



PRESIDENT'S MALARIA INITIATIVE



## INDOOR RESIDUAL SPRAYING FOR MALARIA CONTROL

# Costs of Zambia's public sector indoor residual spraying program, 2008–2010

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# **Costs of Zambia's public sector indoor residual spraying program, 2008–2010**

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Zambia’s indoor residual spraying (IRS) program is considerably more complex than other PMI-supported IRS programs in Africa, with multiple financing streams being channeled to an array of national and international partner organizations for implementation. Information was required from numerous sources and this study would not have been possible without the support and assistance from many people. First, we thank Dr. Mulakwa Kamuliwo, Deputy Director for Public Health and Research–Malaria, and his senior staff at the National Malaria Control Centre (NMCC) for their support in helping the study team to understand the programmatic and financial complexity of the national program, mobilizing district health office staff to provide detailed information about their efforts and inputs, and providing additional data about programmatic and financial performance.

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## Abbreviations

CCN	cooperating country national
GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
GRZ	Government of the Republic of Zambia
HSSP	Health Services and Systems Program
IEC	information, education, and communication
IRS	indoor residual spraying
M&E	monitoring and evaluation
MACEPA	Malaria Control and Evaluation Partnership in Africa
MOH	Ministry of Health
NMCC	National Malaria Control Centre
PMI	United States President's Malaria Initiative
PPE	personal protective equipment
RBM	Roll Back Malaria
STTA	short-term technical assistance
TCN	third country national
TDRC	Tropical Diseases Research Centre
TO	task order
US	United States
USAID	United States Agency for International Development
ZEMA	Zambia Environmental Management Agency

# I. Background

Zambia is one of 15 countries in sub-Saharan Africa where the United States President's Malaria Initiative (PMI) has been supporting indoor residual spraying (IRS) and other interventions to reduce the burden of malaria since 2005. IRS was reintroduced in Zambia as a public sector intervention to fight malaria in 2003 after successful IRS campaigns by the private sector at the Konkola Copper Mines in 2000. During the next eight years, IRS was scaled up as part of a national integrated vector management strategy. The program is implemented by the National Malaria Control Centre (NMCC) of the Ministry of Health (MOH). It is now one of the largest national IRS programs on the African continent, reaching well over one million homes and protecting about six million people—almost half of the population—each year in 54 of the country's 72 districts.

Among the PMI-supported countries implementing IRS, Zambia is unique in the degree to which the national IRS program is managed and implemented by the NMCC and by district health authorities. The NMCC coordinates inputs from a broad range of international partners who, in turn, are financed by a range of funding partners. This complexity has made it difficult to determine the costs of IRS and thus to compare its costs with those of other countries. As the future of IRS as a vector control intervention is debated—amid concerns about the impact of emerging insecticide resistance on program costs and about countries' ability to sustain the programs without substantial financial and technical support from development partners—eyes are on Zambia as a potential model for greater national ownership and sustainability.

It is in this light that this study of the costs of Zambia's national IRS program was commissioned by the United States Agency for International Development (USAID)/PMI. The study also aimed to shed light on key questions facing Zambia's program. The study focuses on costs of the public sector program.<sup>1</sup> Key study questions were

- How do costs per structure sprayed and per person protected in Zambia's IRS program compare with those of other countries?
- Given that Zambia's program is managed and implemented directly by the Government of the Republic of Zambia (GRZ) to a higher degree than most other African national programs, does the configuration of program costs differ from that of other countries?
- What are the expected cost implications of the emergence of mosquito resistance to the pyrethroid class of insecticides and the consequent need to shift to other, more expensive insecticide products?
- What options does the GRZ have in terms of program coverage, given expected cost increases and limitation of financial resources?

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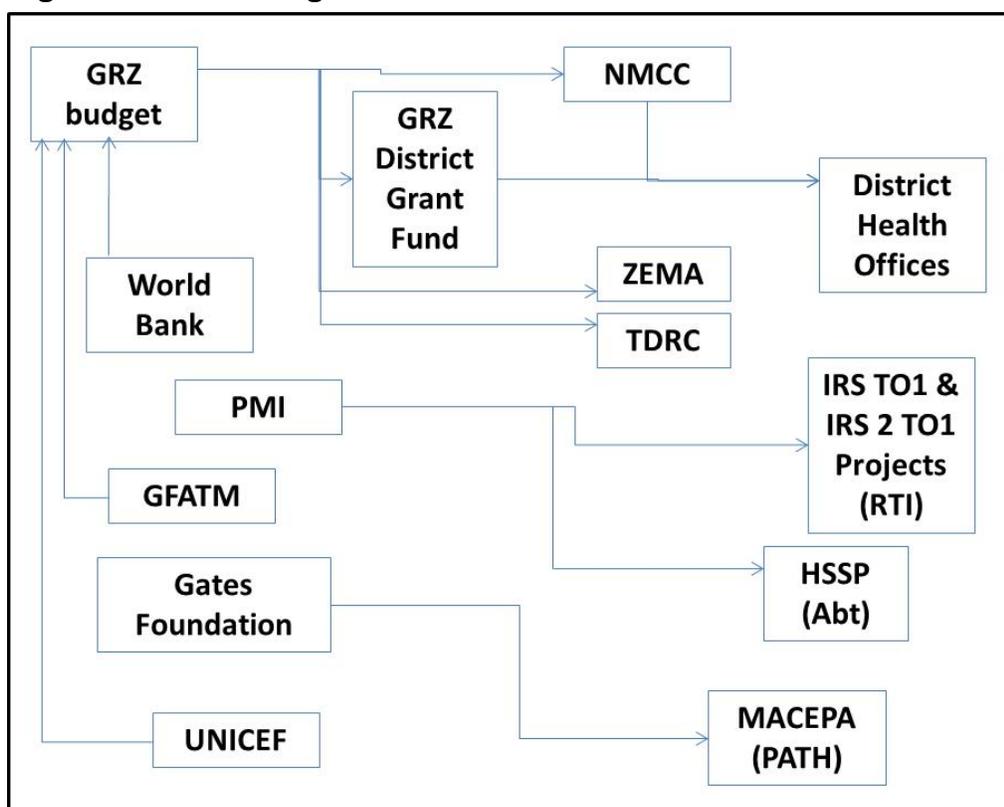
<sup>1</sup> Little information was available to the study team about IRS operations and their costs as implemented by seven private mining and agro-industry firms. However, it was reported that these entities accounted for about 5 percent of total structures sprayed in Zambia in 2008 and exclusion of these costs is not expected to have a substantial impact on costs reported here.

