organized by activity and cost category.

Table MZ2 displays the Mozambique IRS program total capital and recurrent expenditures from 2018. The first column lists the program activities as tracked by the PMI VectorLink Project's financial systems, and the top row lists IRS program cost categories.

Insecticides and administration are the two most expensive IRS activities (30.0 percent and 21.1 percent of expenditures, respectively), followed by spray campaign (16.0 percent of expenditures). PMI VectorLink Mozambique received an insecticide donation of 53,196 bottles of organophosphate insecticides and 75,250 sachets of neonicotinoid insecticides and used 112,364 bottles of organophosphate insecticide (including bottles from previous years) and 72,463 sachets of neonicotinoid insecticide. About 50 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 less than 19 percent of total costs.

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		967,451	730,374			221,297	\$1,919,122	21.1%
Entomology			399,350		766,873	48,316	\$1,214,538	13.3%
Environmental Compliance			62,512		49,273	18,970	\$130,755	1.4%
Equipment Supplies				412,164			\$412,164	4.5%
IEC			10,759		40,557	1,019	\$52,334	0.6%
Insecticide*	2,772,405				591		\$2,772,996	30.0%
M&E			109,192		114,083	32,767	\$256,042	2.8%
Post Spray			73,900		33,649	10,289	\$117,838	1.3%
Spray Campaign			65,580		1,381,059	8,339	\$1,454,978	16.0%
Spray Planning			287,536		491,268	38,025	\$816,829	9.0%
Grand Total	\$2,772,405	\$967,451	\$1,739,203	\$412,164	\$2,877,353	\$379,022	\$9,147,597	100.0%

*Includes estimated cost of OP insecticides procured by the Global Fund based on the unit price of \$15 paid by the Global Fund. The NMCP provided SumiShield 50WG procured also at a base unit of \$15. Total cost of insecticides used by PMI was \$876,720.

13.3 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 m²).

TABLE MZ3: MOZAMBIQUE UNIT COSTS

		Unit Costs
Cost per	Person protected	\$ 5.50
	Structure sprayed	\$ 23.61
	100 m ² sprayed	\$ 19.80

13.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the PMI VectorLink Mozambique IRS program between 2017 and 2018, as implemented by the PMI VectorLink Project.

Table MZ4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost decreased by 7.2 percent from 2017 to 2018. The only cost category to increase in costs was local administration, which rose by over \$424,600 (78.2 percent) from 2017. This increase was driven by an increase in rent, security, and internet services, which accounted for over 50 percent of the overall increase. Labor costs (both local and U.S. labor) decreased between 2017 and 2018 (by 15.7 percent and 18.2 percent) overall and specifically for administration. Costs decreased between 2017 and 2018 for by 11.2 percent and 11.7 percent for spray operations and commodities, respectively.

TABLE MZ4: MOZAMBIQUE IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2017 (Adjusted)	2018	Percentage Change 2017-2018
Insecticide	\$3,078,345	\$2,772,405	-9.9%
Local Admin	\$542,846	\$967,451	78.2%
Local Labor	\$2,063,830	\$1,739,203	-15.7%
Spray Operations	\$3,238,753	\$2,877,353	-11.2%
Commodities	\$466,988	\$412,164	-11.7%
U.S. Labor	\$463,350	\$379,022	-18.2%
TOTAL	\$9,854,111	\$9,147,597	-7.2%

Table MZ5 compares the year-on-year change in Mozambique IRS program output measures and unit costs. Overall, in 2018, the program sprayed protected fewer people and sprayed less area than in 2017, although more structures were sprayed. Because the decrease in people protected was less than the decrease in total expenditures from 2017 to 2018, the unit costs decreased per person protected (by 9.2 percent) and per structure sprayed (by 18.1 percent), while the decrease in the area sprayed was greater than the decrease in total expenditures from 2017 to 2018, indicating that the cost per area sprayed increased (by 7.9 percent).

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

	2017 (Adjusted)	2018	Percentage Change 2017-2018
Output Measures			
People Protected	1,711,518	1,663,078	-2.8%
Structures Sprayed	381,463	387,413	1.6%
Area Sprayed (100 m ²)	513,058	462,068	-9.9%
Unit Costs			
Per Person Protected	\$5.76	\$5.50	-9.2%
Per Structure Sprayed	\$25.83	\$23.61	-18.1%
Per Area Sprayed	\$19.21	\$19.80	7.9%

14. RWANDA

14.1 BACKGROUND

TABLE RW1: RWANDA QUICK FACTS

	2018
Program Dates	Mar 1, 2018–Feb 28, 2019
Number of Districts	2 + Mahama Refugee Camp
# Local Staff	15
Spray Start Date	Sep 10, 2018
Insecticides Used	Organophosphates
# Units of Insecticide Used	163,551
# People Protected*	894,098
# Structures Sprayed*	214,802
# 100 Square Meters Sprayed**	408,878

*Numbers include spraying of the Mahama Refugee Camp

**Reverse calculation using number of insecticide units used during campaign multiplied by the average of 250 m² estimated to be sprayed by one unit and divided by the number of structures sprayed.

