



U.S. PRESIDENT'S MALARIA INITIATIVE



PMI IRS COUNTRY PROGRAMS: 2020 COMPARATIVE COST ANALYSIS

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PMI IRS COUNTRY PROGRAMS: 2020 COMPARATIVE COST ANALYSIS

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ACRONYMS

AIRS	Africa Indoor Residual Spraying
IEC	Information, Education and Communication
IRS	Indoor Residual Spraying
ITN	Insecticide Treated Net
M&E	Monitoring and Evaluation
NMCP	National Malaria Control Program
NMEP	National Malaria Elimination Program
PMI	U.S. President's Malaria Initiative
PPE	Personal Protective Equipment
SOP	Spray Operator
STTA	Short-term Technical Assistance
TCN	Third country national

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 2020 and compares these costs to IRS costs from 2012 through 2019.

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 past nine 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 2020

Project output data (see Table CC1 in the main report) were collected and verified by PMI VectorLink monitoring and evaluation (M&E) staff for the 16 countries with PMI-funded IRS campaigns that were implemented through the PMI VectorLink Project in 2020. In 2020, two new countries began implementing IRS through the PMI VectorLink project: Cote d'Ivoire and Senegal. In total, more than 21 million people, ranging from approximately 193,935 people in Cote d'Ivoire to more than 4.9 million people in Uganda, were protected. In total, the project sprayed almost 5.8 million structures, ranging from 53,962 structures in Cote d'Ivoire to 1,395,569 structures in Uganda, with a total of more than 501 million square meters (m²) of structures sprayed, and about 2.0 million units of insecticide used.

The average structure size varied across countries, ranging from 42.3 m² in Benin to 181.4 m² in Rwanda. The average people per structure sprayed ranged from 2.4 people in Zimbabwe to 4.5 people in Mozambique.

Table CC2 presents the results of the unit cost analysis. The overall unweighted average cost per person protected is \$7.44. The unweighted average cost per structure sprayed across countries is \$26.36. The unweighted average cost per 100 m² sprayed is \$31.43. On average, costs increased by 22 percent per person protected, 22 percent per structure sprayed and 20 percent per area sprayed compared with 2019. When excluding countries that did not have a VectorLink Project in 2019 (Senegal and Cote d'Ivoire), costs increased, on average, by 5 percent per person protected, 2 percent per structure sprayed and 5 percent per area sprayed. This year's percent increase is greater than the increases reported in last year's report comparing 2018 and 2019 (Johns, Haile. 2020). Largest increases in the cost per person protected and per structure sprayed were incurred in Zimbabwe, Madagascar, Mali, Tanzania, and Benin. In Madagascar, Mali, and Tanzania, fewer structures were sprayed and fewer people were protected in 2020 than in 2019; total costs also decreased between the two years but not as much as the decrease in outputs. In Zimbabwe and Benin, more people were protected in 2020 than

in 2019. However, total costs also increased between the two years in greater magnitude than the increase in outputs. The reasons for cost increases are discussed in the relevant country chapters.

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). Note that unlike the past year, spray operators and other seasonal labor began to be classified as temporary local labor in 2020, shifting costs between local labor and spray operations compared to previous years' analyses. The three largest cost categories were insecticide (30.2 percent of all costs), spray operations (28.2 percent of all costs), and local labor (26.2 percent of all costs), constituting an average of 84.6 percent of all costs (compared to 84.7 percent of total costs represented by these three categories in 2019). The lowest cost categories were U.S. labor and short-term technical assistance (STTA) (4.6 percent of all costs), spray commodities (4.3 percent of all costs) and local administration (6.5 percent of all costs).

Impact of COVID-19 on Costs

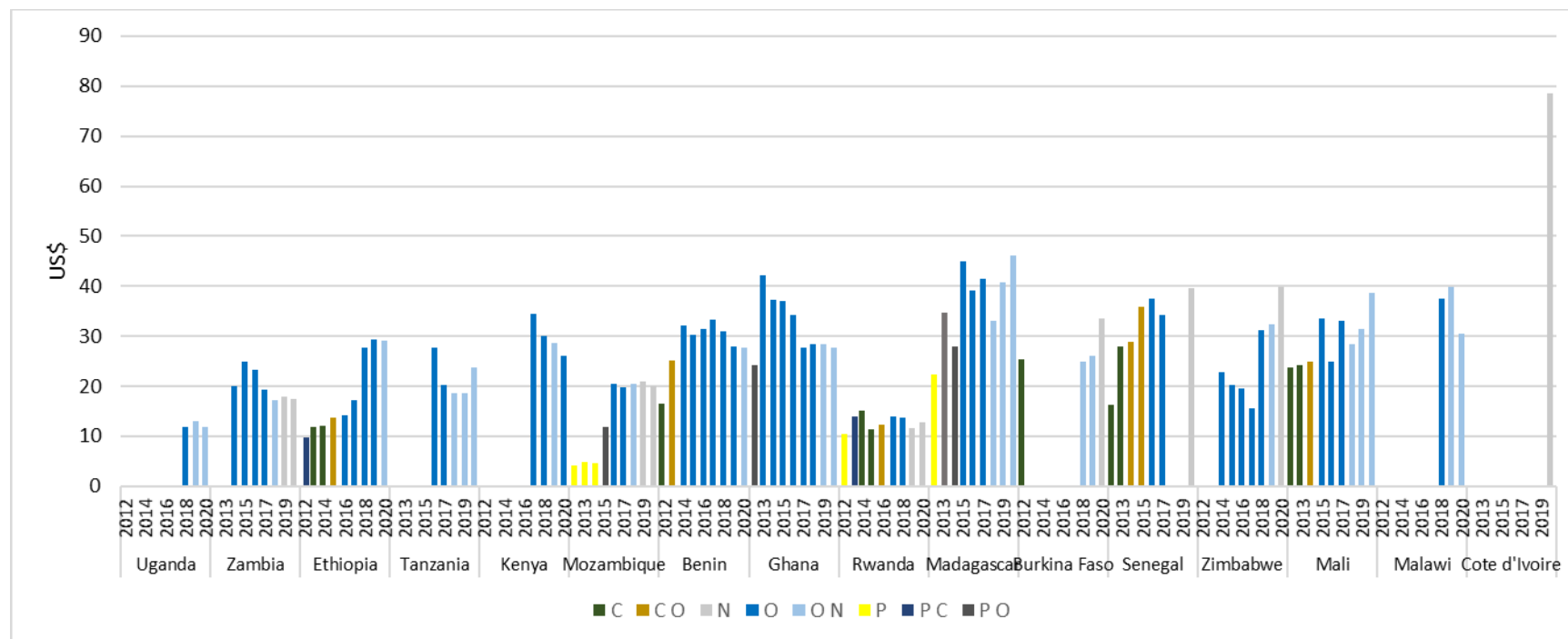
To minimize the spread of COVID-19, spray operations, end-of-day cleanup, monitoring and evaluation, office occupation and operations, and entomological monitoring were modified to protect workers and beneficiaries to the greatest extent possible. Social distancing and ventilation were primary factors in several decisions. An increase in the number of vehicles rented was made to accommodate lower vehicle occupancy, resulting in an estimated 20 percent increase in rental costs, and in some cases, extended campaigns. Planning and training meetings and data entry operations were broken into smaller groups, resulting in more venues and more trainers or facilitators. Large tents were rented for these activities to increase social distancing and improve ventilation. Office costs were increased by "deep-cleaning" requirements, and internet equipment and service subsidies were provided for some cadres working from home. Costs of PPE (masks, gloves, and sanitizers) increased, as more cadres required PPE for COVID-19 transmission prevention. Commodities increased an average of \$31,000 per country when considering countries that sprayed in both 2019 and 2020.

Cost increases were somewhat balanced by eliminating non-critical travel for STTAs and conference attendance, removing door to door mobilization as well as PSDQAs. In some cases, virtual meetings, trainings and telecommuting reduced facility costs. End-of-day clean-up innovations increased task efficiency and produced a reduction in hours worked, and in some cases, reduced maintenance requirements for sprayers. The exact costs associated with COVID-19 related modifications could not be determined with the data collected, however the four countries that submitted work plan budget modifications due to COVID reported an average cost increase of less than 1 percent by removing extraneous activities but prioritizing essential IRS safety measures.

Year-on-Year Comparison

Figure ESI shows the unit costs for the countries included in this analysis for the years 2012 through 2020, as well as the type of insecticide used. Countries are arranged in order of the number of structures sprayed during 2020 spray campaigns, from largest to smallest.

FIGURE ESI: COST PER 100M² SPRAYED 2012 THROUGH 2020



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 2019 and 2020.

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 make up the largest cost category across the IRS programs when looking at total expenditures. The spray operations portion of the cost per area sprayed, which includes subcontracted, direct, and local travel costs for entomology, environmental compliance, operations and M&E incurred throughout the year, constitutes an average of 31.6 percent of the total unit cost across country programs. In 2020, local labor was the second largest cost per area sprayed, on average across countries, constituting 30.1 percent of costs and reflecting the shift of spray operators and other seasonal labor into this category from spray operations.

I. INTRODUCTION

PMI aims to reduce the incidence and prevalence of malaria. PMI has implemented 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 criteria for national or sub-national pre-elimination. The 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 2020, the PMI VectorLink Project provided 16 PMI countries with full IRS operations and logistics support (Benin, Burkina Faso, Cote d'Ivoire, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mozambique, Rwanda, Senegal, Tanzania, Uganda, Zambia, and Zimbabwe). This was the first year of IRS implementation in Cote d'Ivoire and Senegal under the PMI VectorLink project.

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 M&E of all program activities; and
- Completing entomological surveillance and testing insecticide effectiveness in 14 of the 16 spray countries. In Benin, entomological surveillance is conducted by the Center for Entomological Research of Cotonou (CREC) through a direct funding mechanism from PMI, and in Tanzania, entomological monitoring work is conducted under a separate bilateral agreement.

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 through 2019 findings by reporting on 2020 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.

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 comparable 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 8.6 in Madagascar.

TABLE CCI: PMI VECTORLINK PROJECT SPRAY COVERAGE IN 2020, BY COUNTRY

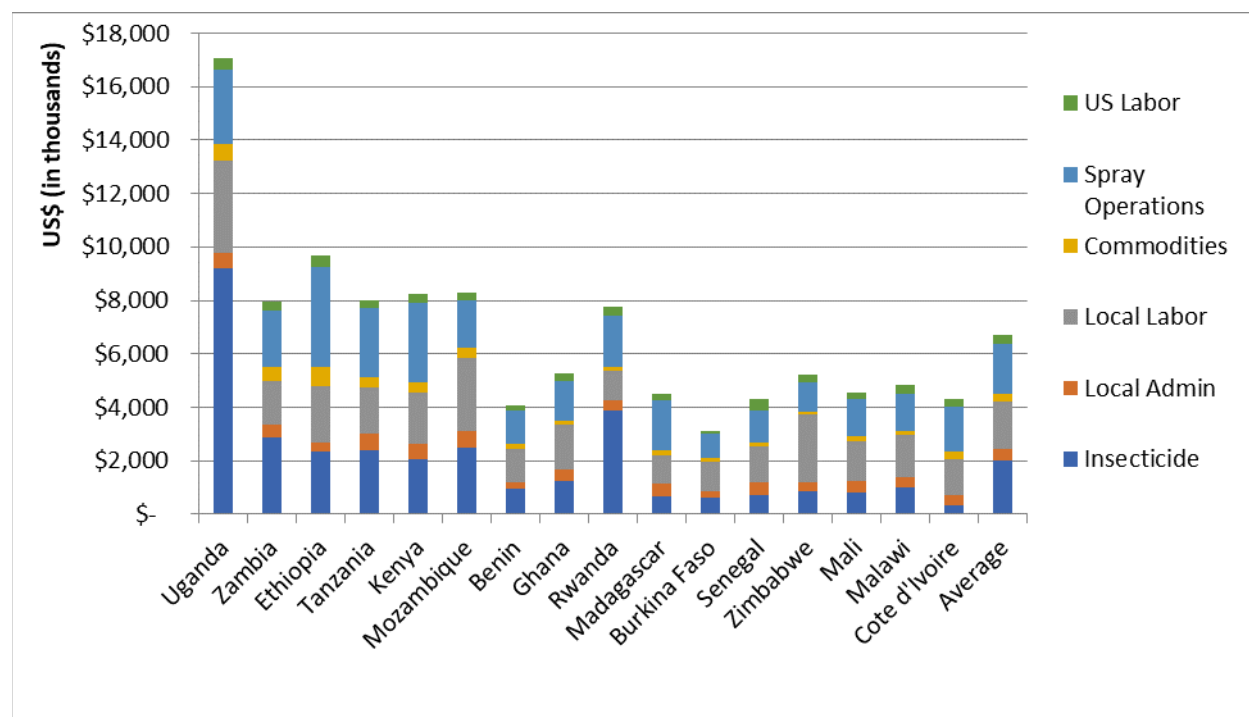
Country	# of People Protected	# of Structures Sprayed	Area Sprayed (100 m ²)	# People per Structure Sprayed	Avg. Size of Structure (m ²)	# People per Area Sprayed
Benin	1,104,928	350,349	148,183	3.2	42.3	7.5
Burkina Faso	508,107	162,037	92,820	3.1	57.3	5.5
Cote d'Ivoire	193,935	53,962	54,538	3.6	101.1	3.6
Ethiopia	1,511,728	527,375	332,335	2.9	63.0	4.5
Ghana	965,467	339,139	191,245	2.8	56.4	5.0
Kenya	1,792,495	436,472	316,750	4.1	72.6	5.7
Madagascar	833,483	197,787	97,478	4.2	49.3	8.6
Malawi	453,383	114,196	158,833	4.0	139.1	2.9
Mali	503,043	129,302	117,303	3.9	90.7	4.3
Mozambique	1,619,088	361,820	413,380	4.5	114.3	3.9
Rwanda	1,355,656	334,802	607,233	4.0	181.4	2.2
Senegal	571,649	136,417	108,900	4.2	79.8	5.2
Tanzania	1,915,151	471,622	336,148	4.1	71.3	5.7
Uganda	4,938,643	1,395,569	1,453,988	3.5	104.2	3.4
Zambia	2,776,336	648,914	454,845	4.3	70.1	6.1
Zimbabwe	315,403	133,078	131,820	2.4	99.1	2.4
Total	21,358,495	5,792,841	5,015,795			
Average	1,334,906	362,053	313,487	3.7	87.0	4.8

The average structure size and number of people per area sprayed provide additional contextual understanding of a country program's spray campaign. Structure size varied widely between countries, ranging from 42.3 m² in Benin to 181.4 m² in Rwanda. The average size of structures sprayed across all 2020 countries was 87.0 m² (not weighting for the different number of structures sprayed between countries). On average each unit of insecticide covered about 3.3 structures.