In part due to the complexity of the IRS program in Zambia, it is not possible to provide conclusive answers to all of these questions, but this report attempts to provide a baseline of information about IRS program costs from which more in-depth data collection and analysis can be conducted, numbers refined, and policy decisions made.

## II. Funding Flows and Institutions

As aforementioned, financing flows for IRS in Zambia are more complex than in the other PMI-supported country IRS programs. Figure 1 shows the institutions from which funding for IRS was derived for the program in the years from 2008 to 2010. The flow chart also shows major recipient organizations that were funded to implement components of the IRS program.

**Figure 1: Funding Flows for IRS in Zambia<sup>a</sup>**



<sup>a</sup> Note that GFATM funds were provided for 2008 only. Abbreviations: GFATM, Global Fund to Fight AIDS, Tuberculosis and Malaria; HSSP, Health Services and Systems Program; MACEPA, Malaria Control and Evaluation Partnership Partnership in Africa; TDRC, Tropical Diseases Research Centre; and ZEMA, Zambia Environmental Management Agency.

With the exception of the GFATM, which ceased funding IRS in Zambia after 2008, all funding source organizations supported the GRZ's IRS program for all three years covered in this study. Table 1 summarizes the roles for each organization with program implementation roles during this period.

**Table 1: Roles of IRS Implementing Partner Organizations**

Organization	Roles
NMCC	<ul style="list-style-type: none"> <li>• Overall program planning and management</li> <li>• Coordination of implementing partners</li> <li>• Mobilization of resources</li> <li>• Provision of operational funds to district health offices</li> <li>• Program monitoring and evaluation (M&amp;E)</li> </ul>
ZEMA	<ul style="list-style-type: none"> <li>• Environmental compliance</li> </ul>
District Health Offices	<ul style="list-style-type: none"> <li>• Logistics assessments and quantification of IRS commodity needs</li> <li>• Microplanning and training of spray operators</li> <li>• Warehousing of IRS commodities</li> <li>• Maintenance of IRS sites</li> <li>• Implementation of spray operations</li> <li>• Community mobilization and information, education, and communication (IEC) for IRS</li> <li>• Solid waste collection and safekeeping and incineration where facilities exist</li> </ul>
Provincial Health Offices	<ul style="list-style-type: none"> <li>• Participating in environmental assessments and compliance inspections</li> </ul>
Tropical Disease Research Center	<ul style="list-style-type: none"> <li>• Insecticide monitoring</li> </ul>
HSSP (Abt Associates)	<ul style="list-style-type: none"> <li>• Training of trainers and financing for cascade training at the district level</li> <li>• Procurement of personal protective equipment (PPE) and consumable supplies for IRS (2008–2009)</li> <li>• National level warehousing of IRS commodities and distribution to districts</li> <li>• Funding for IRS field assessments, including planning and environmental compliance</li> <li>• Funding for geocoding training and field data collection for geocoding</li> <li>• IEC materials' development, production, and distribution</li> <li>• Conducting M&amp;E and IRS impacts study</li> <li>• Financing for spray operations in selected districts (2009 and 2010)</li> <li>• Financing for management and transportation of solid waste material</li> <li>• Insectary refurbishment and financing for entomological monitoring field work</li> </ul>
IRS TO1 & IRS 2 TO1 (RTI International)	<ul style="list-style-type: none"> <li>• Procuring insecticide and spray equipment. Procurement of PPE in 2010.</li> <li>• Constructing evaporation tanks and soak pits</li> <li>• Training on environmental compliance inspection</li> <li>• Environmental monitoring for dichloro-diphenyl-trichloroethane (DDT)</li> <li>• Collection and disposal of solid waste material</li> </ul>
MACEPA (PATH)	<ul style="list-style-type: none"> <li>• Training for geocoding</li> <li>• Mapping</li> </ul>

### III. Approaches and Methods

We used a variety of information collection approaches to capture costs from the diverse set of organizations involved in implementing Zambia's IRS program. Brief descriptions of approaches are provided below.

- Government Program Costs. The following approaches were used for government cost streams:
  - District cash expenditures. Each year, IRS districts obtained block grants from central government funds toward the costs of spray operations. The NMCC provided a summary of spending from these funds for each year from 2008 to 2010 and during data collection visits to district health offices, our team requested more detailed information about expenditures from these funds.

Information provided by the district health office was used to corroborate that provided by the NMCC. Districts were also asked to provide information about additional spending from their discretionary District Grant Fund when central block grant funds were not sufficient to cover all spray operations' costs.