14.2 PROGRAM EXPENDITURES

This section presents an overview of Rwanda IRS program expenditures in 2018. Costs are organized by activity and cost category.

Table RW2 displays the Rwanda IRS program total capital and recurrent expenditures from 2018. The first column lists the program activities as tracked by the PMI VectorLink Project's financial systems, and the top row lists IRS program cost categories.

Insecticides represented 48.8 percent of costs. Administration and spray campaign costs were the next two most expensive activities, representing 16.4 and 11.9 percent of costs, respectively. The project procured 167,028 bottles of organophosphate insecticide, and used 163,551 bottles; the costs below reflect the cost of insecticide used. About 58.7 percent of the total cost for administration consisted of labor, both local and U.S.-based. Local administration, U.S. labor, and commodities costs were minimal compared to expenditures on insecticide, local labor, and spray operations.

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		386,951	430,532			120,083	\$937,567	16.4%
Entomology			50,280		470,310	16,200	\$536,790	9.4%
Environmental Compliance			67,500		4,978	21,505	\$93,983	1.6%
Equipment Supplies				224,698			\$224,698	3.9%
IEC							\$0	0.0%
Insecticide	2,781,842						\$2,781,842	48.8%
M&E			48,977		41,674	17,821	\$108,472	1.9%
Post Spray					6,003		\$6,003	0.1%
Spray Campaign					679,745		\$679,745	11.9%
Spray Planning			184,477		113,513	33,262	\$331,252	5.8%
Grand Total	\$2,781,842	\$386,951	\$781,767	\$224,698	\$1,316,223	\$208,872	\$5,700,353	100.0%

14.3 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 m²).

TABLE RW3: RWANDA UNIT COSTS

	Unit Costs
Person protected	\$ 6.38
Cost per Structure sprayed	\$ 26.54
100 m ² sprayed	\$ 13.94

14.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Rwanda IRS program between 2017 and 2018, as implemented by the PMI VectorLink project. The comparison focuses on output measures, total expenditures, and unit costs.

Table RW4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost decreased by 10.5 percent from 2017 to 2018, representing a decrease in the total annual cost of almost \$670,000. Insecticide costs decreased by 12.8 percent (about \$410,000), while spray operations costs decreased by 16.8 percent (over \$266,000), mostly reflecting the decrease in program scale from 2017 to 2018. Spray operation costs were further decreased by a reduction in the number of days for trainings, in the number of vehicles rented through a walk-to-work pilot, and in the number of radio spots aired. Costs increased for local administration by about \$21,700 and for local labor by about \$152,000. These increases can be explained by the change in third-country national staff salaries during the transition from AIRS to VectorLink as well as increases in the Rwanda salary scale for local staff.

TABLE RW4: RWANDA IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2017 (Adjusted)	2018	Percentage Change 2017-2018
Insecticide	3,191,487	2,781,842	-12.8%
Local Admin	365,285	386,951	5.9%
Local Labor	629,563	781,767	24.2%
Spray Operations	1,582,547	1,316,223	-16.8%
Commodities	333,764	224,698	-32.7%
U.S. Labor	266,831	208,872	-21.7%
TOTAL	\$6,369,477	5,700,353	-10.5%

Table RW5 compares the year-on-year change in PMI VectorLink Rwanda program output measures and unit costs. In 2018, the program achieved lower coverage on all three indicators used in Table RW4 than in 2017. Between 2017 and 2018, the number of people protected decreased 2.8 percent, the number of structures sprayed decreased 7.1 percent, and the area sprayed decreased by 10.3 percent. Given that the decrease in total expenditures was higher than the decrease in two of the coverage indicators, the unit costs decreased by 7.9 percent for cost per person protected and 3.6 percent for cost per structure sprayed. The cost per area sprayed decreased by 0.2 percent.

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

	2017	2018	Percentage Change 2017-2018
Output Measures			
People Protected	919,735	894,098	-2.8%
Structures Sprayed	231,258	214,802	-7.1%
Area Sprayed (100 m ²)	456,020	408,878	-10.3%
Unit Costs			
Per Person Protected	\$6.93	\$6.38	-7.9%
Per Structure Sprayed	\$27.54	\$26.54	-3.6%
Per Area Sprayed	\$13.97	\$13.94	-0.2%

15. TANZANIA

15.1 BACKGROUND

TABLE TZ1: TANZANIA QUICK FACTS

	2018
Program Dates*	Oct 1, 2017–Sep 30, 2018
Number of Districts	17
# Local Staff	34
Spray Start Date	
<i>Mainland (Kagera/Geita)</i>	Nov 23, 2017
<i>Zanzibar</i>	Jan 20, 2018
<i>Mainland (Mwanza/Mara)</i>	Feb 14, 2018
Insecticides Used	Organophosphates Neonicotinoids
# Units of Insecticide Used	234,930 (220,786 OP 14,144 N)
# People Protected	2,840,927
# Structures Sprayed	744,597
# 100 Square Meters Sprayed ⁺	587,325

*These dates were used for the costing analysis to be comparable with previous years' analyses so that all costs, year on year, are included in the report.