2.2 TOTAL PROGRAM EXPENDITURES

This section presents the IRS country programs' total expenditures for 2020. 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 2020 spray campaigns, from largest to smallest.

FIGURE CCI: CAPITAL AND RECURRENT EXPENDITURES, BY COST CATEGORY



Note: Costs of insecticides include insecticides provided by other donors (such as the Global Fund) or the government for Mozambique and Rwanda, respectively.

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 STTA cost category which remain consistent across all country programs at an annual average of about \$306,000 (compared with \$298,000 in 2019). Another category is local administration (rent, utilities, third country national (TCN) allowances). While more variable than the U.S.-based labor cost category, local administration is also considered a fixed cost and averages about \$435,000 across countries. These fixed costs are discussed in more detail in the cost-drivers analysis section. An average of 84.6 percent of total project expenditures is spent directly on the variable costs of spray operations, insecticide, and local labor. Starting in April 2020, costs spent for spray personnel were classified as local labor rather than spray operations as they were in 2019. In country chapters, we indicate when an increase in local labor is largely balanced by a decrease in spray operations.

The average total program implementation expenditures across all countries and cost categories are about \$6.8 million. Countries spraying over 230,000 structures ('large' programs) costs about \$8.1 million on average, medium sized countries (100,000 to 230,000 structures sprayed) costs about \$4.4 million. Cote d'Ivoire sprayed under 100,000 structures and cost about \$4.3 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). Countries are arranged in order of the number of structures sprayed, most to least.

TABLE CC2: 2020 IRS PROGRAM UNIT COSTS

Country	Cost per Person Protected	Cost per Structure Sprayed	Cost per Area Sprayed
Uganda	\$3.45	\$12.22	\$11.73
Zambia	\$2.87	\$12.27	\$17.50
Ethiopia	\$6.40	\$18.35	\$29.12
Tanzania	\$4.17	\$16.95	\$23.78
Kenya	\$4.59	\$18.87	\$26.00
Mozambique	\$5.13	\$22.95	\$20.09
Benin	\$3.70	\$11.67	\$27.60
Ghana	\$5.46	\$15.56	\$27.59
Rwanda	\$5.71	\$23.13	\$12.75
Madagascar	\$5.39	\$22.70	\$46.05
Burkina Faso	\$6.12	\$19.19	\$33.49
Senegal	\$7.55	\$31.64	\$39.64
Zimbabwe	\$16.61	\$39.38	\$39.75
Mali	\$9.03	\$35.13	\$38.72
Malawi	\$10.67	\$42.36	\$30.45
Cote d'Ivoire	\$22.10	\$79.41	\$78.58
Average (unweighted)	\$7.44	\$26.36	\$31.43

The average cost per structure sprayed across countries (not weighted by the number of structures sprayed in each country) was \$26.36. 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 to determine differences in cost drivers by unit cost across the countries. A cost driver is the activity, or unit of an activity, 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 82 percent of total costs across the countries, ranging from 74 percent of total costs in Senegal to 90 percent of costs in Uganda. Therefore, fixed costs (capital items, local administration, U.S.

labor, and commodities) were 18 percent of costs on average. Capital items constitute 3 percent of total costs; commodities were 3 percent of costs and up 1 percent from last year, potentially reflecting increased shipping and international PPE unit 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	3%	2%	2%	2%	10%	16%	54%	20%	90%	\$ 11.73
Zambia	5%	5%	4%	3%	17%	26%	36%	21%	83%	\$ 17.50
Ethiopia	3%	5%	4%	3%	16%	38%	24%	22%	84%	\$ 29.12
Tanzania	6%	4%	4%	2%	17%	32%	30%	22%	83%	\$ 23.78
Kenya	6%	3%	4%	3%	16%	36%	25%	23%	84%	\$ 26.00
Mozambique	6%	4%	4%	2%	17%	21%	30%	33%	83%	\$ 20.09
Benin	6%	5%	5%	2%	17%	30%	23%	30%	83%	\$ 27.60
Ghana	7%	3%	5%	1%	17%	28%	23%	32%	83%	\$ 27.59
Rwanda	4%	2%	4%	1%	12%	24%	50%	14%	88%	\$ 12.75
Madagascar	9%	4%	5%	2%	20%	41%	15%	24%	80%	\$ 46.05
Burkina Faso	6%	3%	3%	1%	13%	30%	20%	36%	87%	\$ 33.49
Senegal	10%	2%	11%	3%	26%	26%	16%	31%	74%	\$ 39.64
Zimbabwe	7%	2%	6%	1%	15%	21%	16%	48%	85%	\$ 39.75
Mali	9%	5%	5%	1%	20%	30%	18%	33%	80%	\$ 38.72
Malawi	7%	3%	7%	2%	18%	28%	21%	33%	82%	\$ 30.45
Cote d'Ivoire	7%	1%	6%	6%	21%	39%	8%	32%	79%	\$ 78.58
Average	7%	3%	5%	3%	18%	31%	21%	30%	82%	\$ 31.43

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, Rwanda and Zambia sprayed the second and third most area among the countries, with SOPs in Rwanda spraying above the overall average area per day, and SOPs in Zambia spraying below the overall average area per day. Ethiopia, Madagascar, Benin, Cote d'Ivoire, and Tanzania 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 (i.e., how close together structures are); however, data are not available to test this explanation. 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	5,847	140,328	24	\$3.23	48	1,453,988	10.4	30,291
Zambia	1,772	53,040	30	\$2.44	35	454,845	8.6	12,996
Ethiopia	1,728	86,010	50	\$8.25	63	332,335	3.9	5,275
Tanzania	2,559	50,919	20	\$8.68	63	336,148	6.6	5,336
Kenya	1,780	42,720	24	\$6.48	24	316,750	7.4	13,198
Mozambique	1,055	36,925	35	\$4.26	35	413,380	11.2	11,811
Benin	1,634	24,816	15	\$7.23	16	148,183	6.0	9,261
Ghana	643	19,290	30	\$6.19	30	191,245	9.9	6,375
Rwanda	1,739	34,780	20	\$5.67	40	607,233	17.5	15,181
Madagascar	705	16,920	24	\$4.49	24	97,478	5.8	4,062
Burkina Faso	627	10,420	17	\$5.88	20	92,820	8.9	4,641
Senegal	565	9,783	17	\$5.88	46	108,900	11.1	2,367
Zimbabwe	239	8,604	36	\$15.00	36	131,820	15.3	3,662
Mali	333	9,990	30	\$5.42	30	117,303	11.7	3,910
Malawi	449	13,021	29	\$9.60	30	158,833	12.2	5,294
Cote d'Ivoire	278	8,340	30	\$6.33	30	54,538	6.5	1,818
Average	1,372	35,369	27	6.56	35.63	313,487	9.6	8,467

3. YEAR-ON-YEAR COMPARISON

This section provides an overview of the major changes in countries' IRS programs across the years, focusing on changes from 2019 to 2020.

Table YR1 provides details on the changes in output measures for all country programs between 2019 and 2020. A complete table of output measures for all country programs for the period 2012-2020 is included in Annex A. Table YR2 shows the changes in unit costs between 2019 and 2020. A complete table of unit costs for all country programs for the period 2012-2020 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.

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

Country	People Protected			Structures Sprayed			Area Sprayed (100 m ²)		
	2019	2020	Percent Change 2019-2020	2019	2020	Percent Change 2019-2020	2019	2020	Percent Change 2019-2020
Uganda	4,479,157	4,938,643	10%	1,291,569	1,395,569	8%	1,352,893	1,453,988	7%
Zambia	2,273,188	2,776,336	22%	536,983	648,914	21%	378,248	454,845	20%
Ethiopia	1,334,868	1,511,728	13%	487,746	527,375	8%	304,420	332,335	9%
Tanzania	2,404,010	1,915,151	-20%	595,923	471,622	-21%	454,843	336,148	-26%
Kenya	2,011,860	1,792,495	-11%	507,777	436,472	-14%	397,193	316,750	-20%
Mozambique	1,484,191	1,619,088	9%	338,330	361,820	7%	395,325	413,380	5%
Benin	1,077,411	1,104,928	3%	335,207	350,349	5%	133,760	148,183	11%
Ghana	875,481	965,467	10%	298,385	339,139	14%	166,833	191,245	15%
Rwanda	1,288,965	1,355,656	5%	314,517	334,802	6%	613,545	607,233	-1%
Madagascar	1,150,922	833,483	-28%	267,874	197,787	-26%	119,158	97,478	-18%
Burkina Faso	587,248	508,107	-13%	201,901	162,037	-20%	136,423	92,820	-32%
Senegal	-	571,649	NA	-	136,417	NA	-	108,900	NA
Zimbabwe	307,209	315,403	3%	131,191	133,078	1%	127,213	131,820	4%
Mali	690,793	503,043	-27%	148,198	129,302	-13%	154,043	117,303	-24%
Malawi	441,375	453,383	3%	107,565	114,196	6%	131,373	158,833	21%
Cote d'Ivoire	-	193,935	NA	-	53,962	NA	-	54,538	NA
Average	1,275,417	1,334,906	5%	347,698	362,053	4%	304,079	313,487	3%

NA: Data are not available because these countries were not sprayed under PMI VectorLink in 2019.

As Table YR1 shows, nine countries (Uganda, Zambia, Ethiopia, Mozambique, Benin, Ghana, Rwanda, Zimbabwe, and Malawi) increased the number of people protected, all of which also increased the number of structures and areas sprayed from 2019 to 2020.

Unit costs decreased from 2019 to 2020 in Uganda, Zambia, Kenya, Mozambique, and Malawi (Table YR2). Unit costs increased in Tanzania, Madagascar, Burkina Faso, Zimbabwe, Rwanda, and Mali, and were mixed in Ethiopia, Benin, and Ghana. Note the change in the unit costs reflects the inclusion of Senegal and Cote d'Ivoire in the average unit costs for 2020 but not for 2019.

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

Country	Person Protected			Structure Sprayed			Area Sprayed (100 m ²)		
	2019	2020	Percent Change 2019-2020	2019	2020	Percent Change 2019-2020	2019	2020	Percent Change 2019-2020
Uganda	\$3.90	\$3.45	-11%	\$13.53	\$12.22	-10%	\$12.92	\$11.73	-9%
Zambia	\$2.97	\$2.87	-4%	\$12.59	\$12.27	-3%	\$17.87	\$17.50	-2%
Ethiopia	\$6.69	\$6.40	-4%	\$18.31	\$18.35	0%	\$29.34	\$29.12	-1%
Tanzania	\$3.54	\$4.17	18%	\$14.27	\$16.95	19%	\$18.69	\$23.78	27%
Kenya	\$5.67	\$4.59	-19%	\$22.48	\$18.87	-16%	\$28.73	\$26.00	-10%
Mozambique	\$5.56	\$5.13	-8%	\$24.38	\$22.95	-6%	\$20.86	\$20.09	-4%
Benin	\$3.46	\$3.70	7%	\$11.12	\$11.67	5%	\$27.86	\$27.60	-1%
Ghana	\$5.41	\$5.46	1%	\$15.88	\$15.56	-2%	\$28.41	\$27.59	-3%
Rwanda	\$5.52	\$5.71	4%	\$22.61	\$23.13	2%	\$11.59	\$12.75	10%
Madagascar	\$4.21	\$5.39	28%	\$18.08	\$22.70	26%	\$40.65	\$46.05	13%
Burkina Faso	\$6.08	\$6.12	1%	\$17.67	\$19.19	9%	\$26.15	\$33.49	28%
Senegal		\$7.55	NA		\$31.64	NA		\$39.64	NA
Zimbabwe	\$13.44	\$16.61	24%	\$31.47	\$39.38	25%	\$32.46	\$39.75	22%
Mali	\$7.01	\$9.03	29%	\$32.69	\$35.13	7%	\$31.45	\$38.72	23%
Malawi	\$11.83	\$10.67	-10%	\$48.53	\$42.36	-13%	\$39.74	\$30.45	-23%
Cote d'Ivoire		\$22.10	NA		\$79.41	NA		\$78.58	NA
Average	\$6.09	\$7.44	22%	\$21.69	\$26.36	22%	\$26.19	\$31.43	20%

NA: Data are not available because these countries were not sprayed under PMI VectorLink in 2019.

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

4. BENIN

4.1 BACKGROUND

TABLE BNI: BENIN QUICK FACTS

	2020
Program Dates	Jan 1, 2020– Dec 31, 2020
Number of Districts	7
# Local Staff	16
Spray Start Date	Apr 13, 2020
Insecticides Used	Organophosphates and Neonicotinoid/ pyrethroid mix
# Units of Insecticide Used	59,273: (1,018 Organophosphates and 58,255 Neonicotinoid/ pyrethroid mix)
# People Protected	1,104,928
# Structures Sprayed	350,349
# 100 Square Meters Sprayed*	148,183

* 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.

4.2 PROGRAM EXPENDITURES

This section will present an overview of Benin IRS program expenditures in 2020. Costs are organized by activity and cost category.

Table BN2 displays the Benin IRS program total capital and recurrent expenditures from 2020. 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 (31.9 percent of expenditures), followed by insecticide (24.0 percent of expenditures), and administration (20.0 percent of expenditures). PMI VectorLink Benin procured 60,970 sachets of Fludora® Fusion insecticide and used 58,255 sachets in addition to 1,018 bottles of Actellic CS300 left from the 2019 campaign (the cost of insecticide used is reflected in Table BN2). About 65.9 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 (95 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		265,707	419,381			93,169	\$778,257	19.0%
Entomology			118		29	646	\$793	0.0%
Environmental Compliance			34,919		21,685	32,792	\$89,395	2.2%
Equipment Supplies			596	216,628			\$217,223	5.3%
IEC*							\$-	0.0%
Insecticide	931,057						\$931,057	22.8%
M&E			54,993		28,727	60,402	\$144,121	3.5%
Post Spray			62,392		28,673		\$91,066	2.2%
Spray Campaign			539,567		697,402	308	\$1,237,276	30.3%
Spray Planning			117,968		475,099	7,005	\$600,072	14.7%
Grand Total	\$931,057	\$265,707	\$1,229,933	\$216,628	\$1,251,614	\$194,321	\$4,089,260	100.0%

Note: IEC: information, education, and communication.

