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Indoor Residual Spraying (IRS) 2 for Malaria Control

Task Order 1 - Final Report

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INDOOR RESIDUAL SPRAYING (IRS) 2 FOR MALARIA CONTROL

Indefinite Quantity Contract (IQC) Task Order I

Final Report
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RTI International is one of the world's leading research institutes, dedicated to improving the human condition by turning knowledge into practice. Our staff of more than 2,800 provides research and technical expertise to governments and businesses in more than 40 countries in the areas of health and pharmaceuticals, education and training, surveys and statistics, advanced technology, international development, economic and social policy, energy and the environment, and laboratory and chemistry services. For more information, visit www.rti.org.

Spray operator pressurizing the spray pump in preparation for the Rwanda 2011 spray round.

ACKNOWLEDGMENTS

RTI dedicates this report to the leadership of National Malaria Control Programs, district and local authorities, community groups, household members, and United States President s Malaria Initiative advisors in the host countries where IRS 2 Task Order 1 was implemented. Success of IRS depends greatly on the involvement of these stakeholders, their participation, and leadership.

We also gratefully acknowledge all RTI IRS staff—based in the field; Nairobi, Kenya; and Washington, DC—who contributed technical guidance, operational expertise, and management support to the project.

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ABBREVIATIONS

BMP	Best Management Practices
CDC	United States Centers for Disease Control and Prevention
CHT	community health teams
CHW	community health workers
CREC	Centre de Recherche Entomologique de Cotonou/Entomological Research Center of Cotonou (Benin)
DDT	dichlorodiphenyltrichloroethane
EMCAB	Environmental Monitoring and Capacity Building in Vector Control Interventions
EPA	Environmental Protection Agency
FY	fiscal year
GIS	geographical information system
GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
IEC	information, education, and communication
IQC	indefinite quantity contract
IRS	indoor residual spraying
ITN	insecticide-treated net
IVM	Integrated Vector Management
MDA	mass drug administration
M&E	monitoring and evaluation
MOA	Ministry of Agriculture
MOE	Ministry of Environment
MOH	Ministry of Health
MOU	memorandum of understanding
NDA	National Drug Association
NMCP	National Malaria Control Program
PDA	personal digital assistant
PEA	Programmatic Environmental Assessment
PMI	United States President's Malaria Initiative
PPE	personal protective equipment
RBM	Roll Back Malaria
SEA	supplemental environmental assessment
SMS	short message service
SOP	standard operating procedure
SOW	scope of work
TO	task order
TOT	training of trainers
U5	under five years of age
USAID	United States Agency for International Development
USG	United States Government
WHO	World Health Organization

Female spray operator at the end of the spray day. Rwanda 2011 spray round.

INTRODUCTION

Malaria remains one of the leading causes of death in Africa. The World Health Organization (WHO) estimates that approximately 655,000 people died from malaria in 2010 globally, of which 596,000 occurred in Africa.[1] Children under five years of age (U5) and pregnant women are the population groups at the greatest risk of contracting malaria. According to WHO, approximately 7% of all deaths among children U5 is caused by malaria.[2] Malaria morbidity is also a primary concern as sick children and adults miss school and work, which can impact livelihoods for months and years to come. On a macro level, malaria mortality and morbidity deters development of economic systems in many sub-Saharan countries by creating widows and orphans and loss of household income in general, whether by sickness or death. Furthermore, high malaria rates place huge burdens on health care systems at all levels, as nurses and doctors spend a disproportionate amount of time attending to malaria patients, and scarce Ministry of Health (MOH) resources are poured into treating patients that contract this preventable and controllable disease.

1. "Ten Facts on Malaria," WHO, last modified April 2012, http://www.who.int/features/factfiles/malaria/en/index.html.
2. "Children: Reducing Mortality" Factsheet No. 178, WHO, last modified September 2012, http://www.who.int/mediacentre/factsheets/fs178/en/index.html.

Approximately 7% of all deaths among children under five years of age in Africa are caused by malaria.

Though the burden of malaria remains high, there have been some promising gains in the past few years from malaria control efforts supported by the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM), the United States Government's President's Malaria Initiative (PMI), other major funders, and host country governments. WHO reports that global malaria mortality rates have declined by 25% from 2000 to 2010 and by 33% within the Africa region.[3]

Through its support to the GFATM and the PMI, the U.S. Government (USG) is one of the largest donors towards global efforts to control malaria. PMI was launched in 2005 as a five-year, $1.2 billion initiative to rapidly scale-up malaria prevention and treatment interventions and reduce malaria-related mortality by 50% in 15 high-burden countries in sub-Saharan Africa.[4] The 2008 Lantos-Hyde Act authorized USG malaria funding for PMI to extend through FY2014, with the goal adjusted to reduce malaria-related mortality by 70% by the end of 2015. This will be achieved by reaching 85% coverage of the most vulnerable groups, i.e. children U5 and pregnant women, with proven preventive and therapeutic interventions, including rapid diagnostic testing and artemisinin combination therapies (ACTs), intermittent presumptive treatment for pregnant women (IPTp), insecticide-treated nets (ITNs), and indoor residual spraying of households with insecticide (IRS).

A family stands in front of their house after it has been sprayed.

3. "Key Malaria Facts," Roll Back Malaria, http://www.rbm.who.int/keyfacts.html.
4. PMI focus countries currently include: Angola, Benin, Democratic Republic of Congo, Ethiopia, Ghana, Greater Mekong Sub-region, Guinea, Kenya, Liberia, Madagascar, Malawi, Mali, Mozambique, Nigeria, Rwanda, Senegal, Tanzania, Uganda, Zambia and Zimbabwe.

BACKGROUND

With funding from PMI, USAID awarded RTI International the IRS indefinite quantity contract (IQC) in 2006, which covered 14 countries and sprayed a total of 10,503,719 structures from 2006 through 2009. Following IRS 1, RTI was awarded the follow-on IRS 2 IQC Task Order 1 (hereafter IRS 2 TO 1) in 2009. This IQC reflected a continued strong commitment from USAID to support the use of IRS as an effective malaria control intervention in Africa. The IRS 2 TO 1 supported 13 countries in Africa with a period of performance of September 2009 through September 2014, although implementation ended in 2012. Through IRS 2 TO1, RTI provided technical, operational, and managerial support to PMI focus countries in sub-Saharan Africa to build local and regional capacity and provide management and quality assurance for the implementation of IRS as an intervention for malaria prevention and control. The following countries were supported through IRS 2 TO1: Angola, Benin, Burkina Faso, Ethiopia, Ghana, Liberia, Madagascar, Mali, Mozambique, Nigeria, Rwanda, Senegal, and Zambia.

With the exception of Burkina Faso and Nigeria, all IRS 2 countries had been supported under IRS 1. Burkina Faso was newly introduced to the PMI IRS project through IRS 2 and began spray campaigns in 2010. Nigeria became a PMI focus country in 2011 but did not conduct an IRS spray round under this contract. RTI's scope of work (SOW) in Nigeria was limited to spray site selection, establishing an entomological baseline, procuring commodities, and conducting training in entomological monitoring for IRS in preparation for an eventual spray round.

Rwanda community mobilizer speaks to a household member.

The IRS 2 TOI scope of work included five main components:

1. Establish a worldwide procurement mechanism to support IRS and prepare and execute all aspects of logistical plans for IRS-related activities, including timely procurement, distribution, and storage of all commodities.

2. Together with National Malaria Control Programs (NMCPs), implement IRS programs and provide operational management support (i.e., field supervision, operations planning, and day-to-day implementation management) and expert short- and long-term technical and administrative assistance, primarily in the PMI focus countries but also in other countries where USAID supports malaria programs.

3. Ensure the safe and judicious use of insecticides, including preparation of environmental assessments, adherence to best practices, and monitoring of activities.

4. Provide ongoing monitoring and evaluation (M&E) for activities and ensure quality control measures are established and implemented.

5. Build and strengthen the capacity of NMCPs in the technical and managerial functions of IRS by engaging, training, and supervising personnel at the central, provincial, and district levels.

Based on the PMI-approved annual work plan for each country, RTI worked collaboratively with PMI, NMCP, and other administrative units and partners to successfully implement each component.

An overview of IRS core indicator results summarized for all IRS TO1 2 countries for 2010 and 2011 is presented on ***Page 5***. ***Appendix A*** and ***Section 5*** present the IRS core indicator results by country.

Table I. IRS Results Summarized across All Countries[a] by IRS 2 TOI Work Plan Year

Structures Sprayed

2010 4,357,123

2011 4,694,411

People Protected

2010 17,404,662

2011 14,475,575

Personnel Trained[b]

2010 13,792

2011 13,777

a. Zambia's results are not included in this table because another partner managed spray implementation in Zambia; RTI managed the the operations' supply chain and environmental compliance, as well as capacity building of spray personnel.

b. This indicator includes the following cadres of spray personnel: spray operators, team leaders, supervisors, and clinicians. It does not include data clerks; information, education, and communication (IEC) mobilizers; drivers; washerpersons; pump technicians; and security guards.

SUBCONTRACTORS

RTI collaborated with the following three key subcontractors as partners under IRS 2 TO1 to execute the SOW in a timely and efficient way:

- Crown Agents: managed commodity procurement, shipping, freight forwarding, and delivery.
- Medical Research Council: managed training and capacity building for entomologic monitoring, pesticide selection, resistance testing, insectary development, and IRS planning in two subregional sites—NIH/Mozambique and University of Dakar.
- Meridian Group International: managed public health information materials development, education and communications approaches, launch planning, and lessons learned documentation.