⁺ Reverse calculation using number of insecticide units used during campaign multiplied by the average of 250 m² estimated to be sprayed by one unit and divided by the number of structures sprayed.

15.2 PROGRAM EXPENDITURES

This section presents an overview of Tanzania IRS program expenditures in 2018. Costs are organized by activity and cost category.

Table TZ2 displays the Tanzania IRS program total capital and recurrent expenditures from 2018. The first column lists the program activities as tracked by the PMI VectorLink Project's financial systems, and the top row lists IRS program cost categories.

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		643,099	752,268		-	218,292	\$1,613,659	15.0%
Entomology			122,161		710,976	31,057	\$864,194	8.0%
Environmental Compliance			71,288		41,424	15,204	\$127,916	1.2%
Equipment Supplies			5,788	291,534		2,536	\$299,857	2.8%
IEC							\$0	0.0%
Insecticide	4,222,167						\$4,222,167	39.2%
M&E			54,253		38,863	33,523	\$126,639	1.2%
Post Spray			106,546		70,296	19,244	\$196,087	1.8%
Spray Campaign			94,634		2,073,692	23,912	\$2,192,238	20.4%
Spray Planning			222,320		867,092	29,765	\$1,119,177	10.4%
Grand Total	\$4,222,167	\$643,099	\$1,429,257	\$291,534	\$3,802,343	\$373,534	\$10,761,934	100.0%

Insecticide is the most expensive IRS activity (39.2 percent of expenditures), followed by the spray campaign activities (20.4 percent of expenditures) and administration (15.0 percent of expenditures). PMI AIRS procured 197,830 bottles of organophosphate and 14,155 sachets of neonicotinoid insecticide, and used about 220,786 bottles of organophosphate insecticide and 14,144 sachets of neonicotinoid insecticide (costs reflect the insecticides used). 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.

15.3 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 m²).

TABLE TZ3: TANZANIA UNIT COSTS

	Unit Costs
Person protected	\$ 3.79
Cost per Structure sprayed	\$ 14.45
100 m ² sprayed	\$ 18.32

15.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Tanzania IRS program between 2017 and 2018, as implemented by the PMI VectorLink Project. The comparison focuses on output measures, total expenditures, and unit costs.

Table TZ4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost increased by 2.4 percent from 2017 to 2018, representing an increase in the total annual cost of about \$348,000 due to an increase in structures sprayed.

The costs of insecticides used increased 12.8 percent (almost \$480,000) from 2017 to 2018. Spray operations and U.S. labor costs also increased by 2.2 percent and 10.1 percent, respectively, from 2017 to 2018. Decreases were seen in the costs of local administration (about 17.1 percent), local labor (about 1.5 percent), and commodities (39.8 percent).

TABLE TZ4: TANZANIA IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2017 (Adjusted)	2018	Percentage Change 2017-2018
Insecticide	\$3,742,699	\$4,222,167	12.8%
Local Admin	\$775,881	\$643,099	-17.1%
Local Labor	\$1,451,552	\$1,429,257	-1.5%
Spray Operations	\$3,720,431	\$3,802,343	2.2%
Commodities	\$484,610	\$291,534	-39.8%
U.S. Labor	\$339,214	\$373,534	10.1%
TOTAL	\$10,514,386	\$10,761,934	2.4%

Table TZ5 compares the year-on-year change in Tanzania IRS program output measures and unit costs. In 2018, the program had higher coverage metrics than in 2017. The number of people protected increased by 10.6 percent from 2017 to 2018, and the number of structures sprayed and area sprayed increased by 12.0 percent and 7.0 percent, respectively. Because the increase in program size was larger than the increase in total expenditures, unit costs decreased from 2017 to 2018. The cost per person protected decreased by about 7.5 percent, while costs per structure sprayed and area sprayed decreased on the order of 8.6 percent and 4.3 percent, respectively, from 2017 to 2018. This can be attributed to an increase in program size while decreasing the costs of commodities in 2018 as compared to 2017 and through careful control of local material purchases throughout the campaign. Additionally, the project increased operational efficiency by increasing the number of SOPs per team thereby reducing the number of team leaders and supervisory staff as well as scaling up the quasi-community-based approach to additional districts, which decreased the number of vehicles rented. Local administration and labor decreased with changes in the site office organigram, replacing one expat staff with a local site office staff.