* IEC did take place through town criers, mass media communication (radio spots), village leaders recruited within their own communities for a very short period, and printing pamphlets and leaflets. These costs were bundled with other printing or seasonal labor costs and are included in spray planning or spray campaign costs.

4.3 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
Person protected	\$ 3.70
Structure sprayed	\$ 11.67
100 m² sprayed	\$ 27.60

4.4 COMPARISON BETWEEN THE PAST TWO YEARS

This section provides a comparison of the PMI VectorLink Benin IRS program between 2019 and 2020, 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 9.7 percent from 2019 to 2020. Local labor increased the most between 2019 and 2020 both in total (about \$564,000) and percentage (85 percent) terms. This year spray operators were classified as local labor rather than spray operations as they were in 2019, and the increase in local labor of about \$564,000 is partly reflected in a decrease in spray operations by about \$391,000. Commodities and US labor also increased by 44 percent and 73 percent respectively, between the two years, while insecticide and local administration costs increased by 4 percent between the two years.

TABLE BN4: BENIN IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2019 (Adjusted)	2020	Percentage Change 2019-2020
Insecticide (used)	\$898,601	\$931,057	4%
Local Admin	\$256,191	\$265,707	4%
Local Labor	\$665,847	\$1,229,933	85%
Spray Operations	\$1,642,600	\$1,251,614	-24%
Commodities	\$150,565	\$216,628	44%
U.S. Labor	\$112,429	\$194,321	73%
TOTAL	\$3,726,234	\$4,089,260	9.7%

Table BN5 compares the year-on-year change in Benin IRS program output measures and unit costs. Overall, in 2020, the program had higher coverage metrics than in 2019. In 2019, the VectorLink program sprayed 6 districts in 2 departments, while in 2020 the VectorLink program sprayed 7 districts in 3 departments, reflected in both increased coverage indicators and increased costs. The number of people protected increased by 2.6 percent from 2019 to 2020, and the number of structures sprayed and area sprayed increased by 4.5 percent and 10.8 percent, respectively. Because the increase in program coverage was of a smaller magnitude than the increase in total expenditures for the number of people protected and structures sprayed, the cost per person protected increased from 2019 to 2020 by 7.0 percent and by 5.0 percent per structure sprayed. However, costs per area sprayed decreased by 0.9 percent from 2019 to 2020.

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

	2019	2020	Percentage Change 2019-2020
Output Measures			
People Protected	1,077,411	1,104,928	2.6%
Structures Sprayed	335,207	350,349	4.5%
Area Sprayed (100 m ²)	133,760	148,183	10.8%
Unit Costs			
Per Person Protected	\$3.46	\$3.70	7.0%
Per Structure Sprayed	\$11.12	\$11.67	5.0%
Per Area Sprayed	\$27.86	\$27.60	-0.9%

5. BURKINA FASO

5.1 BACKGROUND

TABLE BF1: BURKINA FASO QUICK FACTS

	2020
Program Dates	Jan 1, 2020–Dec 31, 2020
Number of Districts	2
# Local Staff	16
Spray Start Date	Jun 1, 2020
Insecticides Used	Neonicotinoids and Neonicotinoid/ pyrethroid mix
# Units of Insecticide Used	37,128 (31,029 N; 6,099 Neonicotinoid/ pyrethroid mix)
# People Protected	508,107
# Structures Sprayed	162,037
# 100 Square Meters Sprayed*	92,820

* 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 presents an overview of Burkina Faso IRS program expenditures in 2020. Costs are organized by activity and cost category.

Table BF2 displays the Burkina Faso IRS program total capital and recurrent expenditures from 2020. 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 (31.7 percent of expenditures), followed by insecticide (20.4 percent of expenditures) and entomology (17.1 percent of expenditures). PMI VectorLink procured 25,320 sachets of SumiShield; and 5,330 sachets of Fludora® Fusion, and used about 31,029 sachets of SumiShield, and 6,099 sachets of Fludora® Fusion (costs reflect the insecticides used). About 79.1 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.

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		205,642	778,624				\$984,267	31.7%
Entomology			5,990		498,182	26,819	\$530,991	17.1%
Environmental Compliance			30,546		9,717	17,520	\$57,783	1.9%
Equipment Supplies				109,744			\$109,744	3.5%
IEC			11,863		2,349		\$14,212	0.5%
Insecticide	633,659						\$633,659	20.4%
M&E			33,901		76,301	40,984	\$151,186	4.9%
Post Spray			50,478		25,995	3,192	\$79,666	2.6%
Spray Campaign			153,092		176,056	2,397	\$331,545	10.7%
Spray Planning			64,504		147,422	3,882	\$215,807	6.9%
Grand Total	\$633,659	\$205,642	\$1,128,999	\$109,744	\$936,022	\$94,794	\$3,108,859	100.0%

5.3 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
Cost per	Person protected	\$6.12
	Structure sprayed	\$19.19
	100 m2 sprayed	\$33.49

5.4 COMPARISON BETWEEN THE PAST TWO YEARS

This section provides a comparison of the PMI VectorLink Burkina Faso IRS program between 2019 and 2020, as implemented by the PMI VectorLink Project. The comparison focuses on output measures, total expenditures, and unit costs.

Table BF4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost decreased by 13 percent from 2019 to 2020, and costs decreased between the two years across all cost categories except local labor. Local labor increased by \$227,867 (25 percent) from 2019 to 2020. This year spray operators were classified as local labor rather than spray operations as they were in 2019, and the increase in local labor is largely reflected in a decrease in spray operations by about \$164,000. US labor decreased by the greatest relative amount (57 percent) from 2019 to 2020, while insecticides, which decreased by 32 percent between the two years, decreased by about \$292,791 and accounted for almost 43 percent of the overall decline in the total program costs.

TABLE BF4: BURKINA FASO IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2019 (Adjusted)	2020	Percentage Change 2019-2020
Insecticide (used)	\$926,449	\$633,659	-32%
Local Admin	\$302,771	\$205,642	-32%
Local Labor	\$901,131	\$1,128,999	25%
Spray Operations	\$1,100,541	\$936,022	-15%
Commodities	\$114,482	\$109,744	-4%
U.S. Labor	\$222,462	\$94,794	-57%
TOTAL	\$3,567,837	\$3,108,859	-13%

Table BF5 compares the year-on-year change in Burkina Faso IRS program output measures and unit costs. Overall, in 2020, the number of people protected decreased by 13 percent from 2019, and the number of structures sprayed decreased by 20 percent, while the area sprayed decreased by 32 percent.

Given the decrease in total program cost was of a smaller magnitude than the decrease in the coverage indicators, unit costs increased from 2019 to 2020 by 1 percent per person protected, 9 percent per structure sprayed, and 28 percent per area sprayed.

TABLE BF5: BURKINA FASO IRS PROGRAM COMPARISON OF OUTPUT MEASURES AND UNIT COSTS

	2019	2020	Percentage Change 2019-2020
Output Measures			
People Protected	587,248	508,107	-13%
Structures Sprayed	201,901	162,037	-20%
Area Sprayed (100 m ²)	136,423	92,820	-32%
Unit Costs			
Per Person Protected	\$6.08	\$6.12	1%
Per Structure Sprayed	\$17.67	\$19.19	9%
Per Area Sprayed	\$26.15	\$33.49	28%

6. COTE d'IVOIRE

6.1 BACKGROUND

TABLE CII: COTE D'IVOIRE QUICK FACTS

	2020
Program Dates	Jan 1, 2020–Dec 31, 2020
Number of Districts	2
# Local Staff	22
Spray Start Date	Aug 10, 2020
Insecticides Used	Neonicotinoids and Neonicotinoid/pyrethroid mix
# Units of Insecticide Used	21,815 (8,231 N; 13,584 N/P mix)
# People Protected	193,935
# Structures Sprayed	53,962
# 100 Square Meters Sprayed*	54,538

* 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.

6.2 PROGRAM EXPENDITURES

This section presents an overview of Cote d'Ivoire IRS program expenditures in 2020. Costs are organized by activity and cost category.

Table CI2 displays the Cote d'Ivoire IRS program total capital and recurrent expenditures from 2020. 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 (22.8 percent of expenditures), followed by the spray campaign (20.6 percent of expenditures) and entomology (16.2 percent of expenditures). PMI VectorLink procured 21,054 sachets of SumiShield and 29,057 sachets of Fludora® Fusion and used about 8,231 sachets of SumiShield and 13,584 sachets of Fludora® Fusion (costs reflect the insecticides used). About 64.7 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.

As a first-year spray country, start-up costs to build soak pits and purchase materials accounted for higher-than-average IRS activity costs. Entomology expenditures include all activity expenses incurred throughout the year for 18 resistance monitoring sites and 4 monthly vector monitoring sites for Abt and its in-country entomology partner Centre Suisse de Recherches Scientifiques en Cote d'Ivoire. Expenditures totaling \$692k reflect a disproportionately large share of costs compared to other IRS countries due to the small size of the spray program in Cote d'Ivoire.

Additionally, supplemental activities requested by PMI, such as the PATH-led baseline evaluation and various entomological capacity building activities (seconding an Abt-employed entomologist to NMCP, training two NMCP staff in medical entomology through a six-month residential training at Institute de Recherche en Sciences de la Sante in Burkina Faso, among others), are all included in costs presented and contribute to the cost per structure.

TABLE CI2: COTE D'IVOIRE 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		344,637	474,545			158,089	\$977,271	22.8%
Entomology			94,529		589,464	8,857	\$692,850	16.2%
Environmental Compliance			38,327		22,263	21,253	\$81,842	1.9%
Equipment Supplies			2,718	260,493			\$263,211	6.1%
IEC			44,408		31,661		\$76,069	1.8%
Insecticide	334,987						\$344,987	8.1%
M&E			82,814		123,406	65,496	\$271,716	6.3%
Post Spray			31,053		41,094	1,433	\$73,580	1.7%
Spray Campaign			319,423		559,504	1,748	\$880,675	20.6%
Spray Planning			297,257		314,532	11,328	\$623,117	14.5%
Grand Total	\$334,987	\$344,637	\$1,385,073	\$260,493	\$1,681,924	\$268,204	\$4,285,319	100.0%

6.3 UNIT COST ANALYSIS

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

TABLE CI3: COTE D'IVOIRE UNIT COSTS

		Unit Costs
Cost per	Person protected	\$22.10
	Structure sprayed	\$79.41
	100 m2 sprayed	\$78.58

Overall, the small number of structures sprayed contributed the most to the high unit costs. The Cote d'Ivoire program country footprint, entomology activities and fixed costs are on a similar scale as other small IRS programs but have much less structures to spread those costs across.

6.4 COMPARISON BETWEEN THE PAST TWO YEARS

PMI VectorLink did not have an IRS program in Cote d'Ivoire in 2019.

7. ETHIOPIA

7.1 BACKGROUND

TABLE ET1: ETHIOPIA QUICK FACTS

	2020
Program Dates	Jan 1, 2020–Dec 31, 2020
Number of Districts	44
# Local Staff	41
Spray Start Date	Jun 2, 2020
Insecticides Used	Organophosphates, Neonicotinoids, and Neonicotinoid/pyrethroid mix
# Units of Insecticide Used	132,934 (132,194 O, 480 N, 260 N/P)
# People Protected	1,511,728
# Structures Sprayed	527,375
# 100 Square Meters Sprayed*	332,335

* 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 2020. Costs are organized by activity and cost category.

Table ET2 displays the Ethiopia IRS program total capital and recurrent expenditures from 2020. 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 represented the largest cost category at 30.7 percent of costs. Insecticides and administration were the next two largest categories of costs, representing 24.3 and 14.1 percent of costs, respectively. PMI VectorLink procured 108,288 bottles of Actellic 300CS, 480 sachets of SumiShield, and 260 sachets of Fludora® Fusion and used 132,194 bottles of Actellic 300CS, 480 sachets of SumiShield, and 260 sachets of Fludora® Fusion. Of the total cost for administration, 75.4 percent 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		329,796	858,054			175,767	\$1,363,617	14.1%
Entomology			254,574		700,491	92,814	\$1,047,879	10.8%
Environmental Compliance			118,407		84,360	65,425	\$268,192	2.8%
Equipment Supplies				705,488			\$705,488	7.3%
IEC								0.0%
Insecticide	2,347,401		351				\$2,347,753	24.3%
M&E			152,755		158,480	72,863	\$384,098	4.0%
Post Spray			14,307		70,586	5,264	\$90,157	0.9%
Spray Campaign			676,320		2,292,305	6,214	\$2,974,839	30.7%
Spray Planning			33,182		451,436	11,886	\$496,504	5.1%
Grand Total	\$2,347,401	\$329,796	\$2,107,951	\$705,488	\$3,757,658	\$430,233	\$9,678,528	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	\$6.40
Structure sprayed	\$18.35
100 m² sprayed	\$29.12

7.4 COMPARISON BETWEEN THE PAST TWO YEARS

This section provides a comparison of the Ethiopia IRS program between 2019 and 2020, 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 increased by 8.4 percent from 2019 to 2020, representing an increase in the total annual cost of about \$748,125. Local labor accounted for the largest increase in costs in absolute terms (53.1 percent or about \$730,963). This year spray operators were classified as local labor rather than spray operations as they were in 2019, and the increase in local labor is less than the cost of spray operators, meaning other local labor costs decreased from 2019 to 2020. However, the decrease in spray operations was not as much as the cost of spray operators, indicating that the non-spray operator costs of spray operations increased by about 13 percent between 2019 and 2020 (compared to an increase in the number of structures sprayed of 8 percent between the two years). In relative terms, commodities saw the greatest increase (73.9 percent), but accounted for 22 percent of the increase in the total costs between the two years. This was primarily due to material purchases for pumps, tents, and personal protective equipment to accommodate increased structures and COVID mitigation. Cost for local administration decreased by about 37.9 percent (\$201,140), and costs for spray operations decreased by 9.4 percent (\$390,316).