To utilize and enhance the strong entomology capacity in sub-Saharan Africa, several regional centers of excellence were subcontracted at the country level by RTI, funded by PMI as partners through another contractual mechanism, or engaged directly by NMCPs to support entomology and capacity building for the IRS operations in various countries. The following centers of excellence were active partners in entomological monitoring for IRS during IRS 2 TO1:

- Centre de Recherche Entomologique de Cotonou in Benin
- Institute of Research on Health Sciences/Centre Muraz in Burkina Faso
- Adama Malaria Reference Training Center in Ethiopia
- Noguchi Memorial Institute for Medical Research in Ghana
- Malaria Research and Training Centre in Mali
- National Institutes for Health in Mozambique
- University of Dakar (also known as Cheikh Anta Diop University) in Senegal
- Jos University in Nigeria

OVERVIEW OF IRS 2 TOI ACHIEVEMENTS

Under IRS 2 TO1, RTI achieved significant successes under the five components included in the task order and met program objectives in each area. Most important, PMI through RTI successfully managed 22 spray rounds in 12 different countries, achieving more than 85% of IRS coverage in all rounds. The following list provides an overview of other notable accomplishments under the IRS 2 TO 1:

- Trained 27,569 spray personnel.
- Conducted timely and cost efficient procurement of 2,801,108 sachets of insecticide and spray equipment for 22 spray rounds.
- RTI developed tools to support/build local capacity, including procurement and warehousing management tools for MOHs and NMCPs.
- The project facilitated improved collaboration among NMCP, PMI, and partners in information sharing and evidence-based decision making on issues such as insecticide selection, entomological monitoring, and spray launch dates.
- RTI managed entomological monitoring activities in 10 countries and results distribution improved dramatically by the end of the task order.
- Piloted the use of mobile technologies for IRS operations in two countries.
- RTI prepared and submitted to PMI a cost analysis of 2008-2010 IRS operations.[5]
- RTI provided 43 pre- and mid-spray environmental compliance inspections and ensured the transfer of responsibility in this area to local authorities in countries that had sufficient capacity (e.g., Senegal and Liberia).
- Strengthened the M&E system for IRS 2 TO1 by implementing an improved relational database for capturing and analyzing data in 11 countries.

STRUCTURE OF THIS REPORT

This final report provides an overview of the achievements, cost efficiencies, lessons learned, and efforts towards sustainability. ***Sections 1–5*** address the five main task order components as described in the IRS 2 TO1 contract. Success stories and results are shared throughout the report under each component. ***Appendix A*** provides comprehensive M&E data. ***Appendices B–E*** present the tools and materials developed for implementation of various IRS components. These can be used as models for other partners and NMCPs starting up or continuing IRS in their countries.

22 spray rounds were completed in 12 countries, with all rounds achieving over 85% of IRS coverage.

5. RTI, International. "An Economic Analysis of the Costs of Indoor Residual Spraying in 12 PMI Countries, 2008–2010." www.fightingmalaria.gov. President's Malaria Initiative (PMI), n.d. Web. http://www.fightingmalaria.gov/technical/irs/IRS_economic_analysis.pdf.

IRS Team Leader in Rwanda records data on spray day.

COMPONENT I:
PROCUREMENT AND SUPPLY CHAIN MANAGEMENT

A timely and efficient procurement and supply chain system is critical to the effective implementation of IRS operations. Specific commodities need to be available at the right time and in the right quantities to provide coverage for the entire targeted area and for spray rounds to be launched and completed at the optimal time (i.e., before the rainy season). RTI applied invaluable lessons gained from implementing IRS 1, including the timing for the procurement and delivery of insecticides, and knowledge of which commodities could be sourced locally and which could not due to quality or availability, to improve the global procurement and supply chain system for IRS 2 TO1. As a result of lessons learned in IRS1, we introduced several new elements and achieved additional cost and program efficiencies. Throughout IRS 2 TO1, RTI implemented changes that simplified ordering processes and added efficiency to the IRS supply chain, including reduced procurement lead times, managing a decreasing number of suppliers, increasing regional purchasing, and flexibility in commodity shifting. RTI also developed tools and manuals that were used to train and guide staff and stakeholders in procurement, supply chain management, and warehousing for IRS commodities and materials. Overall, RTI made positive improvements to the IRS supply chain for IRS 2 TO1 through innovative

A woman removes her belongings from her house as shown in an IEC brochure in Ethiopia.

1.1 CERTIFICATION OF THE RTI PURCHASING SYSTEM

Approval and certification of the RTI purchasing system allowed RTI to conduct procurements in a shorter time frame because the requirement to receive approval from USAID on sourcing efforts greater than $100,000—which included most insecticide and key IRS equipment purchases—was eliminated. By having the approval and certification in place, RTI was able to move forward with placing orders once the competitive procurement process of gathering quotations and selecting the best value vendor was completed. This typically resulted in a 1–2 month reduction in procurements' processing time.

1.2 IMPROVED MANAGEMENT OF THE INTERNATIONAL PROCUREMENT AND SUPPLY CHAIN OF IRS COMMODITIES

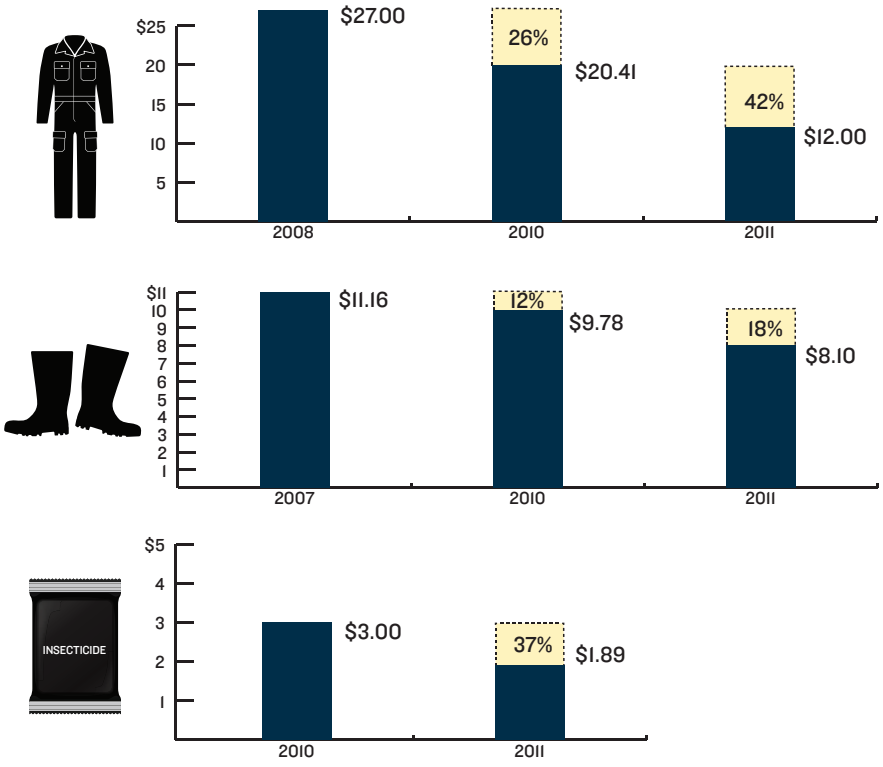
The recruitment of a IRS 2 TO1 supply chain specialist allowed for the provision of full-time procurement expertise that RTI field teams could rely on for guidance on local procurement practices as well. Having a fully dedicated supply chain specialist allowed RTI to closely track the procurement process for all orders (from placing purchase orders to commodity delivery in country); provide more frequent and detailed reports on commodities' procurement and delivery status; ensure consistency and accuracy in commodity specifications and orders; develop realistic forecasts for suppliers; and implement innovations for cost efficiencies (see bulk procurement below). Because the project ensured greater and improved coordination and management of procurement and supply chains RTI's working relationship with the IRS 2 TO1 procurement subcontractor, Crown Agents, was enhanced. Together, Crown Agents and RTI secured a more efficient and economical supply chain and tackled operational challenges as they arose.

1.3 BULK PROCUREMENT OF IRS CORE COMMODITIES

Bulk procurement of IRS core commodities greatly increased efficiency and introduced cost savings into the processes of sourcing, procurement and delivery of insecticides, PPE, and spray pumps for the IRS 2 TO1. Cost savings were realized by leveraging economies of scale in IRS commodities' purchasing and from the use of more economical shipping methods for international suppliers. With early notice of order quantities, suppliers used cost-efficient modes of transportation in securing the necessary raw materials to fulfill each order requirement. In addition, bulk procurement contributed to a decrease in the cost of labor and procurement processing time. For example, in most cases, IRS 2 was able to select one vendor for a certain commodity across all countries; the number of international procurement sourcing events was reduced from 35 to 3.