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

	2017	2018	Percentage Change 2017-2018
Output Measures			
People Protected	2,568,522	2,840,927	10.6%
Structures Sprayed	664,622	744,597	12.0%
Area Sprayed (100 m ²)	549,095	587,325	7.0%
Unit Costs			
Per Person Protected	\$4.09	\$3.79	-7.5%
Per Structure Sprayed	\$15.82	\$14.45	-8.6%
Per Area Sprayed	\$19.15	\$18.32	-4.3%

16. UGANDA

16.1 BACKGROUND

TABLE UGI: UGANDA QUICK FACTS

	2018
Program Dates	Dec 1, 2017–Dec 31, 2018
Number of Districts	15
# Local Staff	45
Spray Start Date <i>Phase 1: Alebtong, Amolatar, Budaka, Butaleja, Butebo, Dokolo, Namutumba, and Pallisa</i>	April 9, 2018
<i>Phase 2: Bugiri, Kaberamaido, Kibuku, Lira, Serere, Otuke, and Tororo</i>	June 11, 2018
<i>Sub-county spray :Lira District</i>	September 3, 2018
Insecticides Used	Organophosphates
# Units of Insecticide Used	554,568
# People Protected	4,436,156
# Structures Sprayed	1,292,309
# 100 Square Meters Sprayed*	1,386,420

* Reverse calculation using number of insecticide units used during campaign multiplied by the average of 250 m² estimated to be sprayed by one unit and divided by the number of structures sprayed.

Note that 2018 was the first year of IRS implementation under the PMI VectorLink Project, and thus a year-on-year comparison is not possible.

16.2 PROGRAM EXPENDITURES

This section presents an overview of Uganda IRS program expenditures in 2018. Costs are organized by activity and cost category.

Table UG2 displays the Uganda IRS program total capital and recurrent expenditures from 2018. The first column lists the program activities as tracked by the PMI VectorLink Project’s financial systems, and the top row lists IRS program cost categories.

TABLE UG2: UGANDA 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	-	478,252	816,005	-	-	419,307	\$1,713,565	10.7%
Entomology	-	-	222,664	-	299,874	101,384	\$623,923	3.9%
Environmental Compliance	-	-	61,492	-	86,108	59,143	\$206,743	1.3%
Equipment Supplies	-	-	-	372,552	-	-	\$372,552	2.3%
IEC	-	-	18,037	-	317,161	4,439	\$339,636	2.1%
Insecticide	8,871,598	-	-	-	-	-	\$8,871,598	55.5%
M&E	-	-	74,900	-	70,843	64,118	\$209,861	1.3%
Post Spray	-	-	106,144	-	101,827	19,516	\$227,487	1.4%
Spray Campaign	-	-	240,290	-	1,936,765	66,078	\$2,243,132	14.0%
Spray Planning	-	-	263,423	-	843,139	76,431	\$1,182,993	7.4%
Grand Total	\$8,871,598	\$478,252	\$1,802,956	\$372,552	\$3,655,716	\$810,416	\$15,991,491	100.0%

Insecticide is the most expensive IRS activity (55.5 percent of expenditures), followed by the spray campaign (14.0 percent of expenditures) and administration (10.7 percent of expenditures). PMI VectorLink procured 587,292 bottles of organophosphate insecticide, and used about 554,568 bottles of organophosphate insecticide (costs reflect the insecticides used). About 72.1 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. Overall the Uganda IRS program showed the lowest unit costs per structure and area sprayed across all VectorLink countries which is partly attributed to the large scale of the program. However Uganda also has the lowest variable costs per area sprayed in local labor and spray operations, not just the fixed cost categories which would be expected due to the size of the program. Contributing to the low cost per area sprayed under spray operations could be the relatively low daily wage rates for SOPs.

16.3 UNIT COST ANALYSIS

This section presents Uganda IRS expenditures as unit costs: per person protected, per structure sprayed, and per area sprayed (in terms of 100 m²).

TABLE UG3: UGANDA UNIT COSTS

	Unit Costs
Person protected	\$ 3.60
Cost per Structure sprayed	\$ 12.37
100 m² sprayed	\$ 11.53

17. ZAMBIA

17.1 BACKGROUND

TABLE ZA1: ZAMBIA QUICK FACTS

	2018
Program Dates	Apr 1, 2018–Mar 31, 2019
Number of Districts	29
# Local Staff	39
Spray Start Date	Oct 15, 2018
Insecticides Used	Organophosphates Neonicotinoids
# Units of Insecticide Used	147,983 (127,079 OP 20,904 N)
# People Protected	2,818,176
# Structures Sprayed	579,490
# 100 Square Meters Sprayed*	369,958

* Reverse calculation using number of insecticide units used during campaign multiplied by the average of 250 m² estimated to be sprayed by one unit and divided by the number of structures sprayed.

17.2 PROGRAM EXPENDITURES

This section presents an overview of Zambia IRS program expenditures in 2018. Costs are organized by activity and cost category.

Table ZA2 displays the Zambia IRS program total capital and recurrent expenditures from 2018. The first column lists the program activities as tracked by the PMI VectorLink Project's financial systems, and the top row lists IRS program cost categories.

Insecticides and administration are the two most expensive IRS activities (32.7 percent and 20.5 percent of expenditures, respectively), followed by the spray campaign (16.3 percent of expenditures). PMI VectorLink Zambia procured 145,668 bottles of organophosphate and 24,866 sachets of neonicotinoid insecticides; 127,079 bottles of organophosphate insecticide and 20,904 sachets of neonicotinoid insecticide were used. About 72.5 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.