TABLE ET4: ETHIOPIA IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2019 (Adjusted)	2020	Percentage Change 2019-2020
Insecticide	\$2,103,827	\$2,347,401	11.6%
Local Admin	\$530,936	\$329,796	-37.9%
Local Labor	\$1,376,988	\$2,107,951	53.1%
Spray Operations	\$4,147,974	\$3,757,658	-9.4%
Commodities	\$405,650	\$ 705,488	73.9%
U.S. Labor	\$365,029	\$ 430,233	17.9%
TOTAL	8,930,404	\$9,678,528	8.4%

Table ET5 compares the year-on-year change in Ethiopia IRS program output measures and unit costs. In 2020, the program protected more people, sprayed more structures and more area than in 2019.

Because both the number of people protected and total costs increased by 13.2 and 8.4 percent, respectively, from 2019 to 2020, the cost per person protected decreased from \$6.69 to \$6.40 (4.3 percent) across the two years. Similarly, the cost per area sprayed decreased by 0.7 percent across the two years. The increases in total costs were greater than the increase in number of structures sprayed from 2019 to 2020, resulting in higher costs per structure sprayed (0.2 percent increase).

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

	2019	2020	Percentage Change 2019-2020
Output Measures			
People Protected	1,334,868	1,511,728	13.2%
Structures Sprayed	487,746	527,375	8.1%
Area Sprayed (100 m ²)	304,420	332,335	9.2%
Unit Costs			
Per Person Protected	\$6.69	\$6.40	-4.3%
Per Structure Sprayed	\$18.31	\$18.35	0.2%
Per Area Sprayed	\$29.34	\$29.12	-0.7%

8. GHANA

8.1 BACKGROUND

TABLE GHI: GHANA QUICK FACTS

	2020
Program Dates	Jan 1, 2020 – Dec 31, 2020
Number of Districts	9
# Local Staff	32
Spray Start Date	March 24, 2020
Insecticides Used	Organophosphates, Neonicotinoids, and Neonicotinoid/pyrethroid mix
# Units of Insecticide Used	76,498 (4,835 O, 31,224 N, 40,439 N/P)
# People Protected	965,467
# Structures Sprayed	339,139
# 100 Square Meters Sprayed*	191,245

* 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. Costs are organized by activity and cost category.

Table GH2 displays the Ghana IRS program total capital and recurrent expenditures from 2020. 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, the spray campaign, and administration constitute almost 65 percent of costs (23.2, 18.4 and 22.7 percent of total costs, respectively). PMI VectorLink procured 25,440 sachets of SumiShield and 41,730 sachets of Fludora® Fusion and used 4,835 bottles of Actellic 300CS, 31,224 sachets of SumiShield, and 40,439 sachets of Fludora® Fusion; the cost for insecticide used is included in this analysis. 63.8 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. An additional \$157,528 was spent on activities related to ITN durability monitoring, which is not included in Table GH2.

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		433,601	610,552			154,045	\$1,198,198	22.7%
Entomology			224,654		437,122	1,716	\$663,493	12.6%
Environmental Compliance			50,339		33,955	39,043	\$123,337	2.3%
Equipment Supplies				143,178			\$143,178	2.7%
IEC			81,714		113,171		\$194,885	3.7%
Insecticide	1,222,113		-				\$1,222,113	23.2%
M&E			45,249		130,028	58,845	\$234,122	4.4%
Post Spray			136,940		119,831	1,904	\$258,675	4.9%
Spray Campaign			458,162		511,547	1,402	\$971,112	18.4%
Spray Planning			61,439		181,706	23,927	\$267,072	5.1%
Grand Total	\$1,222,113	\$433,601	\$1,669,049	\$143,178	\$1,527,362	\$280,882	\$5,276,185	100.0%

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
Cost per	Person protected	\$5.46
	Structure sprayed	\$15.56
	100 m² sprayed	\$27.59

8.4 COMPARISON BETWEEN THE PAST TWO YEARS

This section provides a comparison of the Ghana IRS program between 2019 and 2020, as implemented by the PMI VectorLink Project. The comparison focuses on output measures, total expenditures, and unit costs.

Table GH4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost increased by 11.3 percent from 2019 to 2020, representing an increase in the total annual cost of about \$536,381. Costs increased for local labor by \$755,072, and local administration by \$112,763, which together account for 86.3 percent of the increase in costs. This year's increase in local labor cost was driven by classification of seasonal workers (e.g. spray operators, mobilizers, etc.) as local labor rather than spray operations as they were in 2019; this accounts for about 55 percent of the increase in local labor costs. Other contributing factors includes an average of 7 percent annual increase plus equity adjustments and increased local labor costs associated with expansion to a new district (Tatale-Sanguli District). The increase in costs was partially offset by decreases in costs for spray operations (\$469,210). While about 86 percent of the decrease in spray operations is accounted for by reclassification of seasonal workers, the project undertook changes in operations to reduce the spread of COVID 19 (e.g. no IEC post spray meetings).

TABLE GH4: GHANA IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2019 (Adjusted)	2020	Percentage Change 2019-2020
Insecticide	\$1,173,748	\$1,222,113	4.1%
Local Admin	\$320,838	\$433,601	35.1%
Local Labor	\$913,977	\$1,669,049	82.6%
Spray Operations	\$1,996,572	\$1,527,362	-23.5%
Commodities	\$86,088	\$143,178	66.3%
U.S. Labor	\$248,581	\$280,882	13.0%
TOTAL	\$4,739,804	\$5,276,185	11.3%

Table GH5 compares the year-on-year change in Ghana IRS program output measures and unit costs. In 2020, the program protected more people and sprayed more structures and area, 10.3, 13.7, and 14.6 percent increases, respectively.

Total program costs increased by 11.3 percent, while all the coverage indicators increased by a greater relative magnitude between 2019 and 2020, except for people protected. Thus, the cost per person protected increased by 0.9 percent between the two years, while the cost per structure and area sprayed decreased by 2.1 and 2.9 percent, respectively, between the two years.

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

	2019	2020	Percentage Change 2019-2020
Output Measures			
People Protected	875,481	965,467	10.3%
Structures Sprayed	298,385	339,139	13.7%
Area Sprayed (100 m ²)	166,833	191,245	14.6%
Unit Costs			
Per Person Protected	\$5.41	\$5.46	0.9%
Per Structure Sprayed	\$15.88	\$15.56	-2.1%
Per Area Sprayed	\$28.41	\$27.59	-2.9%

9. KENYA

9.1 BACKGROUND

TABLE KNI: KENYA QUICK FACTS

	2020
Program Dates	Oct 1, 2019–Sep 30, 2020*
Number of Sub-counties	14
# Local Staff	39
Spray Start Date	Feb 10, 2020
Insecticides Used	Organophosphates
# Units of Insecticide Used	126,700
# People Protected	1,792,495
# Structures Sprayed	436,472
# 100 Square Meters Sprayed ⁺	316,750

*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 2020. Costs are organized by activity and cost category.

Table KN2 displays the Kenya IRS program total capital and recurrent expenditures from 2020. 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.

Insecticide is the most expensive IRS cost (25.0 percent of expenditures), followed by spray campaign (23.7 percent of expenditures) and administration (20.9 percent of expenditures). PMI VectorLink procured 116,352 bottles of Actellic CS300 and used about 126,700 bottles. Insecticide costs reflect total insecticides used. About 65.4 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		595,316	890,258			232,627	\$1,718,202	20.9%
Entomology			205,650		249,512	33,335	\$488,497	5.9%
Environmental Compliance			18,083		43,155	18,102	\$79,340	1.0%
Equipment Supplies				368,225			\$368,225	4.5%
IEC			65,220		74,718		\$139,938	1.7%
Insecticide	2,054,798						\$2,054,798	25.0%
M&E			157,998		26,832	36,786	\$221,615	2.7%
Post Spray			133,422		66,255	1,083	\$200,761	2.4%
Spray Campaign			94,773		1,842,998	10,995	\$1,948,766	23.7%
Spray Planning			325,272		676,709	12,549	\$1,014,531	12.3%
Grand Total	\$2,054,798	\$595,316	\$1,890,677	\$368,225	\$2,980,179	\$345,477	\$8,234,672	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	\$ 4.59
Cost per Structure sprayed	\$ 18.87
100 m2 sprayed	\$ 26.00

9.4 COMPARISON BETWEEN THE PAST TWO YEARS

This section provides a comparison of the Kenya IRS program between 2019 and 2020, as implemented by the PMI VectorLink Project. The comparison focuses on output measures, total expenditures, and unit costs. 2019 expenditures, excluding insecticides, have been adjusted to real 2020 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 decreased by 32.6 percent from 2019 to 2020, representing a decrease in the total cost of about \$3,178,393. Costs decreased for all categories over this period, except for local labor. Local labor increased by 8.7 percent (about \$151,245) during this period. About 26 percent of this increase is because, after April, spray operators were classified as local labor rather than spray operations as they were in 2019. Another contributing factor is the five equity raises for employees and the hiring of a new finance and administration manager at a cost higher than budgeted. Spray operations (44.2 percent) and local administration saw the greatest relative decrease between the two years, and together accounted for almost 80 percent of the decrease in total costs from 2019 to 2020. In addition to the recategorization of seasonal workers (e.g. spray operators, mobilizers, etc.) as local labor (which accounts for 2 percent of the decrease in spray operations costs), in 2020, PMI VectorLink made significant programmatic changes to adhere to the allotted budget. Such changes includes (a) a 30 percent reduction in number of structures to be targeted, (b) reduction in the number of spray days

from 30 to 24 days¹, (c) revision of spray supervision structure resulting in a reduction of supervision costs, (d) institution of two walk-to-work days when spray operators are scheduled to spray close to the operations site thereby saving two days of vehicle transportation costs, (e) elimination of the one-day stand-alone trainings for washers, security guards, drivers, and poison management personnel, (f) decrease in the number of days for identified trainings, e.g., mobilizer training reduced from three days to one day. The project eliminated overnight stays during training, thereby minimizing lodging and per diem, with the exception of the Training of Trainers, and (g) door-to-door mobilization was eliminated.

TABLE KN4: KENYA IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2019 (Adjusted)	2020	Percentage Change 2019-2020
Insecticide	\$2,636,023	\$2,054,798	-22.0%
Local Admin	\$894,677	\$595,316	-33.5%
Local Labor	\$1,739,432	\$1,890,677	8.7%
Spray Operations	\$5,340,418	\$2,980,179	-44.2%
Commodities	\$411,582	\$368,225	-10.5%
U.S. Labor	\$390,932	\$345,477	-11.6%
TOTAL	\$11,413,064	\$8,234,672	-32.6%

Table KN5 compares the year-on-year change in Kenya IRS program output measures and unit costs. In 2020, the program protected 10.9 percent fewer people and sprayed 14.0 percent fewer structures. Area sprayed decreased by 20.3 percent in 2020 compared to 2019.

Because the total program costs decreased more in magnitude than did the three coverage indicators from 2019 to 2020, unit costs decreased across the two years. The cost per person protected decreased from \$5.67 to \$4.59 (19.0 percent) across the two years. Cost per structure and area sprayed also decreased by 16.1 and 9.5 percent, respectively.

¹ In 2019, PMI VectorLink sprayed Migori in 24 days and Homa Bay in 30 days. The reduction in days means net reduction in costs through reduced number of vehicle days, offset by a slight increase in seasonal workers and spray team vehicles.

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

	2019	2020	Percentage Change 2019-2020
Output Measures			
People Protected	2,011,860	1,792,495	-10.9%
Structures Sprayed	507,777	436,472	-14.0%
Area Sprayed (100 m ²)	397,193	316,750	-20.3%
Unit Costs			
Per Person Protected	\$5.67	\$4.59	-19.0%
Per Structure Sprayed	\$22.48	\$18.87	-16.1%
Per Area Sprayed	\$28.73	\$26.00	-9.5%

10. MADAGASCAR

10.1 BACKGROUND

TABLE MG1: MADAGASCAR QUICK FACTS

	2020
Program Dates	Jan 1, 2020–Dec 31, 2020
Number of Districts	5
# Local Staff	37
Spray Start Date	Nov 2, 2020
Insecticides Used	Organophosphates, Neonicotinoids, and Neonicotinoid/pyrethroid mix
# Units of Insecticide Used	38,991 (12,096 O, 14,081 N, 12,814 N/P)
# People Protected	833,483
# Structures Sprayed	197,787
# 100 Square Meters Sprayed*	97,478

* 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 2020. Costs are organized by activity and cost category.

Table MG2 displays the Madagascar IRS program total capital and recurrent expenditures from 2020. 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 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		438,404	563,702			151,705	\$1,153,812	25.7%
Entomology			209,728		392,590	7,220	\$609,538	13.6%
Environmental Compliance			51,694		82,129	20,066	\$153,889	3.4%
Equipment Supplies				204,079			\$204,079	4.5%
IEC			18,842		26,865		\$45,707	1.0%
Insecticide	681,291						\$681,291	15.2%
M&E			44,914		140,980	41,706	\$227,600	5.1%
Post Spray			15,411		39,056	2,000	\$56,467	1.3%
Spray Campaign			26,343		871,477	2,233	\$900,052	20.0%
Spray Planning			131,566		312,745	12,362	\$456,672	10.2%
Grand Total	\$681,291	\$438,404	\$1,062,201	\$204,079	\$1,865,842	\$237,292	\$4,489,109	100.0%

Administration and the spray campaign were the two most expensive IRS activities (constituting 25.7 percent and 20.0 percent of expenditures, respectively), followed by insecticides (15.2 percent of expenditures). VectorLink Madagascar procured 12,096 bottles of Actellic CS300, 6,240 sachets of Fludora® Fusion, and 10,320 sachets of SumiShield, and used 12,096 bottles of Actellic CS300, 12,814 sachets of Fludora® Fusion, and 14,081 sachets of SumiShield sachets. The costs of insecticides used are reflected here. 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.

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
Cost per	Person protected	\$5.39
	Structure sprayed	\$22.70
	100 m ² sprayed	\$46.05

10.4 COMPARISON BETWEEN THE PAST TWO YEARS

This section provides a comparison of the VectorLink Madagascar IRS program between 2019 and 2020, as implemented by the project. The comparison focuses on output measures, total expenditures, and unit costs. 2019 expenditures, excluding insecticides, have been adjusted to real 2020 U.S. dollars to allow for a more accurate comparison.