From the start of IRS1 to the end of IRS2 TO1, the project achieved key commodity cost reductions of 50% and 42%, respectively, for PPE and insecticides, by securing reduced unit prices for these commodities. To illustrate how unit costs were dramatically decreased, we can look at the examples of overalls, gumboots, and insecticide. In 2008 under IRS1 TO1, the project paid $27 for a pair of overalls procured internationally. Upon starting up IRS2 TO1 in 2010, RTI negotiated this down to $20.41. Then, in 2011, through the use of local suppliers and bulk procurement agreements, the price dropped even further to $12 for each pair of overalls. Similar dramatic reductions were seen in gumboots. Under IRS1 TO1, the project paid $11.16 for a pair of gumboots in 2007, which dropped to $9.78 in 2010 and further down to $8.10 per pair in 2011. These savings were not limited to PPE. The cost of insecticide was also reduced greatly. In 2010, at the start of IRS2 TO1, a pyrethroid sachet cost the project from $2.85 to $3 per sachet. With a 12 month contract in place, in 2011, RTI was able to secure a price of $1.89 per pyrethroid sachet using the same supplier for all pyrethroid orders.

Figure 1. Project Savings on IRS Commodity Costs

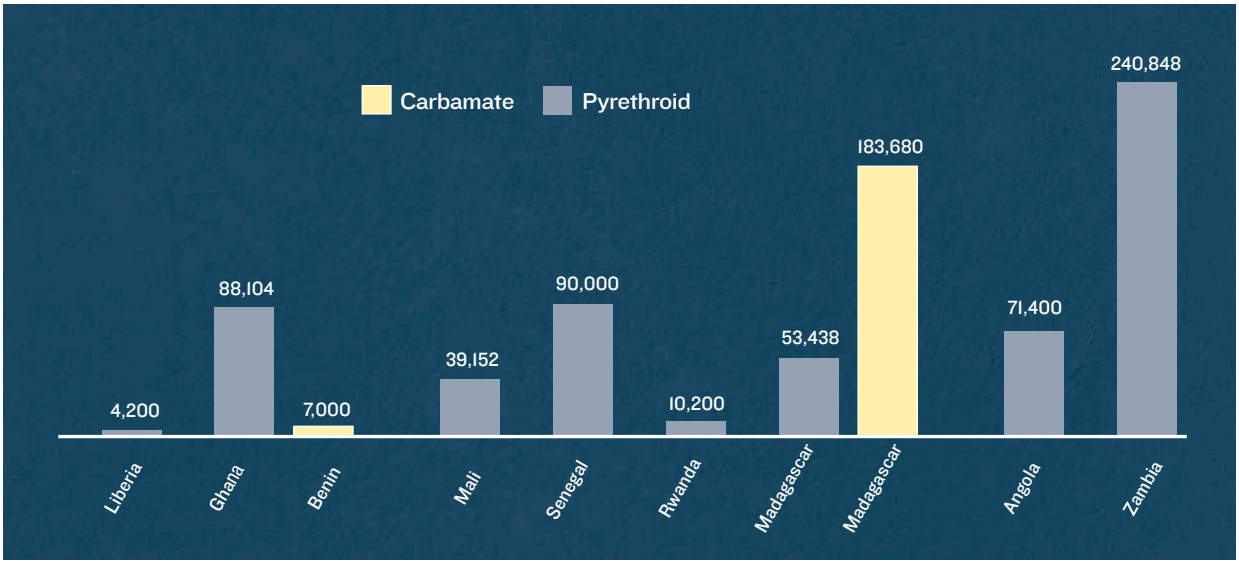


Furthermore, year-long fixed pricing, which was part of the "bulk procurement" contract agreements with suppliers, protected IRS 2 TO1 against the rising cost of commodities, especially PPE. For example, in June 2011, there was a sharp increase in the price of cotton in Ethiopia. However, because an established pricing agreement with a local PPE supplier was in place, RTI maintained low costs of procuring overalls despite market changes.

The project collaborated with suppliers to broker and execute the bulk procurement agreements while complying with USG's competitive procurement processes. The IRS 2 TO1 supply chain specialist worked closely with suppliers to ensure that internationally procured commodities, such as spray pumps and insecticide, could be produced on time and delivered according to agreements. Because this system of advanced planning was established, the project could respond to host countries' last-minute requests for commodities. For example, the Mozambique IRS project requested 650,000 pyrethroid insecticide sachets at the end of May 2011 for delivery less than two months later due to a delayed decision by partners to procure insecticide. IRS 2 successfully accommodated the request via the bulk procurement mechanism—the supplier knew it was responsible for producing pyrethroid insecticide for IRS 2 TO1 and had sufficient stock on hand. The bulk procurement mechanism also allowed for flexibility for cases of delayed commodities because one supplier was able to handle orders across multiple countries. When a Ghana IRS PPE shipment was delayed, RTI worked with the PPE supplier to redirect quantities initially designated for a different country to fulfill the more immediate needs of Ghana without negatively affecting operations in the other country. This was only possible because the project contracted with one supplier instead of different suppliers for each country. As a result, coordination of commodities across all countries became simplified and more efficient.

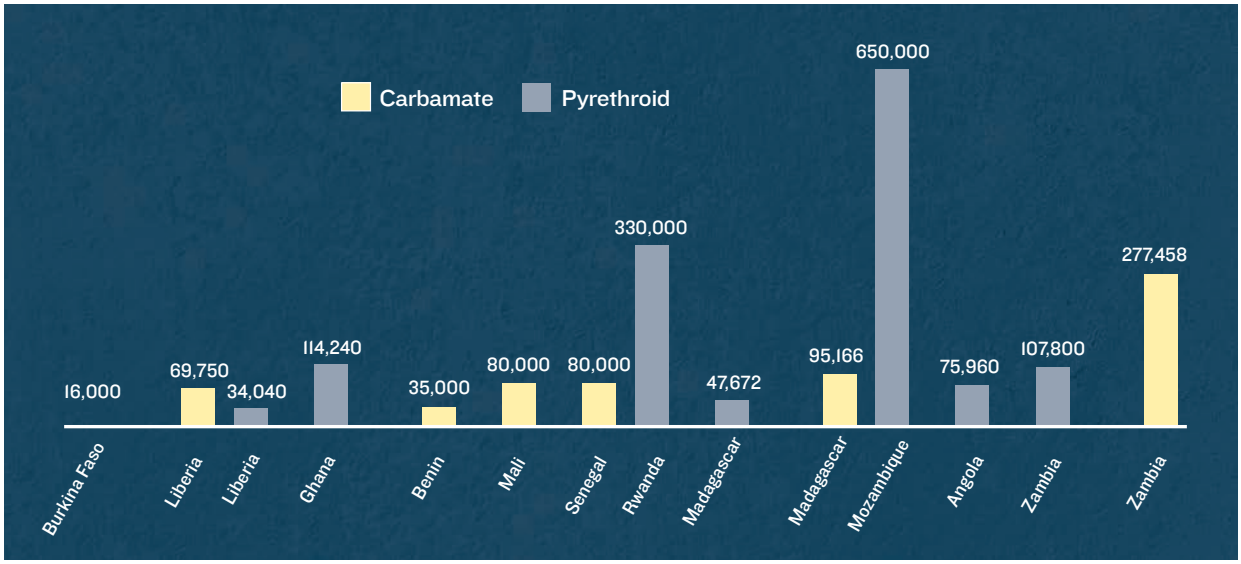
Figures 2 and ***3*** show the total number of insecticide sachets purchased in each country in 2010 and 2011 using the bulk procurement mechanism.

Figure 2. Insecticide Sachets Purchased by Country in 2010*



*In 2010, insecticide for Ethiopia and Mozambique was purchased through separate contractual agreements.

Figure 3. Insecticide Sachets Purchased by Country in 2011*



*In 2011, insecticide for Ethiopia was purchased through a separate contractual agreement.

Vetting and Increased Use of African Local and Regional Suppliers

The benefits of the increased emphasis of the use of local suppliers were threefold. First, by working with regional vendors of IRS commodities, RTI supported building capacity within the countries and regions to provide quality commodities for IRS operations. IRS 2 TO1 field teams worked closely with the supply chain specialist to provide feedback on quality and specifications of products to apprise vendors of quality and efficiency issues and assist them to meet international standards; only vendors that met high quality standards were chosen. Second, sourcing products regionally reduced costs of labor, shipping, clearance, and in some cases distribution. The unit cost of the regional items were often less expensive than the U.S.-based vendors, especially when factoring in shipping (on average 60% lower using regional vendors). Third, by having long-term pricing agreements with local suppliers in place, RTI could accommodate unexpected commodity requests and meet critical deadlines.