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		441,857	995,346			168,643	\$1,605,846	20.5%
Entomology			104,830		227,352	63,026	\$395,209	5.0%
Environmental Compliance			15,877		98,039	5,173	\$119,090	1.5%
Equipment Supplies				280,404			\$280,404	3.6%
IEC			1,856		7,158	53	\$9,067	0.1%
Insecticide	2,561,377						\$2,561,377	32.7%
M&E			71,750		330,384	93,913	\$496,047	6.3%
Post Spray			95,293		33,542	26,764	\$155,599	2.0%
Spray Campaign			75,285		1,191,246	11,622	\$1,278,153	16.3%
Spray Planning			182,388		724,219	34,499	\$941,105	12.0%
Grand Total	\$2,561,377	\$441,857	\$1,542,626	\$280,404	\$2,611,941	\$403,692	\$7,841,896	100.0%

17.3 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 m²).

TABLE ZA3: ZAMBIA UNIT COSTS

Unit Costs	
Person protected	\$ 2.78
Cost per Structure sprayed	\$ 13.53
100 m ² sprayed	\$ 21.20

17.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Zambia IRS program for 2017 and 2018, as implemented by the PMI VectorLink project. The comparison focuses on output measures, total expenditures, and unit costs.

Table ZA4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost decreased by 8.3 percent from 2017 to 2018, representing a decrease in the total annual cost of almost \$707,000.

TABLE ZA4: ZAMBIA IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2017 (Adjusted)	2018	Percentage Change 2017-2018
Insecticide	\$2,970,959	\$2,561,377	-13.8%
Local Admin	\$287,636	\$441,857	53.6%
Local Labor	\$1,309,078	\$1,542,626	17.8%
Spray Operations	\$3,438,914	\$2,611,941	-24.0%
Commodities	\$162,441	\$280,404	72.6%
U.S. Labor	\$379,694	\$403,692	6.3%
TOTAL	\$8,548,722	\$7,841,896	-8.3%

The largest cost decrease in both relative and absolute terms was for spray operations, which decreased by almost \$827,000 from 2017 to 2018 (a 24.0 percent decrease), accounting for 67 percent of the decreased cost between the two years. Insecticide costs decreased by 13.8 percent (about \$409,600), while local administration costs increased by \$154,220 (53.6 percent) from 2017 to 2018. Local labor, commodities, and U.S. labor costs also increased by 17.8 percent, 72.6 percent, and 6.3 percent, respectively, over the same time period. Local admin and site office costs increased largely due to currency deflation, which accounts for about half of the increased costs for local administration from 2017 to 2018, and increased costs for rent and insurance (which together account for about 36 percent of the increased costs between the two years). Commodities increased with the purchase of two project vehicles and the replacement of worn IRS equipment purchased from the home office as opposed to the site office due to quality concerns. Finally, U.S. labor increased due to visits from home office staff for STTA.

Table ZA5 compares the year-on-year change in Zambia IRS program output measures and unit costs. In 2018, the program had lower output metrics across the three categories considered, with decreases in program outputs of over 6 percent and 8 percent compared to 2017 for the number of people protected and structures sprayed, respectively, and over 12 percent less area sprayed. Because the decrease in structures and area sprayed was larger than the decrease in total expenditures, unit costs per structure sprayed and per 100 m² sprayed increased by 0.4 percent and 4.6 percent, respectively, from 2017 to 2018. Thus, the increased in unit costs in 2018 compared to 2017 is due largely to fixed costs (local administration, commodities, U.S. labor) and local labor increasing in costs despite spraying fewer houses and less area (with insecticide costs changing very nearly the same as the area sprayed and spray operations decreasing by more than the output measures). The cost per person protected decreased by about 2.2 percent.

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

	2017	2018	Percentage Change 2017-2018
Output Measures			
People Protected	3,005,676	2,818,176	-6.2%
Structures Sprayed	634,371	579,490	-8.7%
Area Sprayed (100 m ²)	421,928	369,958	-12.3%
Unit Costs			
Per Person Protected	\$2.84	\$2.78	-2.2%
Per Structure Sprayed	\$13.48	\$13.53	0.4%
Per Area Sprayed	\$20.26	\$21.20	4.6%

18. ZIMBABWE

18.1 BACKGROUND

TABLE ZW1: ZIMBABWE QUICK FACTS

	2018
Program Dates	Mar 1, 2018– Feb 28, 2019
Number of Districts	2
# Local Staff	14
Spray Start Date	Nov 5, 2018
Insecticides Used	Organophosphates
# Units of Insecticide Used	42,270
# People Protected	276,343
# Structures Sprayed	112,805
# 100 Square Meters Sprayed*	105,675

* Reverse calculation using number of insecticide units used during campaign multiplied by the average of 250 m² estimated to be sprayed by one unit and divided by the number of structures sprayed.

18.2 PROGRAM EXPENDITURES

This section presents an overview of Zimbabwe IRS program expenditures in 2018. Costs are organized by activity and cost category.

Table ZW2 displays the Zimbabwe IRS program total capital and recurrent expenditures from 2018. The first column lists the program activities as tracked by the PMI VectorLink project's financial systems, and the top row lists IRS program cost categories.