Table MG4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost decreased by 7.3 percent from 2019 to 2020; costs decreased for all costs categories except local labor, which increased by \$15,172, and commodities, which increased \$41,338. All other costs also decreased during this period. Spray operations decreased by \$270,148 and accounts for over 65 percent of the decrease between the two years and reflects the smaller scale of operation in 2020 as

compared to 2019 as the targeted number of structures and the number of structures sprayed decreased respectively from 265,033 in 2019 to 203,513 in 2020, and from 267,874 in 2019 to 197,787. In addition, the project operated out of 17 operations sites in 2019 versus 15 operations sites in 2020. This reduction in the number of seasonal workers and operations sites subsequently led to a reduction in the cost of transportation, mobilization and communication. This year spray operators were classified as local labor rather than spray operations as they were in 2019, and the slight increase in local labor contributes to the decrease in spray operations.

TABLE MG4: MADAGASCAR IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2019 (Adjusted)	2020	Percentage Change 2019-2020
Insecticide	\$743,700	\$681,291	-8.4%
Local Admin	\$471,477	\$438,404	-7.0%
Local Labor	\$1,047,029	\$1,062,201	1.4%
Spray Operations	\$2,135,990	\$1,865,842	-12.6%
Commodities	\$162,741	\$204,079	25.4%
U.S. Labor	\$282,800	\$237,292	-16.1%
TOTAL	\$4,843,737	\$4,489,109	-7.3%

Table MG5 compares the year-on-year change in Madagascar IRS program output measures and unit costs. Overall, in 2020, the program covered about 26.2 percent fewer structures and protected about 27.6 fewer people than it did in 2019; area sprayed decreased by 18.2 percent between the two years.

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

	2019	2020	Percentage Change 2019-2020
Output Measures			
People Protected	1,150,922	833,483	-27.6%
Structures Sprayed	267,874	197,787	-26.2%
Area Sprayed (100 m ²)	119,158	97,478	-18.2%
Unit Costs			
Per Person Protected	\$4.21	\$5.39	28.0%
Per Structure Sprayed	\$18.08	\$22.70	25.5%
Per Area Sprayed	\$40.65	\$46.05	13.3%

Total program costs decreased by between 2019 and 2020 by a lower magnitude than the decrease in the coverage indicators. Thus, because coverage decreased more than costs, the cost per structure sprayed increased by 25.5 percent between the two years. The decrease in the number of people protected (27.6 percent) was larger than the decrease in the program costs between 2019 and 2020, indicating that the cost per person protected increased by 28.0 percent between the two years. The cost per area sprayed increased from \$40.65 in 2019 to \$46.05 in 2020, an increase of 13.3 percent.

II. MALAWI

II.1 BACKGROUND

TABLE MW1: MALAWI QUICK FACTS

	2020
Program Dates	Apr 1, 2020–Mar 31, 2021
Number of Districts	1
# Local Staff	20
Spray Start Date	Oct 26, 2020
Insecticides Used	Organophosphates and Neonicotinoids
# Units of Insecticide Used	63,533 (2,682 O; 60,851 N)
# People Protected	453,383
# Structures Sprayed	114,196
# 100 Square Meters Sprayed*	158,833

* 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.

II.2 PROGRAM EXPENDITURES

This section presents an overview of Malawi IRS program expenditures including technical assistance for government funded IRS in 2020. Costs are organized by activity and cost category.

Table MW2 displays the Malawi IRS program total capital and recurrent expenditures from 2020. 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 (26.1 percent of expenditures), followed by insecticide (20.7 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, and housing costs for one TCN and one expatriate staff. PMI VectorLink procured 60,420 sachets of SumiShield and used 63,533 units of insecticide (2,682 bottles of Actellic CS300 and 60,851 sachets of SumiShield. Costs reflect the insecticides used). About 60 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 79 percent of costs, with local administration, U.S. labor, and commodities costs composing the remaining 21 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		350,824	668,104			241,215	\$1,260,144	26.1%
Entomology*		21,014	109,011		440,022	2,987	\$573,034	11.8%
Environmental Compliance			49,194		29,299	21,085	\$99,578	2.1%
Equipment Supplies				139,925			\$139,925	2.9%
IEC			42,773		84,842		\$127,615	2.6%
Insecticide	1,001,073						\$1,001,073	20.7%
M&E		7,240	120,706		49,762	70,890	\$248,598	5.1%
Post Spray			25,777		20,363	-	\$46,140	1.0%
Spray Campaign			392,312		495,760	798	\$888,870	18.4%
Spray Planning			181,791		253,873	16,582	\$452,246	9.3%
Grand Total	\$1,001,073	\$379,078	\$1,589,669	\$139,925	\$1,373,921	\$353,557	\$4,837,224	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
Cost per	Person protected	\$10.67
	Structure sprayed	\$42.36
	100 m² sprayed	\$30.45

11.4 COMPARISON BETWEEN THE PAST TWO YEARS

This section provides a comparison of the Malawi IRS program between 2019 and 2020, as implemented by the PMI VectorLink Project. The comparison focuses on output measures, total expenditures, and unit costs.

Table MW4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost decreased by 7.3 percent (or about \$383,394) from 2019 to 2020. Costs increased for insecticide and local labor during this period. Additionally, this year spray operators were classified as local labor rather than spray operations as they were in 2019, and the increase in local labor reflected about 32 percent of the decrease in spray operations of about \$898,936. Spray operations decreased by 40 percent between the two years. When excluding the reclassification of spray operators to local labor, spray operations decreased by 27 percent, while local labor, not including spray operators, increased 6 percent.

TABLE MW4: MALAWI IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2019 (Adjusted)	2020	Percentage Change 2019-2020
Insecticide	\$738,773	\$1,001,073	36%
Local Admin	\$399,726	\$379,078	-5%
Local Labor	\$1,229,580	\$1,589,669	29%
Spray Operations	\$2,272,884	\$1,373,921	-40%
Commodities	\$168,287	\$139,925	-17%
U.S. Labor	\$411,367	\$353,557	-14%
TOTAL	\$5,220,617	\$4,837,224	-7.3%

Table MW5 compares the year-on-year change in Malawi IRS program output measures and unit costs. In 2020, the program protected 2.7 percent more people and sprayed 6.2 percent more structures. There was a 20.9 percent increase in total area sprayed in 2020 compared to 2019.

The decrease in total costs and increase in coverage resulted in decreased unit costs per person protected and per structure and area sprayed in 2020 (9.8, 12.7, and 23.1 percent decrease, respectively) as compared to 2019.

TABLE MW5: MALAWI IRS PROGRAM COMPARISON OF OUTPUT MEASURES AND UNIT COSTS

	2019	2020	Percentage Change 2019-2020
Output Measures			
People Protected	441,375	453,383	2.7%
Structures Sprayed	107,565	114,196	6.2%
Area Sprayed (100 m ²)	131,373	158,833	20.9%
Unit Costs			
Per Person Protected	\$11.83	\$10.67	-9.8%
Per Structure Sprayed	\$48.53	\$42.36	-12.7%
Per Area Sprayed	\$39.74	\$30.45	-23.4%

12. MALI

12.1 BACKGROUND

TABLE MLI: MALI QUICK FACTS

	2020
Program Dates	January 1 - December 31, 2020
Number of Districts	3
# Local Staff	21
Spray Start Date	June 15, 2020
Insecticides Used	Organophosphates, Neonicotinoids, and Neonicotinoid/pyrethroid mix
# Units of Insecticide Used	46,921 (9,646 O; 14,965 N; 22,310 N/P)
# People Protected	503,043
# Structures Sprayed	129,302
# 100 Square Meters Sprayed*	117,303

* 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 2020. Costs are organized by activity and cost category.

Table ML2 displays the Mali IRS program total capital and recurrent expenditures from 2020. 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 was the most expensive IRS activity (32.5 percent of expenditures), followed by entomology (18.1 percent of expenditures) and insecticide (17.5 percent of expenditures). PMI VectorLink procured 15,120 sachets of SumiShield and 22,620 sachets of Fludora® Fusion. PMI VectorLink used 9,646 bottles of Actellic CS300, 14,965 sachets of SumiShield, and 22,310 sachets of Fludora® Fusion (costs reflect the amount of insecticide used).

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

	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Ops	US Labor	Grand Total	% of Total
Admin		462,815	891,210			123,533	\$1,477,558	32.5%
Entomology			230,364		568,655	25,032	\$824,050	18.1%
Environmental Compliance			37,871		64,929	40,308	\$143,108	3.2%
Equipment Supplies				168,155			\$168,155	3.7%
IEC			665		8,724		\$9,389	0.2%
Insecticide	796,869						\$796,869	17.5%
M&E			83,984		133,829	38,259	\$256,072	5.6%
Post Spray			3,922		3,070		\$6,992	0.2%
Spray Campaign			229,056		406,556	635	\$636,247	14.0%
Spray Planning			6,363		197,914	19,438	\$223,715	4.9%
Grand Total	\$796,869	\$462,815	\$1,483,435	\$168,155	\$1,383,677	\$247,206	\$4,542,157	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
Cost per	Person protected	\$9.03
	Structure sprayed	\$35.13
	100 m² sprayed	\$38.72

12.4 COMPARISON BETWEEN THE PAST TWO YEARS

This section provides a comparison of the Mali IRS program between 2019 and 2020, 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 6.2 percent from 2019 to 2020. Costs decreased for all categories except local labor, which increased by about \$544,700 (58 percent), and U.S. labor, which increased by about \$32,400 (15.1 percent). This year spray operators were classified as local labor rather than spray operations as they were in 2019, and the increase in local labor somewhat offsets the decrease in spray operations. The M&E team implemented the VectorLink Collect M&E system for IRS for the first time in 2020, which incurred costs for U.S. labor.

Costs decreased for insecticide by almost \$294,000 (26.9 percent), for local administration by almost \$137,000 (22.8 percent), and for spray operations by about \$403,000 (22.6 percent) between 2019 and 2020. These decreases reflect a reduction of target area from 35 to 28 health areas. Savings were offset

somewhat by increased costs associated with COVID-19 mitigation measures such as doubling the number of rental vehicles, increasing the number of training venues to accommodate social distancing, as well as a modest increase in number of days for select seasonal workers such as storekeepers, security guards and data clerks.

TABLE ML4: MALI IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2019 (Adjusted)	2020	Percentage Change 2019-2020
Insecticide	\$1,090,705	\$796,869	-26.9%
Local Admin	\$599,771	\$462,815	-22.8%
Local Labor	\$938,744	\$1,483,435	58.0%
Spray Operations	\$1,786,892	\$1,383,677	-22.6%
Commodities	\$213,745	\$168,155	-21.3%
U.S. Labor	\$214,766	\$247,206	15.1%
TOTAL	\$4,844,623	\$4,542,157	-6.2%

Table ML5 compares the year-on-year change in Mali IRS program output measures and unit costs. In 2020, the program protected 27.2 percent fewer people, and sprayed 12.8 percent fewer structures and 23.9 percent less area than in 2019. Because the decrease in program size was of a higher magnitude than the decrease in total expenditures, unit costs increased from 2019 to 2020. The cost per person protected increased 28.7 percent to \$9.03 per person protected, while costs per structure sprayed and area sprayed increased 7.5 percent and 23.1 percent, respectively, from 2019 to 2020.

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

	2019	2020	Percentage Change 2019-2020
Output Measures			
People Protected	690,793	503,043	-27.2%
Structures Sprayed	148,198	129,302	-12.8%
Area Sprayed (100 m ²)	154,043	117,303	-23.9%
Unit Costs			
Per Person Protected	\$7.01	\$9.03	28.7%
Per Structure Sprayed	\$32.69	\$35.13	7.5%
Per Area Sprayed	\$31.45	\$38.72	23.1%

13. MOZAMBIQUE

13.1 BACKGROUND

TABLE MZI: MOZAMBIQUE QUICK FACTS

	2020
Program Dates	April 1, 2020 – March 31, 2021*
Number of Districts	5
# Local Staff	34
Spray Start Date	October 20, 2020
Insecticides Used	Neonicotinoids and Neonicotinoid/pyrethroid mix
# Units of Insecticide Used	165,352 (45,169 N; 120,183 N/P)
# People Protected	1,619,088
# Structures Sprayed	361,820
# 100 Square Meters Sprayed [†]	413,380

* 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; spray program dates were from March 1, 2020 - February 28, 2021.† 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 2020. Costs are organized by activity and cost category.

Table MZ2 displays the Mozambique IRS program total capital and recurrent expenditures from 2020. 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 the spray campaign are the two most expensive IRS activities (29.7 percent and 29.3 percent of expenditures, respectively), followed by entomology (13.2 percent of expenditures). The NMCP through the Global Fund procured Fludora® Fusion and SumiShield, and PMI VectorLink Mozambique used 102,053 and 45,169 sachets of Fludora® Fusion and SumiShield, respectively. Costs reflect the insecticides used. About 65 percent of the total cost for administration consists of labor, both local and U.S.-based. Local administration, U.S. labor, and commodities costs make up only about 16 percent of total costs.

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

	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Ops	US Labor	Grand Total	% of Total
Admin		324,636	353,678			100,950	\$779,264	9.4%
Entomology			445,532		614,085	33,642	\$1,093,259	13.2%
Environmental Compliance			69,270		11,606	41,241	\$122,118	1.5%
Equipment Supplies				349,078			\$349,078	4.2%
IEC			10,561		865		\$11,426	0.1%
Insecticide	2,467,477						\$2,467,477	29.7%
M&E			144,554		31,459	51,400	\$227,412	2.7%
Post Spray			70,717		22,008		\$92,726	1.1%
Spray Campaign		329,112	1,248,807		764,973	88,374	\$2,431,265	29.3%
Spray Planning			393,628		331,268	5,752	\$730,648	8.8%
Grand Total	\$2,467,477	\$653,748	\$2,736,747	\$349,078	\$1,776,264	\$321,359	\$8,304,673	100.0%

*Includes estimated cost of insecticides procured by the NMCP based on the unit price of \$15 for SumiShield 50WG and a base unit price of \$14.50 for Fludora® Fusion.