- District-level “in-kind” costs. We also used an in-kind costs interview instrument to capture information about the value of items not covered by the IRS block grants or District Grant Funds. These included, for instance, the value of labor by district health office staff that supported IRS operations, use of district health office vehicles for IRS operations, the value of warehousing for IRS commodities, and the value of community contributions such as provision of water for spray teams. The 54 districts where IRS operations occurred during the study period covered were grouped into eight categories. District health office staff were interviewed in 40 districts. For each of the remaining 14 districts, the value of its in-kind contributions was imputed based on the average value of in-kind contributions from districts visited in their group. A per-structure in-kind contribution value was calculated for those districts visited, and this value was multiplied by the number of structures sprayed in the districts not visited.
- District administrative costs. We estimated that IRS comprises an average of about 1.5 percent of the total district health operations in any given year. We collected information from Zambia’s central MOH on total operational budgets for each district in each of the three study years and attributed 1.5 percent of these district costs to IRS.
- Costs from NMCC and ZEMA. An “in-kind” cost interview instrument was also used to capture information about the value of inputs from these national organizations, per those described above for district in-kind costs.
- IRS TO1 and IRS 2 TO1 Project Costs. RTI International was contracted by USAID/PMI to procure IRS commodities and implement other IRS-related activities during 2008–2010 (Table 1). Retrospective financial records were used as the primary data source and a comprehensive list of all 2008–2010 expenditures recorded by RTI was reviewed. Each item was assigned to an expenditure category per Table 2, and appropriate indirect cost factors were applied to yield a “fully loaded” cost. Insecticide costs were derived by multiplying the number of sachets used each year by the fully loaded unit price for each sachet in the year it was purchased.

**Table 2: Cost Categories for IRS Cost Analysis**

IRS Cost Category	Items
Spray operations	<ul style="list-style-type: none"> <li>Planning and logistic assessment activities</li> <li>Environmental compliance, including soak pit/evaporation tank construction</li> <li>Training</li> <li>IEC and community mobilization</li> <li>Warehousing</li> <li>Short-term labor<sup>a</sup></li> <li>Transportation</li> <li>Medical costs</li> <li>Mop-up operations</li> <li>Post-spray meetings</li> <li>M&amp;E activities</li> </ul>
Spray operations commodities	<ul style="list-style-type: none"> <li>Insecticide</li> <li>Spray equipment and equipment repair kits</li> <li>PPE</li> <li>Shipping</li> </ul>
Local labor	<ul style="list-style-type: none"> <li>Cooperating country national (CCN) staff labor<sup>b</sup></li> </ul>
Local (in-country) administration	<ul style="list-style-type: none"> <li>Office leases, utilities, and maintenance</li> <li>Office furniture, equipment, and supplies</li> <li>Services for office support</li> <li>Management travel and transportation</li> </ul>
Short-term technical assistance (STTA) and U.S. costs	<ul style="list-style-type: none"> <li>U.S.- and Nairobi-based support services (e.g., communications, shipping, etc.)</li> <li>Lodging, per diem, and other expenses related to international travel to project country</li> </ul>
U.S./Nairobi labor	<ul style="list-style-type: none"> <li>U.S.- and Nairobi-based labor, including labor associated with in-country STTA</li> </ul>

<sup>a</sup> This category includes non-employee (seasonal) labor engaged to prepare for and conduct spray operations, including spray operators, IEC mobilizers, field supervisors, and data entry clerks.

<sup>b</sup> This category includes salaries of all cooperating country national (CCN) staff employed by IRS TO1 and IRS 2 TO1.

- HSSP Costs. Abt Associates implemented this Health Services and Systems Program from 2008 to 2010. USAID/PMI allocated funds to this project to support the national IRS program, per Table 1. After extensive interviews with Abt Associates' staff in Zambia who have intimate knowledge about HSSP's IRS activities, we created a detailed spreadsheet into which Abt staff were requested to enter expenditure information for each IRS activity area. At the time that this report was being prepared, the study team had not received the completed spreadsheet. As an alternative, the study team used the amounts allocated by USAID/PMI to HSSP for IRS as total funds expended by HSSP. We further assumed that these funds were arrayed proportionally across their mandated IRS activities based on those observed in large IRS programs in other PMI countries studied.<sup>2</sup>

Provincial Health Offices also contributed to IRS through the labor of their environmental health officers. These costs were captured as part of the district level in-kind cost data collection effort and no additional data collection effort was required. Contributions from the TDRC were also not captured because of time constraints for this study. However, the costs of its inputs were likely minimal, given the limited scope of its IRS-related activities; and its exclusion will not have a substantive impact on the costs presented below. Likewise, we were unable to obtain information about the value of MACEPA's contributions to the national IRS program. Given that its inputs were largely limited to geocoding training and funding for a very limited amount of field activities for geocoding, this omission is also not likely to substantially affect the cost patterns presented later in this report.

<sup>2</sup> See Table 5 (page 10) of *An economic analysis of the costs of indoor residual spraying in 12 PMI countries, 2008–2010*. The following countries were defined in that report as having large IRS programs: Ethiopia, Mozambique, Madagascar, Ghana, Rwanda, Senegal, and Benin.

All costs were adjusted using published price deflators for source countries for the various program inputs so that costs across years would be comparable in 2010 terms.<sup>3</sup> All costs presented in this report are therefore reported in 2010 U.S. dollars. Costs per structure sprayed and per person protected were then calculated by dividing the total observed public sector program costs by the total number of structures sprayed and people protected each year by the public sector program.

## IV. Results

### A. Spray Operations Performance Indicators

Table 3 provides topline indicators for Zambia’s national malaria control program from 2008 to 2010. Figures provided by the NMCC on the number of structures sprayed corresponded to those presented in Roll Back Malaria (RBM) documents.<sup>4</sup> However, there were discrepancies between these two sources for the reported number of people protected.