Insecticides and administration are the two most expensive IRS activities (18.3 percent and 32.9 percent of expenditures, respectively), followed by entomology (17.8 percent of expenditures). PMI VectorLink Zimbabwe procured 54,794 bottles of organophosphate insecticide; 42,270 bottles were used (reflected in Table ZW2). About 79 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.

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		268,657	863,567		-	159,638	\$1,291,862	32.9%
Entomology		2,122	381,063		266,999	50,732	\$700,916	17.8%
Environmental Compliance		1,792	118,055		44,838	62,616	\$227,301	5.8%
Equipment Supplies				117,327			\$117,327	3.0%
IEC					7,147		\$7,147	0.2%
Insecticide	719,396					1,684	\$721,080	18.3%
M&E			36,928		50,667	23,192	\$110,787	2.8%
Post Spray					4,039		\$4,039	0.1%
Spray Campaign			104,080		486,498	10,719	\$601,298	15.3%
Spray Planning					149,532	958	\$150,490	3.8%
Grand Total	\$719,396	\$272,571	\$1,503,693	\$117,327	\$1,009,720	\$309,539	\$3,932,247	100.0%

18.3 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 m²).

TABLE ZW3: ZIMBABWE UNIT COSTS

Unit Costs		
Cost per	Person protected	\$ 14.23
	Structure sprayed	\$ 34.86
	100 m ² sprayed	\$ 37.21

18.4 COMPARISON BETWEEN THE LAST TWO YEARS

This section provides a comparison of the Zimbabwe IRS program for 2017 and 2018, as implemented by the PMI VectorLink project. The comparison focuses on output measures, total expenditures, and unit costs.

Table ZW4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost decreased by 11.5 percent from 2017 to 2018, representing a decrease in the total annual cost of over \$511,000. Reductions in costs were seen in insecticide costs (58.8 percent or over \$1.02 million), spray operations costs (3.9 percent or over \$41,000), and commodity costs (12.5 percent or over \$16,000). Costs of local administration, local labor, and U.S. labor increased by 16.3 percent, 38.5 percent, and 61.5 percent, respectively, between 2017 and 2018. These cost increases are reflective of revised salary scales for local labor.

TABLE ZW4: ZIMBABWE IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2017 (Adjusted)	2018	Percentage Change 2017-2018
Insecticide	\$1,747,064	\$719,396	-58.8%
Local Admin	\$234,401	\$272,571	16.3%
Local Labor	\$1,085,508	\$1,503,693	38.5%
Spray Operations	\$1,050,988	\$1,009,720	-3.9%
Commodities	\$134,071	\$117,327	-12.5%
U.S. Labor	\$191,714	\$309,539	61.5%
TOTAL	\$4,443,754	\$3,932,247	-11.5%

Table ZW5 compares the year-on-year change in Zimbabwe IRS program output measures and unit costs. In 2018, the program had lower output metrics across the three categories considered, with decreases of 46.6 percent in the number of people protected, 46.0 percent in the number of structures sprayed, and 57.4 percent in the area sprayed, compared to 2017. Because the decrease in program size was larger than the decrease in total expenditures, unit costs increased from 2017 to 2018 by between 64 percent and 108 percent across the three output metrics. The 2018 campaign changed spray districts and reduced scope for carrying out direct spraying from four districts sprayed in 2017 in Manicaland to two districts in 2018 in Mashonaland East. However, VectorLink provided technical assistance from the home office and local site office to the government of Zimbabwe who took over spraying in the four districts previously sprayed by VectorLink, which contributed to the increase in local and U.S. labor. Additionally, under VectorLink site office administrative costs increased with the set-up of a new provincial office in Mashonaland East and site office labor increases due to the implementation of a new Local Compensation Plan scale in August 2018.

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

	2017	2018	Percentage Change 2017-2018
Output Measures			
People Protected	517,374	276,343	-46.6%
Structures Sprayed	209,055	112,805	-46.0%
Area Sprayed (100 m ²)	247,870	105,675	-57.4%
Unit Costs			
Per Person Protected	\$8.59	\$14.23	65.7%
Per Structure Sprayed	\$21.26	\$34.86	64.0%
Per Area Sprayed	\$17.93	\$37.21	107.6%

REFERENCES

Abbott, Michele, and Ben Johns. April 2013. *PMI IRS Country Programs: Comparative Cost Analysis, August 11, 2011 – December 31, 2012*. Bethesda, MD: Africa Indoor Residual Spraying (AIRS) Project, Abt Associates Inc.

Abbott, Michele, and Ben Johns. December 2014. *PMI IRS Country Programs: Comparative Cost Analysis, Years 1 and 2*. Bethesda, MD. Africa Indoor Residual Spraying Project, Abt Associates Inc.

Cico, Altea, and Benjamin Johns. May 2018. *PMI IRS Country Programs: 2017 Comparative Cost Analysis*. Rockville, MD. PMI VectorLink Project, Abt Associates Inc.