IRS Procurement and Supply Chain Management Tools

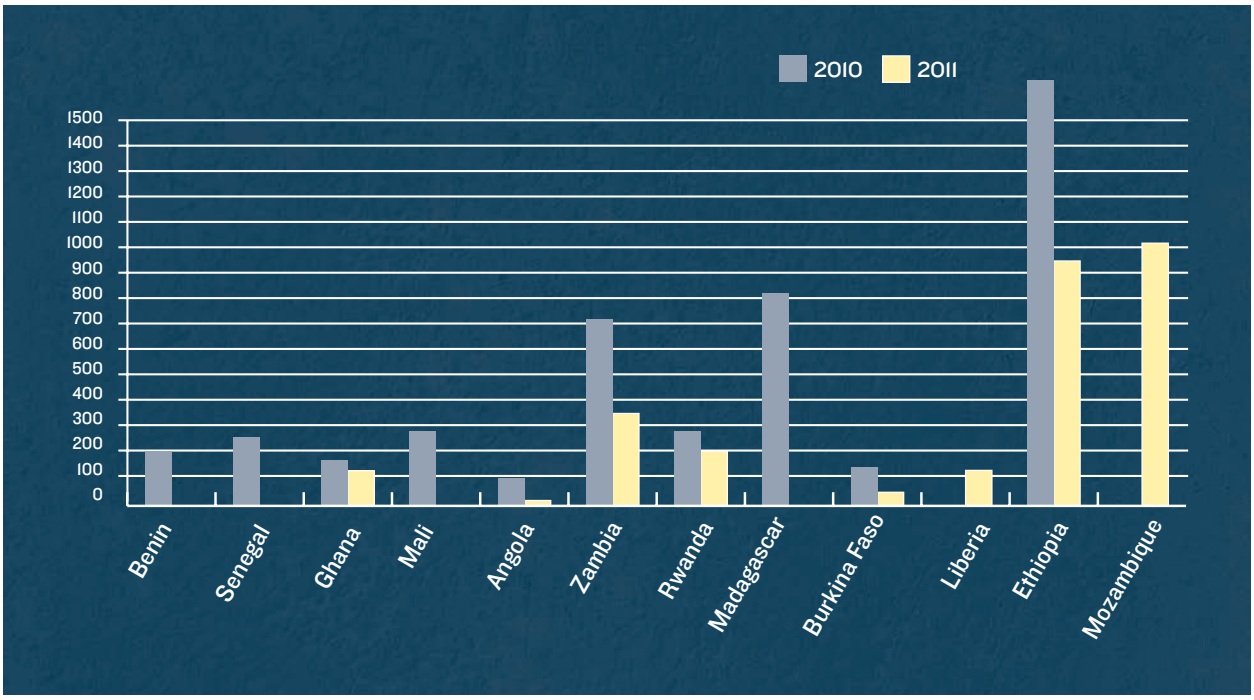
Specific tools developed as a result of IRS 2 TO1 are listed below.

– *Warehouse and Inventory Management Manual.* This manual was developed to ensure that warehouses and storage areas were properly arranged and maintained for IRS commodities according to WHO international standards. The manual covers operating procedures and provides guidance to field-based logistics officers to ensure proper stock management and inventory controls.

– *The Procurement and Supply Chain Management Manual.* This manual serves as a reference to train personnel on the overall procurement process for IRS commodities such as insecticide, spray pumps, and PPE. This document provides specifications that logistics and procurement staff can use when preparing procurement plans, soliciting and selecting vendors, and conducting inspections of commodities upon receipt. By training personnel such as spray operators, store room managers, and supervisors, on the proper maintenance and storage of equipment, IRS 2 was able to use equipment longer. As shown in ***Figure 4***, RTI ensured that pumps were maintained for use over multiple years and, therefore, did not need to procure substantial numbers of spray pumps annually.

– *Procurement Capacity Assessment Tool.* In 2011, RTI developed this tool and submitted to PMI to as-

Figure 4. Procurement of Spray Pumps by Country for 2010 and 2011



Logistics manager in the warehouse in Rwanda.

sist NMCP procurement departments to assess strengths and weaknesses in procurement operations. Although the IRS 2 project ended before the tool could be rolled out, it is fully developed and ready to be implemented. The tool should be delivered during a four-day training session with the procurement managing partner working as a facilitator with the MOH/NMCP procurement team. The tool takes the team through a systematic process of assessment and scoring of procurement capabilities, processes, and regulations. Based on the outcome, the facilitator should work with NMCP to develop a system improvement plan with concrete action items and an implementation timeline for building capacity and operational efficiency in procurement operations.

It is expected that PMI focus countries where IRS 2 TO1 implemented operations will continue to reap the benefits of such innovations and capacity building tools as they are used, discussed, and shared.

1.4 LESSONS LEARNED IN PROCUREMENT AND SUPPLY CHAIN MANAGEMENT

Lessons learned included:

- Establishing bulk procurement mechanisms reduces labor costs, procurement processing time, and shipping costs. In some cases, it also lowers unit costs, as seen with insecticides where 35% cost savings were observed.
- Having a full-time dedicated supply chain specialist is essential to providing consistency and facilitating seamless support across countries.
- Well-developed stock management tools systematize stock management across countries, facilitate oversight, and enhance accountability.
- Feedback regarding quality of personal protective equipment (PPE) should be gathered from spray operators. Often times they are the only ones who know if something is faulty (e.g., gloves that tear easily) since they use such items daily.
- Early agreements on insecticide class selection and target area by NMCP and PMI aid in timely commodity procurement for upcoming IRS operations.
- Identifying local vendors that produce quality commodities is a cost-efficient alternative to contracting international procurements. However, it is important to ensure that the quality of commodities meets WHO and other international technical and operational standards.
- In many countries, district health authorities are able to donate space for IRS warehousing. This should be explored early in implementation to realize cost savings to operations.
- Overseas shipment costs can be greatly reduced by placing orders early so that sea shipment and/or consolidation can occur.
- Spray operators should be fully trained on the use and maintenance of the spray equipment to minimize damage. Supervisors must ensure standard operating procedures (SOPs) are being followed in the handling and use of all equipment to extend longevity and reduce restocking costs.

Washers fill a progressive rinse barrel in Ethiopia.

Spray operators arrive at a spray site in Ethiopia.

COMPONENT 2:
OPERATIONAL MANAGEMENT SUPPORT

involved providing varying degrees of support to our host country counterparts (e.g., national, regional, and/or district levels) through field teams, short-term technical assistance (STTA), and remote assistance from Nairobi, Kenya. The project used a multi-pronged approach to guide NMCPs in the management and operations for IRS and supported them through planning assistance, trainings, and field operations. Furthermore, working alongside NMCP, RTI provided financial management of operational areas, including payment of spray operators, procurement of commodities and vehicles, and tracking project expenditures.

2.1 ACHIEVEMENTS IN PARTNERSHIP COORDINATION WITH MOH/NMCP

Memoranda of Understanding (MOU)

In all countries covered by IRS 2 TO1, RTI's strategy of country engagement began with signing an MOU to define the roles and responsibilities of RTI/PMI and MOH/NMCP. Though not legally binding, RTI used the MOUs to hold partners accountable to their agreed responsibilities. Moreover, MOUs were used to facilitate the transfer of responsibility from RTI to NMCPs from one year to the next. For instance, at the beginning of a work plan year, RTI and host country counterparts reviewed the MOUs and discussed/agreed on responsibilities that were ready to be transferred to the NMCP. RTI updated the MOUs and work plans accordingly, and then both parties signed.

Components of IRS Operational Management Support:

- MOU clarifying partner's roles
- All-partner coordination meetings
- Strategic trainings
- Learning-by-doing
- Tools development and sharing
- Close and consistent communication with NMCP and PMI

National-level Partnership Coordination

Convening the IRS national stakeholders' meeting in each host country is one of the most important activities at the start the work plan year. These high-level meetings brought together MOH/NMCP, other host government entities, and in-country stakeholders to discuss areas for collaboration throughout the IRS operations. In so doing, IRS 2 TO1 established collaborative relationships very early in the planning phase, which, in turn, ensured joint supervision and collaborative microplanning during the year. Securing high level involvement was instrumental to ensuring that IRS was seen as a national program and a priority by MOH. It provided additional validation and advocacy for the project at lower levels with the engagement of national-level staff. For those countries where these meetings did not occur, because of scheduling or lack of human resources, it was often more difficult to manage relationships across sectors and to ensure the involvement of all stakeholders (e.g., Ministry of Environment [MOE], Ministry of Agriculture [MOA], and National Drug Association [NDA]). In contrast, in countries where early collaboration among stakeholders occurred, there was more harmony throughout planning and implementation of IRS operations, fewer communications issues, more efficiency, and in many cases more successful operations. The text boxes in this section provide examples from IRS countries of the impact of national-level IRS meetings.

As the pre-spray period progressed, IRS 2 TO1 played an important role in all countries by ensuring that open lines of communication between PMI, NMCP, RTI, and other key stakeholders were maintained. Consistent and clear communications were a vital element of success for IRS operations in each country. In several countries, the project facilitated improved collaboration among NMCP, PMI, and partners in information sharing and evidence-based decision making on issues such as insecticide selection, entomological monitoring, and spray launch dates. By collaborating with NMCPs, PMI and RTI shared data and assisted NMCPs on using data to inform IRS decision making. During these meetings, RTI also presented planning tools that had been developed during IRS 1. In particular, RTI promoted the use of the IRS implementation plan (***Appendix E***) for planning key activities throughout the various stages of IRS. The IRS implementation plan provided a road map for stakeholders and IRS leadership to ensure that the preparations and implementation of the spray round were on schedule.

Mozambique IRS Steering Committee

In 2010 and 2011, the Mozambique NMCP underwent leadership changes. It became apparent that the Government of Mozambique needed support in setting up an inter-agency coordination forum where IRS could be jointly discussed and decisions could be made about strategy, collaboration, and issues such as insecticide selection. RTI worked with PMI and NMCP to facilitate the formation of an IRS Steering Committee, which would act as an advisory body to the NMCP. RTI served as the rotating secretariat for the Steering Committee, scheduling meetings and preparing minutes and action items. The committee meetings brought discussion of various cross-sector issues to the IRS table. However, as a lessoned learned from this activity, it is a good practice for NMCPs and other agencies to designate a second-line representative who is committed to attending meetings consistently to ensure the continuation and sustainability of the Steering Committee. Often, only involving senior-level officials can cause scheduling barriers and prevent meetings from ever taking place.