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	\$5.13
	Structure sprayed	\$22.95
	100 m ² sprayed	\$20.09

13.4 COMPARISON BETWEEN THE PAST TWO YEARS

This section provides a comparison of the PMI VectorLink Mozambique IRS program between 2019 and 2020, 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 increased by 0.7 percent from 2019 to 2020. Cost increased between 2019 and 2020 by 17.3 percent, 5.9 percent, and 2.5 percent for local labor, insecticide, and local admin, respectively. Local labor increased by \$404,525; this year spray operators were classified as local labor rather than spray operations as they were in 2019, and the increase in local labor is largely reflected in a decrease in spray operations by 20.2 percent (about \$449,350). Cost also decreased by 12.3 percent and 0.6 percent, respectively, for commodities and U.S. labor between 2019 and 2020.

TABLE MZ4: MOZAMBIQUE IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2019 (Adjusted)	2020	Percentage Change 2019-2020
Insecticide	\$2,330,278	\$2,467,477	5.9%
Local Admin	\$637,650	\$653,748	2.5%
Local Labor	\$2,332,222	\$2,736,747	17.3%
Spray Operations	\$2,225,617	\$1,776,264	-20.2%
Commodities	\$397,865	\$349,078	-12.3%
U.S. Labor	\$323,376	\$321,359	-0.6%
TOTAL	\$8,247,007	\$8,304,673	0.7%

Table MZ5 compares the year-on-year change in Mozambique IRS program output measures and unit costs. Overall, in 2020, the program protected more people and sprayed more structures and more area than in 2019. There were two main reasons for this increase. First, in some districts, especially Milange, Molumbo, and Morrumbala, the teams sprayed areas that were not originally planned for spray. These areas, which were mainly urban, had been removed as targets as part of the reduction in targets for all districts. Later, when COVID-19 restrictions prevented camping, and spraying in 19 hard-to-reach areas was not possible, some of the urban areas were added back. Since urban areas are more populated than remote ones, this meant that significantly more houses were sprayed and a larger population was protected. Moreover, most of the hard-to-reach areas were covered by the ITN campaign conducted in September and October 2020. Second, many people displaced by Cyclone Idai (which hit Mozambique in 2019) and related floods settled in the IRS districts, which led to an increase in the number of structures compared with 2019. Many people relocated from areas within the districts; others came from neighboring districts and provinces; and some from Malawi. The affected communities moved to the most appropriate areas based on distances and availability of space, relative to where they were coming from, however, the distribution was not even. This resulted in 23,490 more structures sprayed above the original target.

Because the increase in total program costs was of a smaller magnitude than the increase in people protected, structures sprayed, and area sprayed, unit costs decreased for all three metrics from 2019 to 2020 (7.7 percent, 5.8 percent, 3.7 percent, respectively).

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

	2019	2020	Percentage Change 2019-2020
Output Measures			
People Protected	1,484,191	1,619,088	9.1%
Structures Sprayed	338,330	361,820	6.9%
Area Sprayed (100 m ²)	395,325	413,380	4.6%
Unit Costs			
Per Person Protected	\$5.56	\$5.13	-7.7%
Per Structure Sprayed	\$24.38	\$22.95	-5.8%
Per Area Sprayed	\$20.86	\$20.09	-3.7%

14. RWANDA

14.1 BACKGROUND

TABLE RW1: RWANDA QUICK FACTS

	2020
Program Dates*	March 1, 2020 - February 28, 2021
Number of Districts	3 + Mahama Refugee Camp
# Local Staff	15
Spray Start Date	Aug 24, 2020
Insecticides Used	Neonicotinoid/pyrethroid mix
# Units of Insecticide Used	242,893 (including 4,823 provided by the government to spray Mahama Refugee Camp)
# People Protected [#]	1,355,656
# Structures Sprayed [#]	334,802
# 100 Square Meters Sprayed ^{#+}	607,233

* Previous years reported costs for the calendar year; this report reflects the costs for the program dates listed here.

[#]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 2020. Costs are organized by activity and cost category.

Table RW2 displays the Rwanda IRS program total capital and recurrent expenditures from 2020. 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.

Insecticide is the most expensive IRS cost component (50.2 percent of expenditures), followed by spray campaign and administration costs, representing 20.7 and 13.0 percent of costs, respectively. The project procured 251,810 sachets of Fludora® Fusion and used 242,893 sachets. The costs below reflect the cost of insecticide used. About 63 percent of the total cost for administration consisted of labor, both local and U.S.-based. U.S. labor, commodities, and local administration 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

	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Ops	US Labor	Grand Total	% of Total
Admin		375,407	413,236			214,224	\$1,002,867	13.0%
Entomology			78,782		274,727	2,178	\$355,688	4.6%
Environmental Compliance			73,743		19,455	41,625	\$134,824	1.7%
Equipment Supplies				140,827			\$140,827	1.8%
IEC							\$-	0.0%
Insecticide	3,884,449						\$3,884,449	50.2%
M&E			78,206		25,702	55,382	\$159,290	2.1%
Post Spray			32,609		43,126	469	\$76,204	1.0%
Spray Campaign			313,869		1,281,870	3,467	\$1,599,206	20.7%
Spray Planning			108,697		258,638	22,496	\$389,830	5.0%
Grand Total	\$3,884,449	\$375,407	\$1,099,143	\$140,827	\$1,903,518	\$339,840	\$7,743,185	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	\$5.71
Structure sprayed	\$23.13
100 m² sprayed	\$12.75

14.4 COMPARISON BETWEEN THE PAST TWO YEARS

This section provides a comparison of the Rwanda IRS program between 2019 and 2020, 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 increased by 9 percent from 2019 to 2020, representing an increase in the total annual cost of about \$632,957. Spray operations and local labor costs increased by 41 percent and 27 percent, respectively, and account for over 97 percent of the increased costs compared to 2019. The cost for commodities, local admin and US labor all decreased from 2019 to 2020.. Increases in local labor reflect classification of spray operators as local labor in this report; in 2019 they were classified as spray operations.

TABLE RW4: RWANDA IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2019 (Adjusted)*	2020	Percentage Change 2019-2020
Insecticide	\$3,862,066	\$3,884,449	1%
Local Admin	\$394,812	\$375,407	-5%
Local Labor	\$867,636	\$1,099,143	27%
Spray Operations	\$1,353,065	\$1,903,518	41%
Commodities	\$263,103	\$140,827	-46%
U.S. Labor	\$369,546	\$339,840	-8%
TOTAL	\$7,110,228	\$7,743,185	9%

*Costs for 2019 have been adjusted to reflect the March to February program dates and to include government provided insecticides and thus do not necessarily reflect costs reported in the 2019 Comparative Cost Analysis.

Table RW5 compares the year-on-year change in VectorLink Rwanda program output measures and unit costs. In 2020, the program achieved higher coverage in terms of structures sprayed and people protected than in 2019. Between 2019 and 2020, the number of people protected increased by 5.2 percent and the number of structures sprayed increased 6.4 percent, while the area sprayed decreased by 1.0 percent. Given the higher magnitude of increase in total expenditures compared to the increase in number of people protected and structures sprayed, the unit costs increased 3.5 percent for cost per person protected and 2.3 percent for cost per structure sprayed. Cost per area sprayed increased by 10.0 percent.

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

	2019*	2020	Percentage Change 2019-2020
Output Measures			
People Protected	1,288,965	1,355,656	5.2%
Structures Sprayed	314,517	334,802	6.4%
Area Sprayed (100 m ²)	613,545	607,233	-1.0%
Unit Costs			
Per Person Protected	\$5.52	\$5.71	3.5%
Per Structure Sprayed	\$22.61	\$23.13	2.3%
Per Area Sprayed	\$11.59	\$12.75	10.0%

*Coverage indicators and costs for 2019 have been adjusted to reflect the full March 2019 to February 2020 program, adding in structures sprayed in January 2020 and thus do not necessarily reflect costs reported in the 2019 Comparative Cost Analysis.

15. SENEGAL

15.1 BACKGROUND

TABLE SN1: SENEGAL QUICK FACTS

	2020
Program Dates*	January 1 - December 31, 2020
Number of Districts	4
# Local Staff	22
Spray Start Date	May 28, 2020 (Kedougou & Makacolibatang) July 13, 2020 (Koumpentoum & Kounghoul)
Insecticides Used	Neonicotinoids and Neonicotinoid/pyrethroid mix
# Units of Insecticide Used	43,560 (7,680 O; 35,880 N/P)
# People Protected	571,649
# Structures Sprayed	136,417
# 100 Square Meters Sprayed ⁺	108,900

* 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 Senegal IRS program expenditures in 2020. Costs are organized by activity and cost category.

Table SN2 displays the Senegal IRS program total capital and recurrent expenditures from 2020. 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 SN2: SENEGAL IRS PROGRAM CAPITAL AND RECURRENT EXPENDITURES, BY
ACTIVITY AND COST CATEGORY**

	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Ops	US Labor	Grand Total	% of Total
Admin		467,501	626,698		23,124	350,409	\$1,467,731	34.0%
Entomology			61,065		415,229	3,020	\$479,314	11.1%
Environmental Compliance			78,464		24,017	22,919	\$125,400	2.9%
Equipment Supplies				167,642			\$167,642	3.9%
IEC			18,295		35,766		\$54,061	1.3%
Insecticide	699,113						\$699,113	16.2%
M&E			100,901		24,556	64,115	\$189,572	4.4%
Post Spray			101,872		61,302	2,552	\$165,726	3.8%
Spray Campaign			261,686		316,716	6,539	\$584,941	13.6%
Spray Planning			95,998		278,142	9,073	\$383,214	8.9%
Grand Total	\$699,113	\$467,501	\$1,344,978	\$167,642	\$1,178,852	\$458,627	\$4,316,713	100.0%

Administration is the most expensive IRS activity (34 percent of expenditures), followed by insecticide (16.2 percent of expenditures) and spray campaign activities (13.6 percent of expenditures). PMI VectorLink procured 7,680 sachets of SumiShield insecticide and 35,880 sachets of Fludora® Fusion. PMI VectorLink used all purchased insecticide. About 67 percent of the total cost for administration consists of labor, both local and U.S.-based. Commodities, U.S. labor, and local administration costs are minimal compared to expenditures spray operations, local labor, and insecticide.

15.3 UNIT COST ANALYSIS

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

TABLE SN3: SENEGAL UNIT COSTS

		Unit Costs
Cost per	Person protected	\$7.55
	Structure sprayed	\$31.64
	100 m² sprayed	\$39.64

15.4 COMPARISON BETWEEN THE PAST TWO YEARS

PMI VectorLink did not conduct IRS in Senegal in 2019 so there is no comparison data from the previous year.

16. TANZANIA

16.1 BACKGROUND

TABLE TZI: TANZANIA QUICK FACTS

	2020
Program Dates*	October 1, 2019 - September 30, 2020
Number of Districts	6 Mainland districts, 3 Mainland refugee camps, selected areas of Unguja and Pemba in Zanzibar
# Local Staff	33
Spray Start Date <i>Mainland</i>	Oct 15 - Nov 25, 2019
<i>Zanzibar</i>	February 15 - 27, 2020
Insecticides Used	Organophosphates and Neonicotinoids
# Units of Insecticide Used	135,341 (66,362 O; 68,979 N)
# People Protected	1,915,151
# Structures Sprayed	471,622
# 100 Square Meters Sprayed ⁺	336,148

*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.

16.2 PROGRAM EXPENDITURES

This section presents an overview of Tanzania IRS program expenditures in 2020. Costs are organized by activity and cost category.

Table TZ2 displays the Tanzania IRS program total capital and recurrent expenditures from 2020. 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**

	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Ops	US Labor	Grand Total	% of Total
Admin		600,955	1,059,432			188,636	\$1,849,022	23.1%
Entomology					34,350	594	\$34,944	0.4%
Environmental Compliance			50,492		45,777	39,982	\$136,250	1.7%
Equipment Supplies				395,910			\$395,910	5.0%
IEC							\$-	0.0%
Insecticide	2,400,474						\$2,400,474	30.0%
M&E			112,827		135,234	49,452	\$297,512	3.7%
Post Spray			188,353		55,090	1,590	\$245,034	3.1%
Spray Campaign			99,288		1,641,609	6,879	\$1,747,776	21.9%
Spray Planning			220,737		653,795	10,807	\$885,339	11.1%
Grand Total	\$2,400,474	\$600,955	\$1,731,128	\$395,910	\$2,565,855	\$297,939	\$7,992,261	100.0%

Insecticide is the most expensive IRS activity (30 percent of expenditures), followed by administration (23.1 percent of expenditures) and spray campaign activities (21.9 percent of expenditures). PMI VectorLink procured 77,460 sachets of SumiShield insecticide and 70,992 bottles of Actellic CS300. PMI VectorLink used about 66,362 bottles of Actellic CS300 and 68,979 sachets of SumiShield (costs reflect the insecticides used). About 68 percent of the total cost for administration consists of labor, both local and U.S.-based. U.S. labor and commodities costs are minimal compared to expenditures on insecticide, local labor, and spray operations.

16.3 UNIT COST ANALYSIS

This section presents 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
Cost per	Person protected	\$4.17
	Structure sprayed	\$16.95
	100 m² sprayed	\$23.78

16.4 COMPARISON BETWEEN THE PAST TWO YEARS

This section provides a comparison of the Tanzania IRS program between 2019 and 2020, 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 decreased by 6 percent from 2019 to 2020, representing a decrease in the total annual cost of \$509,867 due to decreases in costs for insecticides and local administration.

The costs of insecticides used decreased by almost 29 percent (about \$976,000) from 2019 to 2020. Local administration also decreased by 37.5 percent from 2019 to 2020. Increases were seen in all other categories of cost, with the highest increases in commodities and spray operations also increased by 26.4 percent and 25.9 percent, respectively. Compared to 2019, the campaign in 2020 sprayed in more remote areas and added several new districts, requiring new operations sites. Thus, increased operations costs between the two years reflect setting up new sites in new areas.