Cico, Altea, and Benjamin Johns. September 2017. *PMI IRS Country Programs: 2016 Comparative Cost Analysis*. Bethesda, MD. Africa Indoor Residual Spraying Project, Abt Associates Inc.

Johns, Benjamin, and Altea Cico. June 2015. *PMI IRS Country Programs: 2014 Comparative Cost Analysis*. Bethesda, MD. Africa Indoor Residual Spraying Project, Abt Associates Inc. 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>.

Johns, Benjamin, and Altea Cico. August 2016. *PMI IRS Country Programs: 2015 Comparative Cost Analysis*. Bethesda, MD. Africa Indoor Residual Spraying Project, Abt Associates Inc.

ANNEX A: YEAR-ON-YEAR COMPARISON OF OUTPUT MEASURES

Country	People Protected							Percent Change 2017-2018
	2012	2013	2014	2015	2016	2017	2018	
Uganda							4,436,156	
Tanzania					2,042,561	2,568,522	2,840,927	11%
Zambia			2,000,824	2,544,290	2,626,718	3,005,676	2,818,176	-6%
Madagascar	1,781,990	1,588,138	1,307,384	1,016,841	1,257,036	2,008,963	2,232,097	11%
Ethiopia	1,506,273	1,629,958	1,647,099	1,655,997	1,688,745	1,877,154	1,264,189	-33%
Kenya						906,388	1,833,860	102%
Benin	762,146	694,729	789,883	802,597	858,113	1,227,536	1,321,758	8%
Mozambique	2,716,176	2,181,896	2,327,815	1,631,058	1,929,654	1,711,518	1,663,078	-3%
Ghana	941,240	534,060	570,572	553,954	570,871	840,438	836,376	0%
Burkina Faso	115,638						766,374	
Rwanda	1,025,181	1,479,342	1,217,837	1,406,520	1,431,410	919,735	894,098	-3%
Mali	762,146	850,104	836,568	494,205	788,922	823,201	665,581	-19%
Zimbabwe			334,746	365,425	550,475	517,374	276,343	-47%
Malawi							501,324	
Average	686,485	639,873	788,052	747,921	981,750	1,171,893	1,596,453	36%

Country	Structures Sprayed							Percent Change 2017-2018
	2012	2013	2014	2015	2016	2017	2018	
Uganda							1,292,309	
Tanzania					515,217	664,622	744,597	12%
Zambia			409,544	519,598	559,550	634,371	579,490	-9%
Madagascar	371,391	343,470	274,533	247,902	310,426	487,636	548,789	13%
Ethiopia	547,421	635,528	667,236	704,945	715,541	738,810	472,569	-36%
Kenya						212,029	440,969	108%
Benin	206,295	228,951	254,072	252,706	269,179	384,761	400,997	4%
Mozambique	536,558	414,232	445,118	337,433	405,597	381,463	387,413	2%
Ghana	355,278	197,655	205,230	205,935	211,283	302,648	298,701	-1%
Burkina Faso	36,870						258,766	
Rwanda	236,610	345,862	297,005	343,131	346,917	231,258	214,802	-7%
Mali	206,295	228,985	228,123	133,527	228,672	227,646	160,723	-29%

Zimbabwe			147,949	162,127	229,377	209,055	112,805	-46%
Malawi							112,264	
Average	178,337	171,049	209,201	207,665	270,840	319,593	430,371	35%

Country	Area Sprayed (100 m ²)							Percent Change 2017-2018
	2012	2013	2014	2015	2016	2017	2018	
Uganda							1,386,420	
Tanzania					437,933	549,095	587,325	7%
Zambia			281,508	341,630	350,045	421,928	369,958	-12%
Madagascar	221,418	198,985	229,240	113,493	133,030	189,860	220,560	16%
Ethiopia	524,334	617,442	624,764	641,994	677,990	627,295	287,243	-54%
Kenya						176,383	406,170	130%
Benin	192,968	125,605	110,505	114,160	116,543	146,913	157,103	7%
Mozambique	974,470	822,735	914,518	649,370	637,380	513,058	462,068	-10%
Ghana	193,220	108,210	112,370	113,285	117,833	164,738	163,860	-1%
Burkina Faso	48,413						133,813	
Rwanda	332,522	529,940	482,958	578,390	634,915	456,020	408,878	-10%
Mali	192,968	233,588	224,868	146,180	211,428	200,673	192,463	-4%
Zimbabwe			167,600	183,315	263,685	247,870	105,675	-57%
Malawi							119,358	
Average	191,451	188,322	224,881	205,844	255,770	263,845	357,206	35%