**Table 3: Zambia IRS Program Indicators, 2008–2010**

Indicator	2008	2009	2010
Structures sprayed	1,042,010	1,139,845	1,172,605
People protected			
• national reports	6,220,826	4,936,005	5,000,380
• RBM report	4,585,808	5,235,808	5,585,808
Implied persons per structure			
• national reports	6.0	4.3	4.3
• RBM report	4.4	4.6	4.8
Insecticide sachets used	315,410	358,641	402,169
• Sachets used per structure	0.32	0.34	0.33

For each year, we calculated the average number of occupants per structure based on the different estimates of people protected. These are shown in the table under the heading, “Implied persons per structure.” The RBM numbers yielded a more stable estimate of the number of persons per structure over the three-year period, although the difference is greatest for 2008. Because of the uncertainty about which set of numbers is more accurate, we calculated costs per person protected using two sets of numbers (see Section D, below), one for each source.

Estimates of the number of sachets used per structure sprayed are very stable across the three study period years, lending further evidence that the reported number of structures sprayed is reliable.

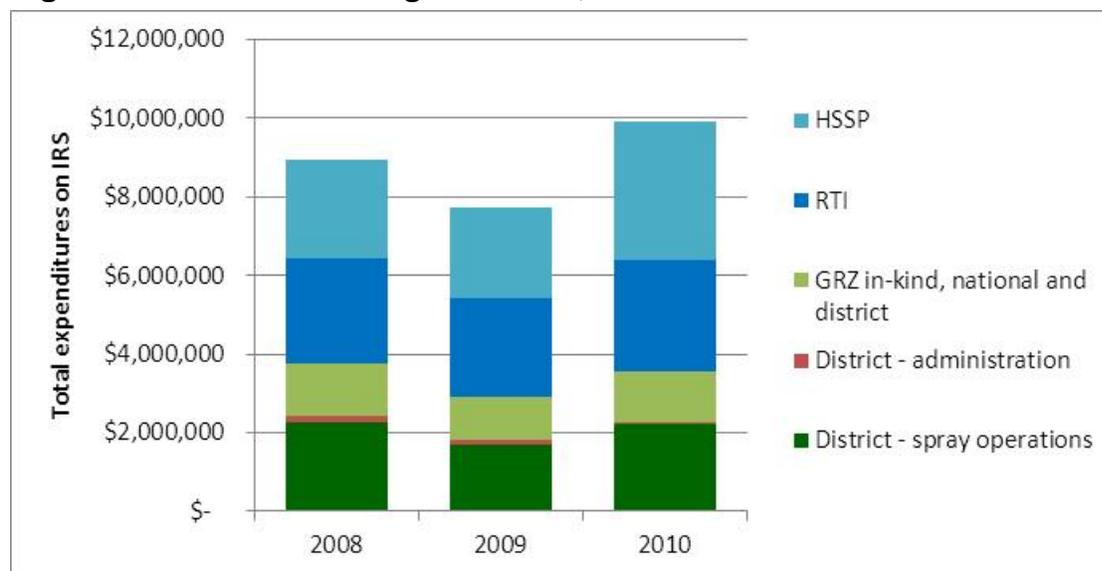
<sup>3</sup> See Jeffrey Sine, Rajeev Colaco, and Hannah Frawley. 2011. *An economic analysis of the costs of indoor residual spraying in 12 PMI countries, 2008–2010*. Prepared by RTI International for USAID/PMI.

<sup>4</sup> See Figure 2.6 (page 33), *Roll Back Malaria Progress and Impact Series, Country Reports, Focus on Zambia*. Issue number 2, April, 2011.

## B. Total IRS Program Costs

Figure 2 shows the total expenditures for the public sector IRS program in each year from 2008 to 2010. Each bar also shows expenditures for the major implementing partners.

**Figure 2: Total IRS Program Costs, 2008–2010**



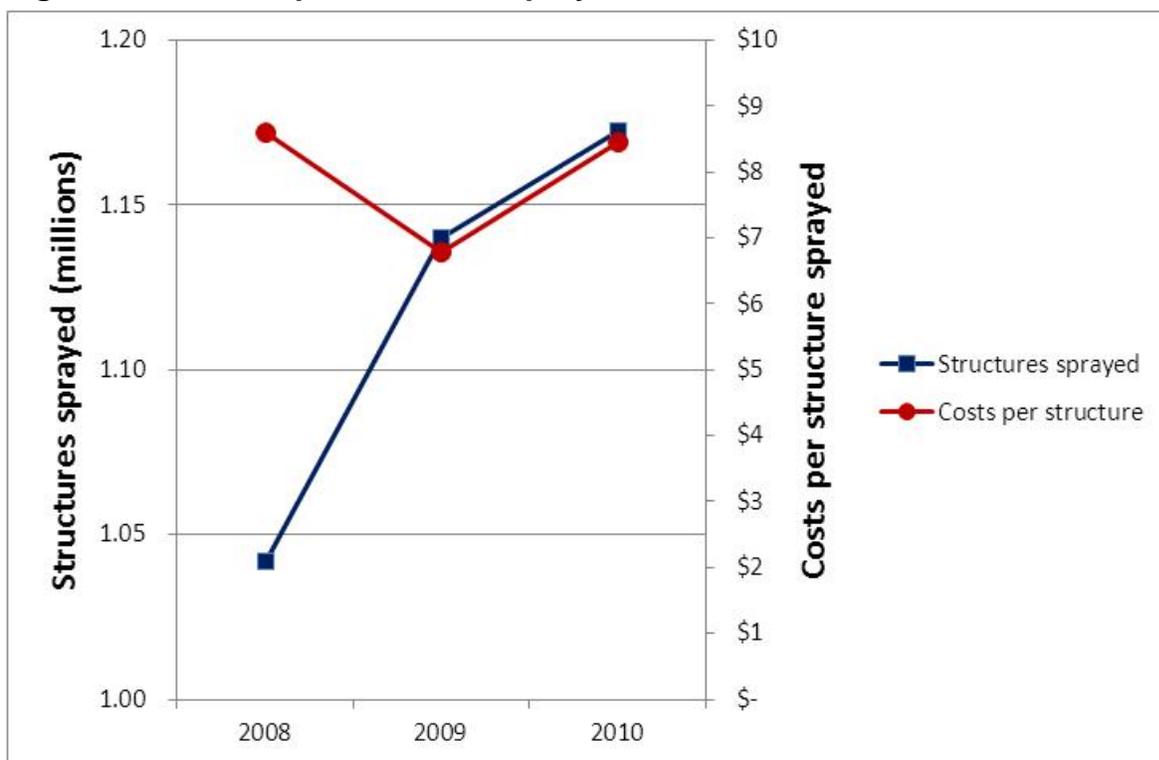
In 2008, 43 percent of all IRS costs were spent by government agencies, including the NMCC, the national level agencies ZEMA and TDRC, and district health offices. This proportion declined to 36 percent by 2010. Part of this decline is attributable to the withdrawal of financial support from the GFATM after 2008 and the commensurate increase in PMI funding to partially offset GFATM resources lost. The additional PMI funds were channeled through HSSP. These compensatory funds financed some district spray operations directly, bypassing district health offices that had been expending GFATM funds channeled through the GRZ budget. The proportion of IRS program costs financed through PMI resources rose from 58 percent in 2008 to 64 percent in 2010, with this increase largely driven by the increase in PMI support for district level spray operations, channeled through HSSP in 2010. Most of the PMI additional funds provided in 2010 supported spray operations in 18 non-PMI IRS districts.<sup>5</sup>