TABLE TZ4: TANZANIA IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2019 (Adjusted)	2020	Percentage Change 2019-2020
Insecticide	\$3,376,560	\$2,400,474	-28.9%
Local Admin	\$961,920	\$600,955	-37.5%
Local Labor	\$1,538,341	\$1,731,128	12.5%
Spray Operations	\$2,038,729	\$2,565,855	25.9%
Commodities	\$313,100	\$395,910	26.4%
U.S. Labor	\$273,479	\$297,939	8.9%
TOTAL	\$8,502,128	\$7,992,261	-6.0%

Table TZ5 compares the year-on-year change in Tanzania IRS program output measures and unit costs. In 2020, the program had lower coverage metrics than in 2019. The number of people protected decreased by 20.3 percent, and the number of structures sprayed and area sprayed decreased by 20.9 percent and 26.1 percent, respectively. The decrease in program size was of a higher magnitude than the decrease in total expenditures, resulting in increased unit costs from 2019 to 2020. The cost per person protected increased by 18 percent to \$4.17 per person protected, while costs per structure sprayed and area sprayed increased on the order of 18.8 percent and 27.2 percent, respectively, from 2019 to 2020. This can be attributed to increases in spray operation and commodities costs, which, as percentages, increased more than the decrease in project scope.

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

	2019	2020	Percentage Change 2019-2020
Output Measures			
People Protected	2,404,010	1,915,151	-20.3%
Structures Sprayed	595,923	471,622	-20.9%
Area Sprayed (100 m ²)	454,843	336,148	-26.1%
Unit Costs			
Per Person Protected	\$3.54	\$4.17	18.0%
Per Structure Sprayed	\$14.27	\$16.95	18.8%
Per Area Sprayed	\$18.69	\$23.78	27.2%

17. UGANDA

17.1 BACKGROUND

TABLE UG1: UGANDA QUICK FACTS

	2020
Program Dates	January 1 - December 31, 2020
Number of Districts	16
# Local Staff	54
Spray Start Date <i>Phase 1:</i> Budaka, Bugiri, Butaleja, Butebo, Dokolo, Namutumba, Pallisa, and Tororo	March 2, 2020
<i>Phase 2:</i> Alebtong, Amolatar, Dokolo, Kaberamaido, Lira, Otuke, and Serere	May 25, 2020
Insecticides Used	Organophosphates, Neonicotinoids and Neonicotinoid/pyrethroid mix
# Units of Insecticide Used	581,595 (72,500 O; 28,161 N; and 480,934 N/P)
# People Protected	4,938,643
# Structures Sprayed	1,395,569
# 100 Square Meters Sprayed*	1,453,988

* 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 Uganda IRS program expenditures in 2020. Costs are organized by activity and cost category.

Table UG2 displays the Uganda IRS program total capital and recurrent expenditures from 2020. 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**

	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Operations	US Labor & STTA	Grand Total	% of Total
Admin		582,533	974,875			151,674	\$1,709,082	10.0%
Entomology			281,021		391,995	57,471	\$730,487	4.3%
Environmental Compliance			92,490		59,038	30,968	\$182,495	1.1%
Equipment Supplies			1,747	612,912			\$614,659	3.6%
IEC			47,749		437,649		\$485,398	2.8%
Insecticide	9,210,515						\$9,210,515	54.0%
M&E			177,538		152,433	112,842	\$442,814	2.6%
Post Spray			298,801		121,757	2,630	\$423,188	2.5%
Spray Campaign			1,310,230		961,815	5,923	\$2,277,968	13.4%
Spray Planning			248,950		684,395	45,064	\$978,408	5.7%
Grand Total	\$9,210,515	\$582,533	\$3,433,401	\$612,912	\$2,809,083	\$406,571	\$17,055,014	100.0%

Insecticide is the most expensive IRS activity (54.0 percent of expenditures), followed by spray campaign (13.4 percent of expenditures) and administration (10.0 percent of expenditures). PMI VectorLink procured 532,050 sachets of Fludora® Fusion, and used 480,934 sachets of Fludora® Fusion, 72,500 bottles of Actellic, and 28,161 sachets of SumiShield (the latter two were purchased in 2019). About 66 percent of the total cost for administration consists of local labor. U.S. labor, local, admin, and commodities costs are minimal compared to expenditures on insecticide, local labor, and spray operations.

17.3 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
Cost per	Person protected	\$3.45
	Structure sprayed	\$12.22
	100 m ² sprayed	\$11.73

17.4 COMPARISON BETWEEN THE PAST TWO YEARS

This section provides a comparison of the Uganda IRS program for 2019 and 2020, as implemented by the PMI VectorLink Project. The comparison focuses on output measures, total expenditures, and unit costs.

Table UG4 compares the year-on-year change in total program capital and recurrent expenditures. The total program cost decreased by 2 percent from 2019 to 2020, representing a decrease in the total annual cost of \$421,308.

TABLE UG4: UGANDA IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2019 (Adjusted)	2020	Percentage Change 2019-2020
Insecticide	\$9,638,259	\$9,210,515	-4%
Local Admin	\$630,088	\$582,533	-8%
Local Labor	\$1,952,928	\$3,433,401	76%
Spray Operations	\$4,024,981	\$2,809,083	-30%
Commodities	\$754,346	\$612,912	-19%
U.S. Labor	\$475,720	\$406,571	-15%
TOTAL	\$17,476,322	\$17,055,014	-2%

Costs increased for local labor, which increased by about \$1,480,000, about a 76 percent increase between 2019 and 2020. In 2020, spray operators were classified as local labor, while in 2019, spray operators were classified under spray operations. Thus, the increase in local labor is reflected in a nearly \$1,216,000 decrease in the costs of spray operations. An almost \$430,000 decrease in the costs for insecticide, while only 4 percent between 2019 and 2020, accounted for a further 22 percent of the total decrease in costs from 2019 to 2020. Commodities and local administration decreased by 19 percent and 8 percent, respectively.

Table UG5 compares the year-on-year change in Uganda IRS program output measures and unit costs. In 2020, the program protected about 10 percent more people and sprayed about 8 percent more structures and area compared to 2019. Because the number of people protected increased while the total costs decreased from 2019 to 2020, the cost per person protected decreased from \$3.90 to \$3.45 (11 percent) across the two years. The decreases in total costs and increase in number of structures and area sprayed from 2019 to 2020 also resulted in lower costs per structure sprayed and per area sprayed (10 percent and 9 percent decrease, respectively).

TABLE UG5: UGANDA IRS PROGRAM COMPARISON OF OUTPUT MEASURES AND UNIT COSTS

	2019	2020	Percentage Change 2019-2020
Output Measures			
People Protected	4,479,157	4,938,643	10.3%
Structures Sprayed	1,291,569	1,395,569	8.1%
Area Sprayed (100 m ²)	1,352,893	1,453,988	7.5%
Unit Costs			
Per Person Protected	\$3.90	\$3.45	-11%
Per Structure Sprayed	\$13.53	\$12.22	-10%
Per Area Sprayed	\$12.92	\$11.73	-9%

18. ZAMBIA

18.1 BACKGROUND

TABLE ZA1: ZAMBIA QUICK FACTS

	2020
Program Dates	April 1, 2020 - March 31, 2021
Number of Districts	15
# Local Staff	47
Spray Start Date	Sep 29, 2020
Insecticides Used	Neonicotinoids and Neonicotinoid/pyrethroid mix
# Units of Insecticide Used	181,938 (91,426 N; 90,512 N/P)
# People Protected	2,776,336
# Structures Sprayed	648,914
# 100 Square Meters Sprayed*	454,845

* 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 Zambia IRS program expenditures in 2020. Costs are organized by activity and cost category.

Table ZA2 displays the Zambia IRS program total capital and recurrent expenditures from 2020. 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 (36.2 percent and 17.5 percent of expenditures, respectively), followed by the spray campaign (12.1 percent of expenditures). PMI VectorLink procured 76,080 sachets of SumiShield and 52,520 sachets of Fludora® Fusion, and the Zambia National Malaria Elimination Program (NMEP) supplied 37,570 sachets of Fludora® Fusion that was left over from their 2019 campaign. PMI VectorLink used 91,426 sachets of SumiShield and 90,512 sachets of Fludora® Fusion. About 68 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 minimal compared to expenditures on insecticide, local labor, and spray operations.

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

	Insecticide	Local Admin	Local Labor	Spray Commodities	Spray Ops	US Labor	Grand Total	% of Total
Admin		449,868	790,275			151,980	\$1,392,122	17.5%
Entomology			196,552		212,109	37,479	\$446,140	5.6%
Environmental Compliance			30,037		232,692	32,450	\$295,179	3.7%
Equipment Supplies				546,189			\$546,189	6.9%
IEC			23,361		55,842		\$79,203	1.0%
Insecticide	2,881,690						\$2,881,690	36.2%
M&E			68,302		470,442	84,255	\$622,998	7.8%
Post Spray			58,538		65,633	2,722	\$126,893	1.6%
Spray Campaign			212,112		750,371	4,466	\$966,948	12.1%
Spray Planning			268,450		317,029	16,175	\$601,654	7.6%
Grand Total	\$2,881,690	\$449,868	\$1,647,626	\$546,189	\$2,104,118	\$329,526	\$7,959,016	100.0%

18.3 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	\$2.87
Cost per Structure sprayed	\$12.27
100 m ² sprayed	\$17.50

18.4 COMPARISON BETWEEN THE PAST TWO YEARS

This section provides a comparison of the Zambia IRS program for 2019 and 2020, 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 increased by 17.7 percent from 2019 to 2020, representing an increase in the total annual cost of about \$1,199,069. When not adjusting for inflation, the increase was \$242,222.

TABLE ZA4: ZAMBIA IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2019 (Adjusted)	2020	Percentage Change 2019-2020
Insecticide	\$2,381,016	\$2,881,690	21%
Local Admin	\$371,280	\$449,868	21%
Local Labor	\$1,232,891	\$1,647,626	34%
Spray Operations	\$2,251,944	\$2,104,118	-7%
Commodities	\$273,820	\$546,189	99%
U.S. Labor	\$248,996	\$329,526	32%
TOTAL	\$6,759,947	\$7,959,016	17.7%

All cost categories increased from 2019 to 2020, except spray operations, which decreased by about \$148,000 (7 percent). The largest increase in relative costs was for commodities (99 percent between the two years reflecting \$272,369). The largest absolute increase in costs between the two years was for insecticides at 21 percent, reflecting an increase of slightly more than \$500,000. Local labor, U.S. labor, and local administration costs also increased by 34 percent, 32 percent, and 21 percent, respectively, over the same period. Key reasons for these increases include costs related to COVID-19 mitigation (increased transport costs to allow for social distancing, procurement of additional masks and sanitizers, and tent rentals to accommodate outdoor trainings). Moreover, additional operations sites were established to reduce the number of SOPs per site, in line with project standards, and an additional satellite office in Luapula Province was established. The project also helped the NMEP to fill gaps in the Global Fund/ Government of the Republic of Zambia IRS program, including 1,534 Goizper spray pumps, 1,500 pairs of overalls, and 2,000 units each of clear safety goggles, gloves, and cartridges for respirators, and 800 units of mutton cloth.

Table ZA5 compares the year-on-year change in Zambia IRS program output measures and unit costs. In 2020, the program protected more people and sprayed more structures and more area than in 2019 by 22.1 percent, 20.8 percent, and 20.3 percent, respectively, compared to 2019. While the number of districts supported during the campaign reduced from 20 in 2019 to 15 in 2020, the changes in which districts VectorLink supported resulted in an increase in the number of structures targeted by the team in 2020 compared to 2019. In addition, the coverage rate achieved by the team was substantially higher in 2020 (97 percent vs. 90 percent in 2019), which led to more structures and more people protected.

Because the increase in total program costs was of a smaller magnitude than the increase in people protected, structures sprayed, and area sprayed, unit costs decreased for all three metrics from 2019 to 2020 (4 percent, 3 percent, 2 percent, respectively).

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

	2019	2020	Percentage Change 2019-2020
Output Measures			
People Protected	2,273,188	2,776,336	22.1%
Structures Sprayed	536,983	648,914	20.8%
Area Sprayed (100 m ²)	378,248	454,845	20.3%
Unit Costs			
Per Person Protected	\$2.97	\$2.87	-4%
Per Structure Sprayed	\$12.59	\$12.27	-3%
Per Area Sprayed	\$17.87	\$17.50	-2%

19. ZIMBABWE

19.1 BACKGROUND

TABLE ZW1: ZIMBABWE QUICK FACTS

	2020
Program Dates	Mar 1, 2020 - Feb 29, 2021
Number of Districts	2
# Local Staff	19
Spray Start Date	Nov 2, 2020
Insecticides Used	Neonicotinoid/pyrethroid mix
# Units of Insecticide Used	52,728
# People Protected	315,403
# Structures Sprayed	133,078
# 100 Square Meters Sprayed*	131,820

* 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.

19.2 PROGRAM EXPENDITURES

This section presents an overview of Zimbabwe IRS program expenditures in 2020. Costs are organized by activity and cost category.

Table ZW2 displays the Zimbabwe IRS program total capital and recurrent expenditures from 2020. 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 and the spray campaign are the two most expensive IRS activities (37.3 percent and 20.9 percent of expenditures, respectively), followed by insecticide (15.9 percent of expenditures). VectorLink Zimbabwe procured 42,416 sachets of Fludora® Fusion; 52,728 sachets were used (Table ZW2 reflects the cost of insecticide used). About 80 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		380,584	1,409,453			163,371	\$1,953,408	37.3%
Entomology			333,447		424,039	35,137	\$792,623	15.1%
Environmental Compliance			146,762		32,501	16,232	\$195,496	3.7%
Equipment Supplies				80,881			\$80,881	1.5%
IEC					4,351	21,228	\$25,580	0.5%
Insecticide	831,805						\$831,805	15.9%
M&E			109,641		19,677	36,882	\$166,200	3.2%
Post Spray					2,010		\$2,010	0.0%
Spray Campaign			520,001		572,931	1,912	\$1,094,844	20.9%
Spray Planning			4,307		77,467	15,436	\$97,210	1.9%
Grand Total	\$831,805	\$380,584	\$2,523,611	\$80,881	\$1,132,976	\$290,198	\$5,240,056	100.0%

19.3 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	\$16.61
	Structure sprayed	\$39.38
	100 m ² sprayed	\$39.75

19.4 COMPARISON BETWEEN THE PAST TWO YEARS

This section provides a comparison of the Zimbabwe IRS program for 2019 and 2020, 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 increased by 26.9 percent from 2019 to 2020 (9.6 percent in nominal terms), representing an increase in the total annual cost of over \$1,110,926 (\$459,797 in nominal terms). Cost for spray operations decreased from 2019 to 2020 by \$8,009. The cost of local labor increased by \$1,040,812. During this period, the local chief of party was replaced by a TCN with six months of overlap. In addition, this year, spray operators were classified as local labor rather than spray operations as they were in 2019. The increase in local labor of about \$292,000 more than offsets the decrease in spray operations.