Subnational Coordination

For countries such as Angola and Madagascar, which had especially limited human resources and systems available for successful IRS operations, RTI recruited temporary or full-time subnational IRS coordinators (e.g., at province, district, or municipality level). In other countries such as Senegal and Ghana, which had greater subnational level resources and systems, RTI collaborated with the IRS focal person at the subnational level. However, as a key lesson learned from IRS 1, to ensure seamless functioning of IRS, it is necessary to have someone designated as the IRS focal person in the lowest administrative unit targeted for IRS operations. Without this position, supervision becomes lax and the operations' accountability structure breaks down. Therefore, if MOH and NMCP were not able to provide this position, RTI engaged a local expert from the area targeted for IRS, who could eventually be hired by the MOH/NMCP or serve as a trainer once a permanent IRS focal person was appointed. These positions were highly instrumental in building the capacity of subnational-level MOH staff to manage IRS operations for their catchment areas. It is worth noting that countries recovering from recent internal conflict (e.g., Liberia and Angola) were more likely to lack adequate human resources for IRS at both the national and subnational levels; therefore, these countries needed additional support both technically and financially.

Most zones or districts targeted for IRS operations maintained an office where the warehouse was located and M&E and finances were managed. Coordinators in these areas held primary authority and leadership for the IRS operations in their respective zones and districts; and ensured strong linkages between the district health office, NMCP, the community, and the RTI IRS project staff. They were responsible for reporting on logistics, procurement, environmental compliance and IEC in their zone or district to the chief of party (COP) of the project. In most country settings, IRS operations were organized in a cascading model starting with zone or district coordinators, then site coordinator, supervisors, team leaders, and finally spray operators. RTI COPs were responsible for mentoring zone or district coordinators and providing support and oversight. This model worked very well for the IRS 2 TO1 project and RTI was able to build high-level capacity of many zone and district coordinators accordingly.

Ghana National Malaria Vector Control Oversight Committee

In Ghana, RTI IRS field staff worked with NMCP to facilitate meetings of the National Malaria Vector Control Oversight Committee. The committee included several task teams that addressed specific areas such as capacity building, training, and insecticide resistance management. Committee members represented a wide range of malaria-related organizations, academic institutions, and private sector companies and included PMI, NMCP, GFATM, RTI, AngloGold Ashanti, EPA, and Zoomlion Ghana Limited (waste management company).

Post-Spray Evaluation Meetings

In every country, RTI facilitated post-spray evaluation meetings. Depending on the country, this would happen at the subnational (e.g., zones or districts) or national level, or both. These meetings provided a forum for NMCP, MOH, MOE, and other stakeholders to discuss results and lessons learned from the spray round and general operations, as well as discuss any insecticide resistance issues and suggestions for improving future spray rounds. Because of RTI-facilitated increased capacity, NMCPs and IRS focal health personnel led these meetings in the majority of IRS countries.

Securing high level involvement was instrumental to ensuring that IRS was seen as a national program and a priority by the MOH.

Lessons Learned in Partnership Coordination

Key experiences from which the IRS 2 project learned valuable lessons are listed below.

- Early meetings at the national level are essential for securing involvement and support from key stakeholders.
- Consistent communication with PMI, MOH/NMCP, and in-country stakeholders facilitates good working relationships and early problem solving.
- Regular meetings at the district level facilitate program ownership and transfer of skills to promote sustainability of the program.
- MOUs clarify roles and responsibilities and create a framework for transferring IRS responsibilities to the host country.
- Each IRS targeted area must have an IRS focal person that coordinates operations. If MOH or NMCP cannot supply this person, the implementing partner must find a local professional with the technical background and skills to train for this role.
- Ideally, implementing partner staff positions should be co-located with host country counterparts to facilitate knowledge transfer; however, this is difficult to achieve in the majority of countries due to scarcity of resources. Innovative means of collaboration must be sought such as inviting the NMCP IRS focal person to sit at offices of implementing partner.
- Use of the IRS implementation plan is instrumental as it provides a road map for operations teams and for staying on schedule.

2.2 ACHIEVEMENTS IN INFORMATION, EDUCATION, AND COMMUNICATION (IEC)

To successfully implement IRS operations, IEC activities must be well coordinated with spray operations to ensure that communities are sensitized about the purpose of IRS and know their roles and responsibilities in IRS before, during, and after spray operations. Furthermore, IEC messages aimed to address the questions and concerns of the community regarding the purpose of IRS and dispel misconceptions of IRS to reduce refusals.

Therefore, the main objectives of IEC activities for IRS 2 TO1 were to inform communities and stakeholders about the benefits of IRS as a malaria prevention strategy, ensure high participation of community members in IRS, and inform the beneficiary communities of the necessary preparations required to ensure adequate human and environmental safety for successful spray operations. RTI partnered with Meridian Group International Inc. to manage and oversee IEC activities.

King of Huambo Province attending the 2010 IRS evaluation meeting in Huambo, Angola.

An IEC mobilizer in Rwanda walking under an IEC banner promoting the acceptance of IRS for reducing malaria in the village.

As a key tenet of the IEC strategy, the IRS project worked with zone-, district-, or municipality-level health staff to enter into villages and communities by first meeting with local authorities and gaining their support for IRS. This helped greatly as local authorities and religious leaders in the area have high influence at the community level to promote households' acceptance of IRS. For example, well-mobilized communities with high levels of support for IRS often provided water to the spray operators to prepare the insecticide for spraying, which reduced operating costs.

Furthermore, under IRS 2 TO1, all IRS countries operated under a more efficient model for IEC by engaging community health workers to serve as IEC mobilizers. Community health workers (CHWs) and village health agents were recruited by local administration and trained by IRS 2 TO1 staff and district health personnel in IEC for IRS. This model of CHW involvement allowed IRS sensitization to be integrated with other community health programs. The use of CHWs as IEC mobilizers also lowered transportation costs for IEC and improved the effectiveness of IEC since the mobilizers were familiar with the households in their assigned villages and could better locate every structure in the area. This approach also minimized refusals of IRS since many household members were familiar with the IEC mobilizer, which provided additional credibility to the IEC messages being shared. Under IRS 2 TO1, 43,321 IEC mobilizers were trained by RTI in collaboration with district health authorities.

The main methods to disseminate messages included conducting door-to-door sensitization, convening community meetings and civil society forums, and broadcasting messages through mass media. In IRS 2 TO1, to be more cost-effective, the project took a strategic approach to distributing IRS apparel (e.g., t-shirts, caps, etc.); i.e., instead of conducting mass distributions at community events, IRS apparel was provided to community leaders or community health workers.

The objectives of IEC and community mobilization for IRS included:

- Involving and engaging key stakeholders from the start to promote IRS's acceptance and sustainability.
- Training IEC mobilizers in IRS IEC messaging and data collection.
- Providing information to the community on malaria and the benefits of IRS in preventing and controlling malaria, thereby maximizing household acceptance of IRS.
- Informing beneficiaries about their roles in IRS before, during, and after spray operations.
- Providing accurate information to the key stakeholders and beneficiaries about safety issues related to environmental and health effects of insecticide used in IRS.
- Addressing community beliefs and dispelling misconceptions about IRS.

Table 2. Number of IEC Mobilizers Trained in IRS 2 TO1 Countries

Country	2010	2011
Angola	177	243
Benin	253	472
Burkina Faso	322	288
Ethiopia	1,276	2048
Ghana	324	389
Liberia	244	540
Madagascar	14,818	10,770
Mali	772	1,172
Mozambique	246	987
Rwanda	3,185	4,795
Total	21,617	21,704

*RTI did not manage IEC in Nigeria, Senegal, and Zambia.

Under IRS 2 TO1, by 2011, RTI successfully transitioned the IEC component to local authorities in 50% of the IRS countries.[6] In these countries, a focal person at the zonal or district health office managed the IEC component with minimal support from IRS 2 TO1 staff. In so doing, the health communications officer integrated IRS messages with other key health messages and provided for increased district ownership of the program. Existing structures of CHWs from the beneficiary communities raised awareness of IRS throughout the community and also led discussions at women's groups, school clubs, and religious gatherings.

Innovations in IEC

Several IEC innovations were introduced in IRS 2 TO1. An important lesson learned from implementing IRS 1 was the need to develop another system to identify structures sprayed (IRS 1 used household stickers, which were not effective). In 2010, RTI introduced the IRS structure card (see Figure 5, Section 4) that were kept in the household and were used to record IRS data for up to five years. Structure cards were distributed during door-to-door mobilization by the IEC mobilizers. IRS structure cards assisted with quality assurance and supervision, since each card had the name of the corresponding spray operator.

The IEC component was successfully transitioned to local authorities in 50% of the IRS countries.

6. The following countries assumed leadership/management of IEC component: Angola, Benin, Burkina Faso, Ethiopia, Liberia, and Mozambique.

Lessons Learned in IEC

Experiences of IRS 2 TO1 from which the project gained valuable lessons are summarized below.