## C. Costs per Structure Sprayed, 2008–2010

Figure 3 shows the total number of structures sprayed and costs per structure sprayed for 2008–2010. The left axis represents the number of structures sprayed and the right axis represents the costs per structure sprayed.

<sup>5</sup> Spray operations in 36 districts targeted by the NMCC for IRS were supported by PMI. Other targeted IRS districts were supported by a combination of GRZ budget funds, funds from the World Bank Malaria Booster Program, and the GFATM. With the cessation of GFATM support in 2010, PMI provided some support to the non-PMI districts as well.

**Figure 3: Costs per Structure Sprayed, 2008–2010**

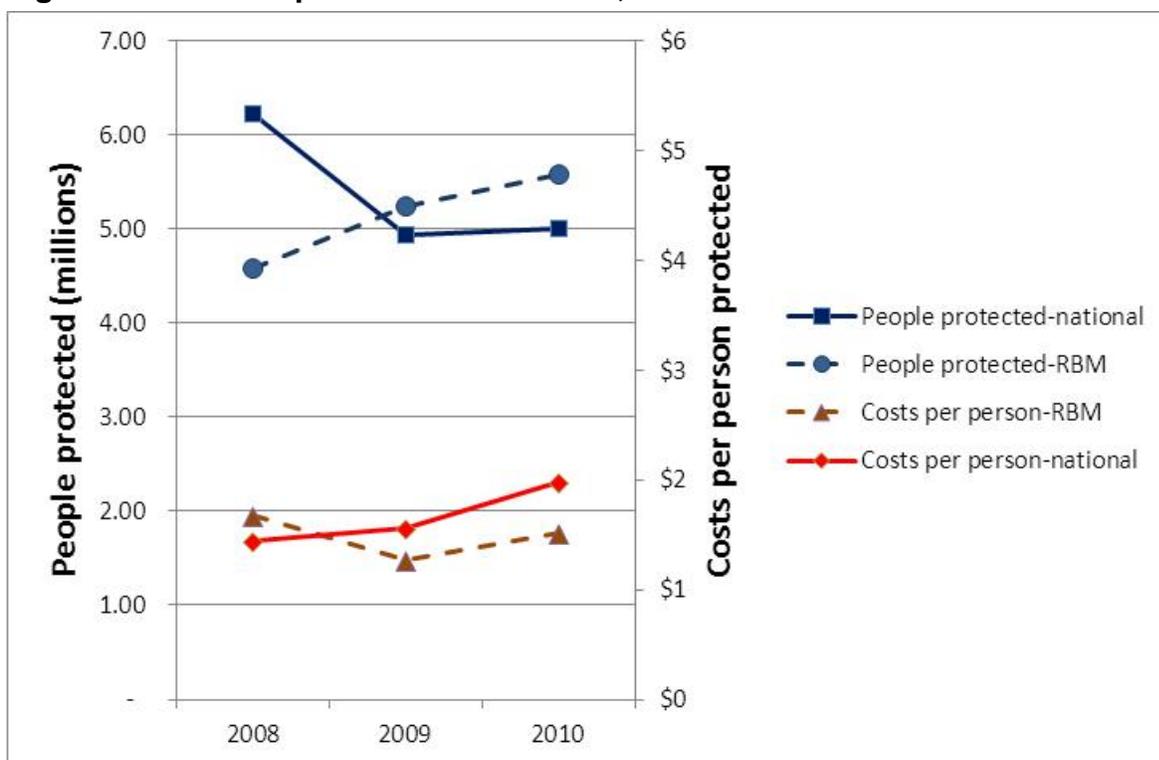


As aforementioned, the reported number of structures sprayed was consistent across two information sources and is thus considered to be reliable. The costs per structure sprayed in 2008 was \$8.59 (in constant 2010 dollars). It declined to \$6.78 in 2009 and rose again in 2010 to \$8.48. The decline observed in 2009 is a function of the fact that while the number of structures sprayed increased nearly 10 percent over 2008, total IRS program costs identified in 2009 were 14 percent lower than in 2008. It is unclear whether the lower amount of costs identified in 2009 represents an undercount of expenditure or whether total expenditures were indeed for some reason lower than in the previous year.