TABLE ZW4: ZIMBABWE IRS PROGRAM COMPARISON OF EXPENDITURES

Cost Category	2019 (Adjusted*)	2020	Percentage Change 2019-2020
Insecticide	\$821,394	\$831,805	1.3%
Local Admin	\$358,047	\$380,584	6.3%
Local Labor	\$1,482,799	\$2,523,611	70.2%
Spray Operations	\$1,140,985	\$1,132,976	-0.7%
Commodities	\$67,838	\$80,881	19.2%
U.S. Labor	\$258,067	\$290,198	12.5%
TOTAL	\$4,129,129	\$5,240,056	26.9%

*Adjusted for US inflation; over the two years, the majority of transactions occurred in US dollars.

Table ZW5 compares the year-on-year change in Zimbabwe IRS program output measures and unit costs. In 2020, the program had higher output metrics across the three categories considered, with increases of 2.7 percent in the number of people protected, 1.4 percent in the number of structures sprayed, and 3.6 percent in the area sprayed, compared to 2019. However, the increase in program size was not as large as the increase in total expenditures (adjusted or nominal). Unit costs increased from 2019 to 2020 by between 22.5 percent and 25.1 percent (adjusted; 5.8 percent to 8.1 percent in nominal terms) across the three output metrics.

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

	2019 (Adjusted)	2020	Percentage Change 2019-2020
Output Measures			
People Protected	307,209	315,403	2.7%
Structures Sprayed	131,191	133,078	1.4%
Area Sprayed (100 m ²)	127,213	131,820	3.6%
Unit Costs			
Per Person Protected	\$15.56	\$16.61	23.6%
Per Structure Sprayed	\$36.44	\$39.38	25.1%
Per Area Sprayed	\$37.58	\$39.75	22.5%

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.
- Johns, Benjamin and Altea Cico Sitruk. May 2019. *PMI IRS Country Programs: 2018 Comparative Cost Analysis*. Rockville, MD. PMI VectorLink Project, Abt Associates Inc.
- Johns, Benjamin and Mignote Haile. May 2020. *PMI IRS Country Programs: 2019 Comparative Cost Analysis*. Rockville, MD. PMI VectorLink Project, Abt Associates Inc.

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

Country	People Protected									Percent Change 2019-2020
	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Uganda							4,436,156	4,479,157	4,938,643	10%
Zambia			2,000,824	2,544,290	2,626,718	3,005,676	2,818,176	2,273,188	2,776,336	22%
Ethiopia	1,506,273	1,629,958	1,647,099	1,655,997	1,688,745	1,877,154	1,264,189	1,334,868	1,511,728	13%
Tanzania					2,042,561	2,568,522	2,840,927	2,404,010	1,915,151	-20%
Kenya						906,388	1,833,860	2,011,860	1,792,495	-11%
Mozambique	2,716,176	2,181,896	2,327,815	1,631,058	1,929,654	1,711,518	1,663,078	1,484,191	1,619,088	9%
Benin	762,146	694,729	789,883	802,597	858,113	1,227,536	1,321,758	1,077,411	1,104,928	3%
Ghana	941,240	534,060	570,572	553,954	570,871	840,438	836,376	875,481	965,467	10%
Rwanda	1,025,181	1,479,342	1,217,837	1,406,520	1,431,410	919,735	894,098	1,288,965	1,355,656	5%
Madagascar	1,781,990	1,588,138	1,307,384	1,016,841	1,257,036	2,008,963	2,232,097	1,150,922	833,483	-28%
Burkina Faso	115,638						766,374	587,248	508,107	-13%
Senegal	1,095,093	690,029	708,999	514,833	496,728	619,578			571,649	
Zimbabwe			334,746	365,425	550,475	517,374	276,343	307,209	315,403	3%
Mali	762,146	850,104	836,568	494,205	788,922	823,201	665,581	690,793	503,043	-27%
Malawi							501,324	441,375	453,383	3%
Cote d'Ivoire									193,935	
Average	669,118	603,016	733,858	686,608	890,077	1,064,130	1,396,896	1,275,417	1,334,906	5%

Country	Structures Sprayed									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	Percent Change 2019-2020
Uganda							1,292,309	1,291,569	1,395,569	8%
Zambia			409,544	519,598	559,550	634,371	579,490	536,983	648,914	21%
Ethiopia	547,421	635,528	667,236	704,945	715,541	738,810	472,569	487,746	527,375	8%
Tanzania					515,217	664,622	744,597	595,923	471,622	-21%
Kenya						212,029	440,969	507,777	436,472	-14%
Mozambique	536,558	414,232	445,118	337,433	405,597	381,463	387,413	338,330	361,820	7%
Benin	206,295	228,951	254,072	252,706	269,179	384,761	400,997	335,207	350,349	5%
Ghana	355,278	197,655	205,230	205,935	211,283	302,648	298,701	298,385	339,139	14%
Rwanda	236,610	345,862	297,005	343,131	346,917	231,258	214,802	314,517	334,802	6%
Madagascar	371,391	343,470	274,533	247,902	310,426	487,636	548,789	267,874	197,787	-26%
Burkina Faso	36,870						258,766	201,901	162,037	-20%
Senegal	306,916	207,116	204,159	130,170	124,757	156,362			136,417	
Zimbabwe			147,949	162,127	229,377	209,055	112,805	131,191	133,078	1%
Mali	206,295	228,985	228,123	133,527	228,672	227,646	160,723	148,198	129,302	-13%
Malawi							112,264	107,565	114,196	6%
Cote d'Ivoire									53,962	
Average	175,227	162,612	195,811	189,842	244,782	289,416	376,575	347,698	362,053	4%

Country	Area Sprayed (100 m ²)									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	Percent Change 2019-2020
Uganda							1,386,420	1,352,893	1,453,988	7%
Zambia			281,508	341,630	350,045	421,928	369,958	378,248	454,845	20%
Ethiopia	524,334	617,442	624,764	641,994	677,990	627,295	287,243	304,420	332,335	9%
Tanzania					437,933	549,095	587,325	454,843	336,148	-26%
Kenya						176,383	406,170	397,193	316,750	-20%
Mozambique	974,470	822,735	914,518	649,370	637,380	513,058	462,068	395,325	413,380	5%
Benin	192,968	125,605	110,505	114,160	116,543	146,913	157,103	133,760	148,183	11%
Ghana	193,220	108,210	112,370	113,285	117,833	164,738	163,860	166,833	191,245	15%
Rwanda	332,522	529,940	482,958	578,390	634,915	456,020	408,878	613,545	607,233	-1%
Madagascar	221,418	198,985	229,240	113,493	133,030	189,860	220,560	119,158	97,478	-18%
Burkina Faso	48,413						133,813	136,423	92,820	-32%
Senegal	267,185	162,623	150,465	98,010	97,973	122,745			108,900	
Zimbabwe			167,600	183,315	263,685	247,870	105,675	127,213	131,820	4%
Mali	192,968	233,588	224,868	146,180	211,428	200,673	192,463	154,043	117,303	-24%
Malawi							119,358	131,373	158,833	21%
Cote d'Ivoire									54,538	
Average	184,219	174,946	206,175	186,239	229,922	238,536	312,556	304,079	313,487	3%

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

Country	Person Protected									Percent Change 2019-2020
	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Uganda							\$3.69	\$3.90	\$3.45	-11%
Zambia			\$2.80	\$3.34	\$3.11	\$2.70	\$2.27	\$2.97	\$2.87	-4%
Ethiopia	\$3.38	\$4.45	\$4.60	\$5.34	\$5.72	\$5.79	\$6.30	\$6.69	\$6.40	-4%
Tanzania					\$5.94	\$4.35	\$3.86	\$3.54	\$4.17	18%
Kenya						\$6.70	\$6.66	\$5.67	\$4.59	-19%
Mozambique	\$1.45	\$1.80	\$1.78	\$4.69	\$6.75	\$5.93	\$5.70	\$5.56	\$5.13	-8%
Benin	\$4.15	\$4.54	\$4.48	\$4.32	\$4.28	\$3.99	\$3.67	\$3.46	\$3.70	7%
Ghana	\$4.98	\$8.53	\$7.35	\$7.59	\$7.06	\$5.43	\$5.54	\$5.41	\$5.46	1%
Rwanda	\$3.40	\$5.01	\$6.03	\$4.69	\$5.44	\$6.91	\$6.28	\$5.52	\$5.71	4%
Madagascar	\$2.76	\$4.33	\$4.90	\$5.02	\$4.14	\$3.92	\$3.27	\$4.21	\$5.39	28%
Burkina Faso	\$10.59						\$4.36	\$6.08	\$6.12	1%
Senegal	\$3.97	\$6.58	\$6.14	\$6.83	\$7.40	\$6.78			\$7.55	
Zimbabwe			\$11.37	\$10.18	\$9.40	\$7.45	\$11.93	\$13.44	\$16.61	24%
Mali	\$6.03	\$6.64	\$6.69	\$9.92	\$6.65	\$8.03	\$8.18	\$7.01	\$9.03	29%
Malawi							\$8.92	\$11.83	\$10.67	-10%
Cote d'Ivoire									\$22.10	
Average	\$4.52	\$5.24	\$5.61	\$6.19	\$5.99	\$5.66	\$5.76	\$6.09	\$7.44	22%

Country	Structure Sprayed									Percent Change 2019-2020
	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Uganda							\$12.66	\$13.53	\$12.22	-10%
Zambia			\$13.67	\$16.37	\$14.61	\$12.81	\$11.03	\$12.59	\$12.27	-3%
Ethiopia	\$9.30	\$11.42	\$11.36	\$12.54	\$13.50	\$14.70	\$16.85	\$18.31	\$18.35	0%
Tanzania					\$23.57	\$16.80	\$14.75	\$14.27	\$16.95	19%
Kenya						\$28.63	\$27.70	\$22.48	\$18.87	-16%
Mozambique	\$7.34	\$9.50	\$9.31	\$22.65	\$32.10	\$26.62	\$24.46	\$24.38	\$22.95	-6%
Benin	\$15.33	\$13.78	\$13.94	\$13.72	\$13.65	\$12.74	\$12.10	\$11.12	\$11.67	5%
Ghana	\$13.18	\$23.06	\$20.42	\$20.43	\$19.07	\$15.08	\$15.52	\$15.88	\$15.56	-2%
Rwanda	\$14.72	\$21.43	\$24.72	\$19.23	\$22.46	\$27.48	\$26.14	\$22.61	\$23.13	2%
Madagascar	\$13.25	\$20.04	\$23.35	\$20.60	\$16.75	\$16.15	\$13.29	\$18.08	\$22.70	26%
Burkina Faso	\$33.22						\$12.93	\$17.67	\$19.19	9%
Senegal	\$14.16	\$21.94	\$21.31	\$27.01	\$29.46	\$26.85			\$31.64	
Zimbabwe			\$25.73	\$22.95	\$22.57	\$18.44	\$29.23	\$31.47	\$39.38	25%
Mali	\$22.28	\$24.64	\$24.54	\$36.71	\$22.94	\$29.04	\$33.88	\$32.69	\$35.13	7%
Malawi							\$39.84	\$48.53	\$42.36	-13%
Cote d'Ivoire									\$79.41	
Average	\$15.87	\$18.23	\$18.84	\$21.22	\$20.97	\$20.44	\$20.74	\$21.69	\$26.36	22%

Country	Area Sprayed (100 m ²)									Percent Change 2019-2020
	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Uganda							\$11.80	\$12.92	\$11.73	-9%
Zambia			\$19.89	\$24.90	\$23.36	\$19.26	\$17.28	\$17.87	\$17.50	-2%
Ethiopia	\$9.71	\$11.75	\$12.13	\$13.77	\$14.25	\$17.31	\$27.72	\$29.34	\$29.12	-1%
Tanzania					\$27.73	\$20.33	\$18.69	\$18.69	\$23.78	27%
Kenya						\$34.41	\$30.07	\$28.73	\$26.00	-10%
Mozambique	\$4.04	\$4.78	\$4.53	\$11.77	\$20.43	\$19.79	\$20.51	\$20.86	\$20.09	-4%
Benin	\$16.39	\$25.12	\$32.06	\$30.37	\$31.52	\$33.36	\$30.88	\$27.86	\$27.60	-1%
Ghana	\$24.24	\$42.12	\$37.30	\$37.14	\$34.19	\$27.70	\$28.29	\$28.41	\$27.59	-3%
Rwanda	\$10.48	\$13.98	\$15.20	\$11.41	\$12.27	\$13.94	\$13.73	\$11.59	\$12.75	10%
Madagascar	\$22.22	\$34.59	\$27.97	\$45.01	\$39.09	\$41.47	\$33.08	\$40.65	\$46.05	13%
Burkina Faso	\$25.30						\$25.00	\$26.15	\$33.49	28%
Senegal	\$16.27	\$27.94	\$28.91	\$35.87	\$37.52	\$34.20			\$39.64	
Zimbabwe			\$22.71	\$20.29	\$19.63	\$15.56	\$31.20	\$32.46	\$39.75	22%
Mali	\$23.82	\$24.16	\$24.89	\$33.53	\$24.81	\$32.95	\$28.29	\$31.45	\$38.72	23%
Malawi							\$37.47	\$39.74	\$30.45	-23%
Cote d'Ivoire									\$78.58	
Average	\$16.94	\$23.06	\$22.56	\$26.41	\$25.89	\$25.86	\$25.29	\$26.19	\$31.43	20%

ANNEX C: METHODOLOGY

OBJECTIVE

This report presents and compares the findings of a cost analysis of the expenses that were incurred during the past nine years of IRS program implementation in 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) 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 nine 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 2020 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 2012-2020 (Abbott and Johns 2013, Abbott and Johns 2014, Johns and Cico 2015, Johns and Cico 2016, Cico and Johns 2017, Cico and Johns 2018, Johns and Cico Sitruk 2019). 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 plus shipping 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 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 from 2012-2020. 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.

Entomology expenditures include all entomology costs and activities incurred throughout the year including subcontracts, travel, labor and entomology related materials, not only IRS related work (e.g. spray quality and residual efficacy).

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 of 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 VectorLink country programs. Rather, we estimate the area sprayed based on the amount of insecticide used. Thus, there 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.