- *IEC conducted by other partners.* IEC management by separate partners required extra synchronization to ensure IEC and IRS were seamlessly coordinated. In several countries, including Senegal, Rwanda, and Ethiopia, the IEC component for IRS operations was managed by other PMI-funded implementing partners, which often posed coordination challenges between IEC and IRS field activities. It is essential that IRS operations and IEC are closely coordinated to ensure beneficiary communities are mobilized in advance of the start of spray operations and mobilizers are available in case issues arise the day of spraying. When a separate implementing partner manages the component, RTI relies on consistent communications and smooth functioning of the IEC partners' management and operations systems for the spray round to operate seamlessly. In one example, the IEC NGO implementing partner in Senegal had challenges with paying IEC mobilizers, causing a halt in IEC activities during the spray round, a situation beyond RTI's control. The issue was not resolved until the last week of spraying, and the project had to adjust operations and commit unanticipated resources to work with local authorities to ensure communities were mobilized for spraying. When NMCP and Zonal or District Health Teams led IEC and community mobilization with RTI's and PMI's support, there were fewer challenges and the delivery of the community mobilization component was often more successful. It is possible for IRS operations and IEC activities to be managed by separate entities. However, for this to be successful PMI and NMCP should provide active coordination and ensure accountability, since there is little recourse for the IRS implementing partner if IEC activities are jeopardized.

- *Lack of MOH/NMCP interest in IEC*. Initially, many MOHs did not prioritize IEC and community mobilization activities, resulting in lower allocation of resources for IEC. As a result, RTI had to plan for additional technical assistance for IEC when it could have been covered by existing positions within MOH structures. The lack of involvement in IEC also reduced the level of community ownership of IRS; in those instances when health and local authorities led the IEC effort, it assisted greatly in promoting a sense of community ownership and acceptance for IRS.
- *Importance of literacy*. Illiteracy and low literacy can hamper the implementation of projects that require data recording. IEC mobilizers record demographic data during their door-to-door sensitization, but in many countries it was difficult to find IEC implementers who had requisite literacy levels to support project implementation. It is important to work closely with local health authorities to ensure that they understand the responsibilities of the IEC mobilizers and the criteria for selection. If necessary, IEC mobilizers who are not literate should be paired with more experienced IEC staff who can provide assistance.

- *Integrating with other community health programs for efficiencies*. In every country, there are opportunities to link with other public health programmatic platforms, including expanded programs for immunization, neglected tropical diseases mass drug administration programs, and ITN distribution campaigns. In some countries (e.g., Mali and Benin), integration with MDA was done and resulted in successful community mobilization campaigns, reducing costs and building local capacity for long-term project sustainability.
- *Engaging key stakeholders early.* Successful implementation of community mobilization requires time and planning. When stakeholders were engaged early, good partnerships formed, which led to good participation and successful spray campaigns.
- *Using local CHWs to conduct community mobilization*. This proved to be an effective strategy to build local capacity and sustainability. Existing structures of CHWs are common in most PMI-supported countries in Africa. Given their involvement in several other health programs that take place in their communities, they are a great resource to deliver and/or integrate IEC messages for IRS. Since CHWs are already a part of the MOH community health education structure, the addition of IRS messages into their workload ensures that IRS messages are disseminated to community members all year long along with other public health messages. This ensures continuity of IRS message dissemination. Moreover, because these community workers usually live in the same place from year to year, there is no need to do conduct full trainings each year, which results in cost efficiencies for the project. Another advantage of using CHWs was gaining high community acceptance of IRS, because CHWs are well-known to community members.
- *Conducting public service announcements*. Broadcasting IRS messages on local radio stations was a useful tool to raise awareness of IRS campaign, remind the community of the spray day and important safety messages, and dispel rumors or misconceptions about IRS during the spray round. Because most communities have access to a radio, broadcasting IRS programming was a cost-effective way of reaching large audience with IEC messages to maximize readiness and acceptance of IRS.

2.3 PROVISION OF FINANCIAL AND OPERATIONAL MANAGEMENT AND STTA

Financial and Operational Management was provided by a combination of home office staff, regional project staff, and country project office staff as well as short term technical assistance by project staff and expert consultants. Senior Management included the project director, deputy project director, and director of finance and administration. Each had separate responsibilities for oversight and high level management of IRS 2 TO1. All IRS country offices included a COP, finance manager and logistics manager, among other positions depending on the need in that country. These positions ensured successful and smooth operations in country and were also central for capacity building efforts. RTI aimed to hire cooperating country nationals (CCN) for IRS field staff positions and the majority of countries employed CCNs in all positions.

COPs were the main point of contact for the project in each country. They worked closely with PMI, NMCP, and all other key in-country stakeholders to ensure efficient management of operations and to transfer skills to counterparts. The success of the project relied on a strong COP with solid operational and relationship management skills.

The finance manager in each country was responsible for the day-to-day financial management of the project. Responsibilities of this position included, developing the work plan budget, recording expenses, ensuring the timely payment of spray operators, payment of vendors, and monthly reconciliation with the regional office. The logistics managers were responsible for ensuring that USAID procurement regulations were followed at the country level and ensuring project logistics were coordinated in a timely efficient manner. Logistics managers issued solicitations to local vendors, issuing LPOs to selected vendors; received shipments from customs; ensured proper storage and management of commodities at the central and district levels; and trained district-level staff on stock management processes. Managers worked closely with district logistics staff and played a key role in pesticide management skills transfer. The regional procurement specialist provided support to logistics managers at the country level as needed.

Technical support was also provided through STTA by other RTI staff and expert consultants. In countries where additional support was needed in operations and technical areas (e.g., environmental compliance and entomology), RTI provided STTA from the Nairobi-based staff to supplement the expertise in country. RTI aimed to keep STTA at a minimum in order to maintain cost efficiency, but ensured support was provided where necessary in order to build in country capacity for the future. Both remote assistance and STTA was provided by the following regional and home office project staff: environmental compliance officers (3), communications specialist (1), M&E specialist (1), entomological monitoring specialist (1), finance managers (2), technical program manager (3), and project administrative specialists (3).

Lessons Learned Regarding Financial and Operational Management and STTA

- Having financial oversight function available in the same time zone as many country offices enabled real-time support for field office finance managers.
- Logistics managers must have strong experience in warehouse management as well as procurement and distribution of commodities on large-scale programs. Warehouse management is an important key part of IRS operations and having a logistics manager with these skills provides a resource for training MOH/NMCP personnel at the various subnational levels.
- Where possible, payments to spray operators should be made through bank transfer or mobile phone payments. It also provides an opportunity for spray operators to open bank accounts and learn personal finance management skills. Finance managers should compare transfer and withdrawal fees to find the most competitive banking service provider.
- Having regional STTA available reduces travel costs. Under IRS 2 TO1, RTI found it cost efficient to use staff and partners from countries that had completed spray operations to provide STTA to countries in need of assistance. This also provided for sharing of best practices and knowledge exchange for staff from both countries.
- Initially, STTA support was needed in entomology, environmental compliance, and M&E. Because of our efforts to build local or regional capacity in these areas, the project reduced STTA support in half during 2011, the final year of IRS 2.
- Post-conflict countries, such as Angola and Liberia, required more STTA because it was challenging to find staff with the requisite skill set and experience. It was also difficult to find local authorities available to train and assume IRS responsibilities due to scarcity of MOH/NMCP and other host government resources.

Spray pump mechanics repairing spray pumps at the warehouse.

IRS 2 staff member helps to build a fence around a soak pit location in preparation for the spray round in Rwanda.

COMPONENT 3:
PERSONAL SAFETY AND ENVIRONMENTAL COMPLIANCE

Building on accomplishments and lessons learned from IRS 1, during IRS 2 TO1, RTI was able to push beyond implementation to introduce innovations, new tools and resources, and build capacity at the country level for ensuring judicious use of insecticides, environmental compliance, and safeguarding personal safety and health. Improvements continued in areas of stock management, warehouse management, innovations in the use of soak pits, quality assurance in PPE, and insecticide handling. RTI strongly supported country-level training and capacity building by conducting inspections and sharing of environmental compliance tools to promote sustainability and skills transfer. Moreover, we enhanced environmental compliance tools and developed new user-friendly tools to assist MOH/NMCP, national environmental, and other local authorities to ensure a high level of safety and environmental compliance at operational sites in the field.

3.1 ACHIEVEMENTS IN SAFETY AND ENVIRONMENTAL COMPLIANCE SUPPLEMENTAL ENVIRONMENTAL ASSESSMENTS (SEA)

In IRS 2 TO1, RTI continued to ensure SEAs in all countries were updated and reflected any programmatic changes. In 2010 and 2011, several country projects expanded to new geographical areas and selected new classes of insecticide to combat resistance to pyrethroids. Under IRS 2 TO1, PMI instructed RTI to amend SEAs to include all relevant insecticide classes and include additional zones and districts surrounding the spray areas due to the numerous shifts and expansions in target spray areas or changes in insecticide class made during work planning. The regionalized and class level SEAs allowed flexibility to USAID Missions and RTI in responding to the changing needs of the country projects, without having to amend the SEA. IRS 2 TO1 adopted this approach so that additional amendments were not needed once new geographical areas were added or a new class of insecticide was selected for areas already included in the document. During the IRS 2 TO1 period of performance, Ethiopia, Mozambique, and Zambia switched from using dichloro-diphenyl-trichloroethane (DDT) to pyrethroids and their SEAs were subsequently amended to reflect the use of other classes of insecticides; similarly, other countries switched from a pyrethroid to a carbamate and needed to amend their SEAs to include the use of carbamate. For example, RTI prepared new SEAs for Burkina Faso in 2010 and Nigeria in 2011—these two SEAs were prepared at the insecticide class level and regional geographic levels.