#### **D. Costs per Person Protected, 2008–2010**

Figure 4 shows the two sets of figures for the number of people protected by the GRZ's IRS program and costs per person protected in each year from 2008 to 2010. The left axis represents the total number of people protected and the right axis represents the costs per person protected. The solid blue line shows the number of people protected from 2008 to 2010 as reported by the NMCC, whereas the dashed blue line shows that series as reported in the RBM's Zambia Country Profile document. The solid red and dashed brown lines show the number of people protected from the NMCC and RBM sources, respectively.

**Figure 4: Costs per Person Protected, 2008–2010**



Using the numbers provided by the NMCC for persons protected, the costs per person protected by Zambia’s public sector IRS program has risen 38 percent from \$1.44 in 2008 to \$1.98 in 2010. A different trend is observed when costs per person protected are calculated using the RBM numbers; costs decline steeply by 24 percent from \$1.95 in 2008 to \$1.48 in 2009 and then increase steeply again by 20 percent from 2009 to \$1.78 in 2010. Regardless of which set of data is closer to the actual costs, these costs per person protected are lower than any observed in other PMI-supported country IRS programs in Africa.

**E. Distribution of Expenditures across IRS Cost Categories**

Tables 4–6<sup>6</sup> show how total spending each year was arrayed across the major cost categories of an IRS program. Cost categories, per those shown in Table 2 are shown in the first column of each graph. The last two columns on the right side of each table shows comparisons of percentage distribution of expenditures across these IRS cost categories for Zambia versus seven other African countries with large IRS programs.

<sup>6</sup> For Tables 4–6, some of the numbers do not sum to values presented in the “Total” row/column due to rounding.

**Table 4: Distribution of Expenditures across IRS Cost Categories, 2008 (US\$ millions)**

Cost category	RTI	HSSP	District health offices	District, in-kind	District, administration	NMCC	ZEMA	Total	Zambia	7-Country average
Spray operations	\$ 0.36	\$ 1.66	\$ 2.02	\$ 1.03		\$ 0.19	\$ 0.01	\$ 5.26	59%	52%
Insecticide	\$ 1.57							\$ 1.57	18%	13%
Spray equipment	\$ 0.19							\$ 0.19	2%	2%
PPE		\$ 0.30						\$ 0.30	3%	3%
Shipping	\$ 0.21	\$ 0.04						\$ 0.26	3%	4%
Local labor	\$ 0.09	\$ 0.18	\$ 0.22					\$ 0.49	6%	7%
Admin-local	\$ 0.03	\$ 0.24			\$ 0.17	\$ 0.11		\$ 0.56	6%	10%
STTA & U.S. costs	\$ 0.06	\$ 0.04						\$ 0.10	1%	4%
U.S./TCN labor	\$ 0.14	\$ 0.07						\$ 0.22	2%	6%
Total	\$ 2.65	\$ 2.53	\$ 2.25	\$ 1.03	\$ 0.17	\$ 0.30	\$ 0.01	\$ 8.95	100%	100%

**Table 5: Distribution of Expenditures across IRS Cost Categories, 2009 (US\$ millions)**

Cost category	RTI	HSSP	District health offices	District, in-kind	District, administration	NMCC	ZEMA	Total	Zambia	7-Country average
Spray operations	\$ 0.06	\$ 1.54	\$ 1.52	\$ 0.90		\$ 0.14	\$ 0.01	\$ 4.18	54.1%	50%
Insecticide	\$ 1.69							\$ 1.69	21.9%	16%
Spray equipment	\$ 0.17							\$ 0.17	2.2%	2%
PPE	\$ 1.27	\$ 0.24						\$ 0.24	3.2%	2%
Shipping	\$ 0.14	\$ 0.04						\$ 0.17	2.2%	1%
Local labor	\$ 0.09	\$ 0.16	\$ 0.17					\$ 0.42	5.5%	7%
Admin-local	\$ 0.09	\$ 0.22			\$ 0.10	\$ 0.08		\$ 0.48	6.3%	9%
STTA & U.S. costs	\$ 0.09	\$ 0.04						\$ 0.13	1.7%	5%
U.S./TCN labor	\$ 0.16	\$ 0.07						\$ 0.23	3.0%	8%
Total	\$ 2.49	\$ 2.32	\$ 1.70	\$ 0.90	\$ 0.10	\$ 0.21	\$ 0.01	\$ 7.73	100%	100%

**Table 6: Distribution of Expenditures across IRS Cost Categories, 2010 (US\$ millions)**

Cost category	RTI	HSSP	District health offices	District, in-kind	District, administration	NMCC	ZEMA	Total	Zambia	7-Country average
Spray operations	\$ 0.11	\$ 3.06	\$ 2.00	\$ 1.10		\$ 0.12	\$ 0.01	\$ 6.39	64.4%	49%
Insecticide	\$ 1.26							\$ 1.26	12.6%	18%
Spray equipment	\$ 0.30							\$ 0.30	3.0%	2%
PPE	\$ 0.41							\$ 0.40	4.1%	3%
Shipping	\$ 0.04							\$ 0.04	0.4%	2%
Local labor	\$ 0.18	\$ 0.16	\$ 0.22					\$ 0.56	5.6%	7%
Admin-local	\$ 0.09	\$ 0.21			\$ 0.06	\$ 0.06		\$ 0.42	4.2%	9%
STTA & U.S. costs	\$ 0.12	\$ 0.04						\$ 0.16	1.6%	2%
U.S./TCN labor	\$ 0.31	\$ 0.08						\$ 0.39	3.9%	7%
Total	\$ 2.81	\$ 3.54	\$ 2.22	\$ 1.10	\$ 0.06	\$ 0.18	\$ 0.01	\$ 9.92	100%	100%