ANNEX B: YEAR-ON-YEAR COMPARISON OF UNIT COSTS

Country	People Protected							Percent Change 2017-2018
	2012	2013	2014	2015	2016	2017	2018	
Uganda							\$3.60	
Tanzania					\$5.41	\$4.09	\$3.79	-7%
Zambia			\$3.15	\$3.96	\$2.89	\$2.84	\$2.78	-2%
Madagascar	\$2.83	\$4.47	\$5.05	\$5.13	\$3.45	\$3.52	\$3.24	-8%
Ethiopia	\$3.25	\$4.31	\$4.45	\$5.19	\$4.83	\$4.95	\$5.98	21%
Kenya						\$5.89	\$6.28	7%
Benin	\$4.23	\$4.62	\$4.56	\$4.41	\$4.29	\$3.99	\$3.72	-7%
Mozambique	\$1.54	\$1.91	\$1.88	\$4.94	\$6.06	\$6.83	\$5.50	-19%
Ghana	\$5.26	\$8.90	\$7.93	\$8.05	\$5.43	\$4.74	\$5.74	21%
Burkina Faso	\$10.93						\$4.50	
Rwanda	\$3.71	\$5.21	\$6.22	\$4.86	\$5.12	\$6.93	\$6.38	-8%
Mali	\$6.09	\$6.70	\$6.76	\$10.00	\$6.33	\$7.85	\$8.11	3%
Zimbabwe			\$14.06	\$12.36	\$10.10	\$8.59	\$14.23	66%
Malawi							\$7.99	
Average	\$4.73	\$5.16	\$6.01	\$6.55	\$5.39	\$5.47	\$5.85	7%

Country	Structures Sprayed							Percent Change 2017-2018
	2012	2013	2014	2015	2016	2017	2018	
Uganda							\$12.37	
Tanzania					\$21.44	\$15.82	\$14.45	-9%
Zambia			\$15.40	\$19.37	\$13.57	\$13.48	\$13.53	0%
Madagascar	\$13.56	\$20.66	\$24.04	\$21.05	\$13.97	\$14.49	\$13.18	-9%
Ethiopia	\$8.95	\$11.05	\$10.98	\$12.19	\$11.39	\$12.59	\$15.99	27%
Kenya						\$25.18	\$26.11	4%
Benin	\$15.63	\$14.03	\$14.17	\$14.01	\$13.66	\$12.72	\$12.25	-4%
Mozambique	\$7.80	\$10.07	\$9.84	\$23.87	\$28.82	\$30.64	\$23.61	-23%
Ghana	\$13.92	\$24.04	\$22.04	\$21.65	\$14.68	\$13.16	\$16.07	22%
Burkina Faso	\$34.27						\$13.34	
Rwanda	\$16.09	\$22.29	\$25.50	\$19.93	\$21.12	\$27.54	\$26.54	-4%
Mali	\$22.49	\$24.89	\$24.79	\$37.02	\$21.85	\$28.38	\$33.59	18%
Zimbabwe			\$31.81	\$27.87	\$24.25	\$21.26	\$34.86	64%

Malawi							\$35.69	
Average	\$16.59	\$18.15	\$19.84	\$21.88	\$18.47	\$19.57	\$20.83	6%

Country	Area Sprayed (100 m ²)							Percent Change 2017-2018
	2012	2013	2014	2015	2016	2017	2018	
Uganda							\$11.53	
Tanzania					\$25.22	\$19.15	\$18.32	-4%
Zambia			\$22.41	\$29.46	\$21.68	\$20.26	\$21.20	5%
Madagascar	\$22.75	\$35.66	\$28.79	\$45.98	\$32.59	\$37.23	\$32.80	-12%
Ethiopia	\$9.34	\$11.38	\$11.73	\$13.39	\$12.02	\$14.82	\$26.30	77%
Kenya						\$30.26	\$28.35	-6%
Benin	\$16.71	\$25.57	\$32.57	\$31.02	\$31.55	\$33.32	\$31.27	-6%
Mozambique	\$4.29	\$5.07	\$4.79	\$12.40	\$18.34	\$22.78	\$19.80	-13%
Ghana	\$25.60	\$43.90	\$40.25	\$39.36	\$26.32	\$24.19	\$29.29	21%
Burkina Faso	\$26.10						\$25.80	
Rwanda	\$11.45	\$14.54	\$15.68	\$11.82	\$11.54	\$13.97	\$13.94	0%
Mali	\$24.04	\$24.40	\$25.15	\$33.82	\$23.63	\$32.20	\$28.05	-13%
Zimbabwe			\$28.08	\$24.65	\$21.09	\$17.93	\$37.21	108%
Malawi							\$33.57	
Average	\$17.54	\$22.93	\$23.27	\$26.88	\$22.40	\$24.19	\$25.53	6%

ANNEX C: METHODOLOGY

OBJECTIVE

This report presents and compares the findings of a cost analysis of the expenses that were incurred during the past seven years of IRS program implementation in 14 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 (Abbott and Johns 2014).

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, 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 seven years. Information collected was augmented and verified through staff interviews. Program output and operational data were collected from the VectorLink 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 2018 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, 2017, and 2018 (Abbott and Johns 2013, Abbott and Johns 2014, Johns and Cico 2015, Johns and Cico 2016, Cico and Johns 2017, Cico and Johns 2018). 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 and Cico 2015).

This comparative costing analysis covers IRS implementation in 2012, 2013, 2014, 2015, 2016, 2017, and 2018. 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 IEC 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, 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.