3.2 IRS SAFETY AND ENVIRONMENTAL COMPLIANCE GUIDELINES

During IRS 1, RTI developed and circulated SOPs on environmental assessments, worker safety and health, and solid and liquid waste disposal. These SOPs were based on WHO standards and our experience in IRS. In IRS 2 TO1, in a collaborative effort among RTI, PMI, and the International Resources Group Environmental Monitoring and Capacity Building in Vector Control Interventions (EMCAB) project, the environmental and personal safety compliance SOPs were compiled into a comprehensive IRS environmental and personal safety manual titled *Best Management Practices for Indoor Residual Spraying in Vector Control Interventions* [7] (hereafter BMP Manual). The IRS BMP Manual was produced and printed in 2010, and has since formed the basis for all training, preparation, implementation, and monitoring of environmental and personal safety aspects of IRS operations supported by PMI. In addition, in 2011, the IRS 2 TO1 project finalized SOPs on *Incineration of Wastes and on Stock Control and Inventory Management* that provide in-depth guidelines and instructions in waste incineration and stock management. The project used this SOP to train IRS 2 field staff, environmental compliance authorities in host countries, and independent inspectors.

7. The IRS BMP Manual can be accessed here: http://pmi.gov/technical/pest/bmp_manual_aug10.pdf

Spray operator cleaning his pump using the progressive rinsing technique.

3.3 REGIONAL TRAININGS ON THE IRS BMP MANUAL

RTI, in conjunction with the USAID-supported EMCAB project, conducted two regional environmental capacity building training programs: one in Kisumu, Kenya (June 28–July 2, 2010), for Anglophone countries; and one in Antitsirabe, Madagascar (Nov 15–19, 2010), for Francophone countries.

The workshops aimed to prepare host country professionals from PMI-supported IRS countries in sub-Saharan Africa to use a uniform approach (based on the IRS BMP manual) for implementing safety and environmental compliance activities in accordance with WHO standards and host country and USAID environmental regulations. Participants included host country independent consultants (potential environmental compliance inspectors), representatives from host country MOEs and EPAs and members of host country NMCPs. Many participants of these trainings conducted environmental compliance inspections in their home countries after the training.

3.4 SAFETY AND ENVIRONMENTAL COMPLIANCE INSPECTIONS

Based on lessons learned in IRS 1, the level of technical assistance provided by IRS 2 TO1 in environmental compliance inspections was increased in 2010 to boost quality and standards, and subsequently reduced in 2011 in many countries after capacity was built. Inspections were carried out by IRS 2 TO1 regional environmental officers, IRS 2 environmental compliance field officers, host country personnel, and independently by EMCAB.

RTI IRS Project Inspections (Pre- and Mid-spray)

A total of 24 and 19 internal inspections were undertaken by RTI IRS regional environmental officers in 2010 and 2011, respectively (***Table 3***).

Table. 3 Number of Inspections Conducted by the IRS 2 Project Environmental Compliance Officers

Year	Pre Spray	Mid-Spray	Total
2010	10	14	24
2011	8	11	19
Total	18	25	43

In 2011, IRS 2 TO1 evaluated the readiness of each country to independently conduct the pre-spray and/or mid-spray inspection, either through national/district authorities or independent inspectors trained at the EMCAB training. In many cases, RTI transferred responsibility of conducting the pre-spray inspection, but retained the mid-spray inspection for quality assurance depending on the readiness of the country. (See text box for countries where RTI successfully transferred this responsibility.) However, IRS 2 TO1 faced challenges in transferring this activity in many countries, because many of the EMCAB-trained consultants were no longer available to conduct inspections due to a variety of reasons such as many moved out of the area, changed job functions, or were not available when inspections were needed. Furthermore, because the EMCAB training in Lusophone countries was postponed, there were no formally trained personnel available to conduct pre-inspections in Mozambique and Angola. In those countries, IRS 2 staff provided pre- and mid-spray inspections to ensure full environmental compliance.

Independent Evaluations

By the end of 2011, EMCAB conducted independent environmental compliance evaluations in all of the IRS 2 TO1 countries, except Angola and Zambia. Overall, the reports from IRG indicated that IRS 2 TO1 physical infrastructure (i.e., warehouses and soak pits) and systems were operating efficiently and effectively; it also noted field supervision and stock management as areas for improvement. As a result, RTI carried out immediate and consistent follow up with IRS 2 TO1 country teams to make sure that each of the recommendations was implemented to ensure the quality of work in the field.

Support to GFATM-supported IRS districts

In Zambia, the host country government had a parallel IRS program supported by the GFATM. IRS 2 TO1 assisted this program with conducting quality control, training, and environmental monitoring (e.g., RTI delivered a customized training for all logistics and warehouse personnel in stock management and inventory control).

USAID Office of Inspector General (OIG) Warehouse Audits

As suggested in the BMP Manual, OIG conducted stock management and inventory audits of selected countries (Malawi, October 2009; and Benin, September 2010). The audit results recommended that RTI invest more time and resources in tracking core IRS commodities such as insecticide, spray pumps, and PPE. In response to the audit recommendations, RTI enhanced the SOPs on stock management and inventory control and conducted a special training for all logistics and warehouse personnel based on this SOP and accompanying stock tracking tools. The SOP was field tested in Zambia, where significant improvement in the management of IRS commodities, including in non-PMI districts, was observed after the training. Specialized logistics and warehouse training became a mandatory requirement for all logistics and warehouse personnel.

Spray operators finished for the day in Rwanda.

During the 2011 spray rounds in Senegal and Liberia, environmental compliance inspections were conducted by trained national authorities and local independent consultants, underlining the strong local environmental management capacity built in those countries through IRS 2 TOI and EMCAB.

3.5 INSECTICIDE MONITORING ENVIRONMENTAL MONITORING OF DDT SAMPLES

Although there were no IRS countries that used DDT during IRS campaigns in 2010 or 2011, the IRS 2 project continued to monitor the residual presence of DDT in soil and crop samples and to test the quality of DDT being used by the national IRS program in Mozambique. In June 2011, RTI sent 43 random samples of Mozambique MOH-procured DDT to a WHO-approved laboratory in Belgium for assessing the DDT active ingredient according to WHO specification for DDT. The results of laboratory testing stated that 56% of the tested batches complied with WHO specification WHO/CIF/1.R9 for controlling the quality of DDT wettable powder. RTI immediately shared results with PMI Mozambique and PMI instructed the project to procure pyrethroid because previous susceptibility studies showed the effectiveness of pyrethroid in Zambezia, the target province.

Soil and Crop Monitoring for DDT

RTI conducted soil and crop monitoring for DDT residue in Mozambique and Zambia, two countries that sprayed DDT in IRS 1. Although both countries switched to using pyrethroids for IRS 2 TO1, annual soil and crop monitoring was done to track the effects of the previous use of DDT in the soil around the sprayed area after up to two spray rounds (two years of IRS). Objectives of the DDT studies included the following:

- Evaluating the spatial relationships among sprayed structures and detectable DDT residues in soils from homesteads and agricultural gardens/fields.
- Evaluating the magnitude of DDT contamination of crops stored indoors after DDT has been applied in IRS.
- Determining the difference in DDT concentrations in outdoor soils and indoor crops after one round of IRS.
- Determining whether DDT from IRS is entering the environment surrounding the IRS homesteads.

The DDT studies also looked at districts where DDT concentrations were higher or lower and aimed to determine what were the contributing factors were for those differences. In all cases, baseline soil samples were taken to compare to post-spray samples and both pre and post spray samples were tested for DDT residue. The results of all three studies have been submitted to PMI for review and consideration in discussions regarding DDT for IRS.

Quality Assurance Monitoring of Procured Insecticides

In IRS 2 TO1, the active ingredient of procured insecticides in all countries was tested as an indicator for determining insecticide quality before field application. Upon arrival in country, samples from the newly procured insecticide were sent to the regional environmental officer for forwarding to an ISO-certified laboratory that tested and analyzed the level of active ingredient in accordance with WHO specifications. All samples from 24 RTI insecticide procurements showed compliance with specifications.

3.6 DISPOSAL AND INCINERATION OF CONTAMINATED WASTE

Under IRS 1, a few countries (such as Madagascar, Liberia, Mozambique, Ethiopia, and Mali) faced challenges in incinerating contaminated waste since there were no in-country facilities that complied with WHO standards. Under IRS 2 TO1, RTI worked with MOE, NDA, and MOHs in these countries to identify and implement a solution to the previously stored contaminated waste. RTI assisted in implementing tailored solutions for each country.

- In Madagascar, adequate incineration facilities were identified at a private waste management firm (i.e., ADONIS).
- In Liberia, an incinerator located at a United Nations hospital was able to meet the specification for IRS contaminated waste.
- In Mali and Ethiopia, IRS 2 TO1 supported the procurement of mobile incinerators for use in IRS.
- In Mozambique, all DDT-contaminated waste was shipped to South Africa where appropriate incineration facilities were located. For non-DDT-contaminated waste, the MOE approved the use of a sanitary landfill (with impermeable lining underneath and leachate collection system).