The distributions of Zambia program costs across IRS cost categories compares reasonably well with those from the other seven large IRS program countries. In all three years, spray operations composed a higher proportion of total expenditures compared with these other countries. Insecticide comprised a higher proportion of total expenditures in Zambia in 2008 and 2009 (18% and 21.9%, respectively) but a lower proportion in 2010 (12.6%), most likely because several of the comparison countries had already switched to a more expensive carbamate insecticide product.<sup>7</sup> The proportions for spray equipment and PPE were remarkably similar for Zambia and the comparison group of countries. As expected, the proportions spent on the other cost categories in the Zambia program—local labor, local administration, STTA and U.S.-based costs, and U.S./TCN labor—were lower than those in the seven comparison countries. This is likely a consequence of the greater degree to which the Zambia program is managed by national agencies and their staff. The lower proportions devoted to these cost categories in part also drives the higher proportions spent on spray operations and insecticide.

## V. Summary and Conclusions

### A. Data and Information on Costs

Funding and implementation arrangements for Zambia’s national IRS program are complex. Funding is derived from a combination of at least six national and international sources and at least seven organizational partners contribute to program implementation (Figure 1). Such complex arrangements make collection of data and information on costs challenging. There is no central point of responsibility in Zambia for tracking IRS programmatic expenditures and given the short time span afforded for this study, some caution is advised in using the numbers provided in this report for planning IRS resource needs. Some of those challenges include

- ***Overlapping Funding Streams.*** For instance, several international development partners provide financial resources to the GRZ and those funds are merged with mainstream GRZ budget funds before they are allocated to districts for program implementation. As a result, districts do not account for their spending on IRS by original source of funds. It is thus difficult to reconcile specific funding streams.
- ***Conflicting Information.*** Records kept at the national level do not always match those kept by districts or by international organizations. This was the case for information about district expenditures for IRS and, most noticeably, for information about the number of people protected by IRS.
- ***Proprietary Concerns about Providing Expenditures Data.*** All program partners were quite forthcoming with respect to information about their roles in IRS program implementation. However, obtaining expenditure information proved difficult. We were unable to obtain actual expenditures from two partners—HSSP and MACEPA.

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<sup>7</sup> Carbamates are as much as three times more expensive per sachet compared with the pyrethroid products commonly used in IRS programs.

- ***Access to Information.*** Due largely to time constraints to conduct this study, we were unable to seek out and mobilize information on IRS expenditures from TDRC and from private sector entities (seven mining and agro-industrial firms that implement independent IRS programs for their employees' residential areas).

Some of these challenges likely resulted in under estimation of expenditures for IRS and others may have resulted in over estimation. Yet other challenges, notably the conflicting information about people protected by IRS, resulted in unclear estimates of the unit costs of people protected. For instance:

- ***Missing Costs from TDRC and MACEPA.*** These resulted in an undercount of total resources contributed to the IRS program. However, given the limited scope of each of these organizations with respect to the national IRS program (TDRC conducted insecticide monitoring activities and MACEPA provided resource for geocoding training and some geocoding field activities), their costs are not likely to have constituted more than several percentage points of total national spending on IRS.
- ***Assumed Costs for HSSP.*** As noted earlier, we used the amount listed in PMI's annual Malaria Operational Plans for Zambia that provides an upper limit of what HSSP would have been able to spend on IRS. Because most programs spend less than the full amount that could possibly have been obligated to them, this likely resulted in an over count of total resources contributed to the IRS program.
- ***Missing Information about the Costs on Amortized Goods.*** Most information provided to the study team was in the form of aggregate spending. Other than the information from RTI (to which the study team had full access), the information provided lacked spending details or was unclearly presented. It was thus not possible to identify those goods used for IRS whose costs should be amortized across multiple years. Costs were therefore captured in the years in which they occurred. For instance, these include spray equipment, some PPE, vehicles used for IRS, office furniture, and equipment. This causes an uneven pattern of consequences on estimated costs per year, increasing estimated total costs attributed in years when goods are purchased and decreasing total costs in years that should have included the amortized value of good purchased in previous years.
- ***Missing Costs from Private IRS Implementers.*** Based on information about the total number of structures sprayed in 2008 by these private IRS partners, their activities composed no more than 5 percent of all IRS conducted in the country.

It is difficult to know whether the balance was on the positive (over estimation) or negative (under estimation) side but we may assume, based on this assessment of data collection challenges, that the impact was likely minimal.

## B. Results

*Total Costs of IRS and Costs per Structure Sprayed.* Total expenditures on IRS, in constant 2010 US dollars, were \$8.9 million in 2008, \$7.7 million in 2009, and \$9.9 million in 2010. Total expenditures declined by 14 percent from 2008 to 2009, while the number of structures sprayed increased 9 percent in the same period. This may be explained by two factors: (1) withdrawal of GFATM funds after 2008 and (2) currency devaluation. On the former, it appears that there was little time for the IRS program to adjust to GFATM's decision and availability of funds in 2009 was consequently negatively affected. (In 2010, PMI increased its planned funding for IRS in Zambia by an extra \$1.29 million to compensate for the national program funding shortfall, explaining the resurgence of spending on IRS that year.) On the latter, the value of the Zambian Kwacha against the U.S. dollar was volatile in 2009, falling by about 31% from 2008 to 2009 (it fell by only 3 percent from 2009 to 2010). This eroded the value of kwacha-denominated costs in 2009 when they were converted at prevailing exchange rates to U.S. dollars for this analysis.

The best way to assess the degree to which total costs for IRS have been captured is to compare resulting costs per structure sprayed and per person protected with those known from other country programs. Viewed this way, total expenditures captured here appear to be reasonable. Zambia's costs per structure sprayed are at the low end of those observed in other PMI-supported countries with large IRS programs, though not the lowest.<sup>8</sup> Compared with these other PMI-supported country IRS program, lower total costs (and costs per structure) would be expected in Zambia given the management structure of the program and certain programmatic differences. As noted at the outset of this report, the Zambian IRS program is managed and implemented to a much greater degree by government agencies than in other PMI-supported country programs. Management costs are almost certainly lower in such a program where commercial rates are not paid for office requirements, public sector salaries prevail, and administrative costs are shared with a much larger base. On the programmatic side, during interviews conducted for this study with district health officials, we learned of many differences that could also account for these lower costs:

- More responsibility is placed on spray operators for activities at IRS wash sites, and washers are largely not employed in Zambia.
- Limitations on funds for transporting spray teams appears to have forced districts to use fewer rented vehicles, lowering the costs of transportation during spray operations. Typically, transportation is a major cost for other country programs with less complex financing streams.
- Spray operators in Zambia bear a heavier burden of their costs for transportation between their homes and spray sites, whereas in other countries transportation is either provided or the costs compensated. (It was even noted in one district that

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<sup>8</sup> Costs per structure in Ethiopia were even lower in 2008 and 2009 (\$7.60 and \$6.86, respectively). The next lowest costs per structure was observed in Ghana in 2009 at \$9.42. See *An economic analysis of the costs of indoor residual spraying in 12 PMI countries, 2008–2010*.

the average daily cost of this transportation generally equals or exceeds the daily wage paid to spray operators.)

These practices may save the program on costs. However, they may also compromise the quality of spray operations or cause future costs to increase (perhaps by creating disincentives for experienced spray operators to return to work during the next spray campaign and thus requiring more new operators to be recruited and fully trained).

**Costs per Person Protected.** As described earlier, information about the numbers of people protected each year by the public sector's IRS program differed by the two sources used. Moreover, the pattern of these differences was not consistent across the three years studied. The numbers provided by the NMCC for 2008 were 26 percent higher than those derived from the RBM report, but 6 and 12 percent lower for 2009 and 2010, respectively. The pattern of differences in calculated costs per person protected was opposite in each year (36 percent lower for the NMCC-provided numbers in 2008 and 6 and 10 percent higher in 2009 and 2010, respectively).

Regardless of which estimate is considered to be more accurate, as for costs per structure sprayed, costs per person protected by IRS are at the lower end of those observed in other PMI-supported countries with large IRS programs. The lowest cost observed in that group of countries in the same period was \$2.05, which occurred in Madagascar in 2010. Ethiopia's costs per person protected were the next lowest, at \$2.27 and \$2.15 in 2009 and 2010, respectively. Zambia's costs on this measure are clearly among the lowest.

**Uses of Funds across IRS Cost Categories.** One of the more surprising findings from this analysis is that use of funds for IRS in Zambia follows a pattern similar to that seen in other country IRS program (Tables 4–6). A somewhat higher proportion of total funds was devoted to spray operations in Zambia. Lower proportions were devoted to other cost categories (i.e., local labor, local administration, STTA, and labor from international sources). This pattern is as would be expected given that costs for labor and administration in public sector agencies in countries like Zambia would be expected to be less expensive compared with the international contractor model that prevailed in the countries to which Zambia's costs were compared. One note of caution is warranted: in the absence of information from the HSSP implementing organization, the pattern of HSSP spending across IRS cost categories was assumed to follow the pattern observed in other PMI-supported country IRS programs.<sup>9</sup> This should be confirmed with actual data from HSSP records.

**Future Cost Prospects.** Like many country IRS programs, Zambia's IRS program is facing new challenges. Resistance is emerging to the relatively low-cost pyrethroid insecticide products and the country will need to switch to other classes of insecticides for IRS to remain effective as an indoor mosquito-killing agent. Most countries are switching to carbamates, which are considerably more expensive (approximately \$11.80 per sachet as compared with just over \$3 per sachet for a pyrethroid). Assuming that each

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<sup>9</sup> We used the same proportional breakdown as that reported for the seven large IRS program countries cited earlier in this report. This was modified for the "STTA & U.S. costs" and "U.S./TCN labor" categories where we assumed that given differences between the HSSP and IRS 1 and IRS 2 projects, in HSSP these categories consumed resources at half the proportion observed for the IRS 1 and IRS 2 projects.

structure would need to be sprayed twice per year with a carbamate product to achieve the same level of protection afforded with a single spray round using the currently used pyrethroid, costs in Zambia would rise to almost \$14 per structure and \$3 per person protected. The total resources that are required to maintain the program at its current level of coverage and effectiveness would rise from \$9.9 million to nearly \$16.3 million, which is a 64 percent increase.

On a cost-per-structure or per-person-protected basis, these higher costs would increase Zambia's IRS program to the level of many other countries in Africa with large IRS programs. However, the country has struggled in the past two years to mobilize the funds necessary to implement the program in its current configuration. Prospects for success in being able to mobilize such a large increase in funds are unclear. Like a number of other countries, other options may be possible. Malaria prevalence rates having fallen considerably since Zambia began its massive IRS program scale up in 2003. There may be areas of the countries in which blanket IRS is no longer required to maintain progress made to date. In these areas, it may be possible to advance IRS to a targeted spraying strategy, conserving resources for those areas where prevalence rates have not yet fallen to a point that would justify switching from blanket to targeted spraying. Efforts to review scientific data on the changing pattern of malaria in Zambia that are already underway should be considered from the program cost perspective as well.