3.7 INNOVATIONS

Conversion of Evaporation Tanks

Evaporation tanks still existed in countries that used DDT in previous spray rounds. To prepare the site for the use of non-DDT insecticides, soak pits were required instead of evaporation tanks. The RTI IRS environmental management team developed a model to convert evaporation tanks into soak pits in a way that would conserve the evaporation tanks for later use if needed. The conversion was designed with a pipe that rechanneled the wastewater away from the evaporation tank pond into a soak pit that was constructed next to the evaporation tank. It was important that the previously used evaporation tanks be filled with sand so that water could not collect and form breeding grounds for mosquitoes.

Conversion of evaporation tank for DDT in Mozambique to soak pits for pyrethroids.

Use of Mobile Incinerators

In Mali and Ethiopia, IRS 2 TO1 supported the procurement of mobile incinerators after the 2011 spray rounds. In both countries, the contaminated waste from previous rounds was being held securely in warehouses since there was no facility that was capable of reaching the temperatures needed for incineration of insecticide contaminated waste. In each country, the mobile incinerators were taken to a central point within each district to capture and incinerate all contaminated waste after spray operations were completed. In contrast to fixed incinerators, mobile incinerators saved operational funds by avoiding the need to transport the waste from districts to a central incineration site, especially in countries with large distances between the field and incineration facilities.

Temporary Soak Pits

To minimize the cost of soak pit construction and the time and funds needed to transport spray teams to and from central soak pits, IRS TO1 used temporary soak pits, which could be easily established at the village level. Temporary soak pits were cost effective due to their smaller size and shallow design, and because they did not need permanent washing slabs and fences. Individual teams of spray operators used the temporary soak pits during spray campaigns in their assigned village sites. Once the team moved to a different site, the soak pits were closed. The team used tarpaulin for ground cover and fencing that later would be reused at a different site.

3.8 LESSONS LEARNED IN SAFETY AND ENVIRONMENTAL COMPLIANCE

Key lessons learned are included in the list below.

- *Building local capacity in safety and environmental management for IRS operations*.
  The number of personnel trained on IRS best environmental management practices in the EMCAB training program was small. Two Regional EMCAB Environmental workshops in Kenya and Madagascar trained approximately two people per participating country (usually one government cadre and one private consultant per country). However, in many cases, these representatives were either unavailable when the inspections were needed or no longer worked in the same capacity. This situation highlights the need to build greater capacity at the country level to ensure that there is a cadre of trained inspectors who are available locally. For future trainings, RTI recommends that at least four people per country are trained—two from MOE or NMCP; and two independent inspectors, either through a local training program or international program such as EMCAB. To ensure their availability, all participants should commit to be available in the following year. Training of these cadres should be scheduled near the beginning of spray rounds.
- *MOEs or other counterpart host government entities must be involved in environmental monitoring of IRS operations*. It is important to engage government counterparts early in the process to facilitate buy-in and ownership of the IRS program from planning to implementation to monitoring. For example, early involvement creates mutual trust and collaborative relationships; as a result, joint supervision can be coordinated so that inspectors are available during the spray round. In addition, resources are more likely to be shared and offered to the IRS project when government partners are aware of the project's needs and scheduling.
- *Need for external visits and independent monitoring*. It was noted throughout IRS 1 and IRS 2 TO1 that IRS country programs become more diligent about environment compliance when they anticipate an external monitoring visit. External monitoring should therefore be encouraged, and routine supervision must take place to boost compliance and maintain accountability at all levels.
- *Need for consistent and diligent supervision*. Strong supervision is a challenge for the IRS project. Many environmental compliance activities are repetitive and very detail oriented. As the spray operations progress, personnel can become careless vis-à-vis PPE requirements, soak pit conditions, and storage of commodities. In countries that have sprayed multiple spray rounds, supervisors will often falsely assume that spray teams have a solid understanding of environmental compliance. It is imperative that supervisors stay committed to observing and conducting inspections according to the supervision checklist. Incentives and recognition can be offered to keep supervisors and other spray personnel engaged and compliant. This can be small tokens such as certificates or being recognized as "spray operator (or supervisor) of the week."
- *Documentation of standard procedures*. The SOPs and now the PMI IRS BMP Manual are important contributions to the IRS programs. They provide the necessary guidance and references on matters of environmental compliance from planning to the final stage of the IRS process.

- *Mobile incineration*. This innovation represents a viable solution to conduct IRS waste disposal in countries where appropriate incineration facilities are not available or are located far from the spray sites. Over time, mobile incineration has the potential to offer savings to IRS operations in transportation and incineration costs, especially in larger countries where districts are spread out over long distances and far from the locations with fixed incinerator.
- *Extending validity of SEAs*. Around 75% of IRS countries had annual changes in insecticide classes and/or target spray areas in 2010 or 2011. Instead of carrying out annual SEAs specific to a targeted area and insecticide class, RTI found that making the SEAs valid for five years and broadening the insecticide class level to regional or national level provided countries with flexibility to change or expand the program without the rigorous process of the SEA amendments.
- *Conducting customized trainings*. For those countries (e.g., Zambia, Ethiopia, Kenya, and Angola) where the IRS 2 TO1 project delivered specialized trainings for logistics and warehouse management personnel, improved performance and quality on the inventory control and stock management occurred. This focused training should be encouraged in all key sectors of IRS operations.

4

COMPONENT 4:
MONITORING AND EVALUATION

Conducting M&E of the IRS operations was included in RTI's IRS 2 TO1 scope of work (SOW) for all IRS countries, except Zambia, where M&E was managed by another implementing partner (i.e., Abt Associates), and Nigeria, where operations had not yet begun. M&E was conducted to ensure quality control measures were established and implemented. RTI learned numerous lessons and developed several best practices for M&E under IRS 1, and built on such successes and experiences to improve M&E under IRS 2 TO1.[8]

8. For more information on RTI's M&E experience supporting IRS 2, see the following report RTI International. Taking Stock of M&E Lessons: *Successes, Challenges, and Innovations Indoor Residual Spraying (IRS 2) Task Order 1*, 2011, prepared for USAID.

4.1 ACHIEVEMENTS IN M&E FOR IRS OPERATIONS

IRS Operations Indicators

A set of IRS output indicators was discussed and agreed upon between RTI and PMI at the outset of IRS 2 TO1. To ensure common understanding and clarify terms, definitions, and indicators, RTI developed an SOP for M&E. The SOP was based on agreements reached between PMI and RTI on how progress and outcomes of IRS 2 TO1 should be measured and what defines the terms used in those indicators (see also PMI M&E Strategy: http://pmi.gov/technical/mne/me_strategy.pdf and PMI indicators http://pmi.gov/resources/malaria/pmi_indicators.pdf).

The following agreed upon core output indicators for PMI reporting were used in all countries under IRS 2 TO1:

- Percentage of eligible structures in spray areas that were sprayed as a proportion of total found eligible structures (spray coverage)
- Number of eligible structures (houses) sprayed
- Number of people residing in structures sprayed (population protected)
  - Number of pregnant women residing in structures sprayed
  - Number of U5 children residing in structures sprayed
- Number of people trained to deliver IRS (disaggregated by gender and by type of training)

Working with NMCPs in IRS M&E

In Mozambique, the MOH requested that PMI IRS TO1 report IRS coverage based on estimated structures in the target area instead of structures actually found in the target area. In this case, IRS 2 TO1 in Mozambique reported on both indicators to satisfy the needs of the NMCP as well as PMI. In Senegal, the NMCP requested that spray operators also record data to calculate spray coverage for rooms, in addition to structures, and RTI ensured this was included on the IRS 2 TO1 spray card.

During the work planning period, IRS 2 TO1 COPs worked closely with in-country PMI resident advisors and NMCP leadership to agree on any additional indicators, beyond the PMI IRS core indicators that would be used to measure progress and success of IRS 2 TO1. The majority of NMCPs agreed to the basic set of PMI IRS indicators; however, in some countries (e.g., Mozambique and Senegal), the NMCP required additional indicators for reporting, such as the proportion of *targeted* households that were sprayed or number of *rooms* sprayed in addition to structures. See text box for additional details on indicator requirements in Mozambique and Senegal.

Table 4 below shows the core indicator country level results for spray rounds covered under IRS 2 TO1.

Table 4. IRS Results by Country for 2010 and 2011 Work Plan Year

Country	Structures Sprayed		People Protected		Personnel Trained[a]	
	2010	2011	2010	2011	2010	2011
Angola	135,856	145,264	650,782	689,668	834	884
Benin	166,910	145,247	636,448	426,232	459	560
Burkina Faso	33,897	33,832	118,691	110,064	172	315
Ethiopia	646,870	858,657	2,064,389	2,920,469	4,049	4,125
Ghana	342,876	354,207	849,620	926,699	572	536
Liberia	48,375	89,710	420,532	834,671	437	673
Madagascar	576,320	502,697	2,895,058	2,585,672	1,612	1,224
Mali	127,273	202,821	440,815	697,512	549	730
Mozambique	618,290	660,064	2,945,721	2,825,648	1,996	1,584
Rwanda	303,659	358,734	1,365,949	1,571,625	2,088	2,235
Senegal	254,559	240,770	959,727	887,315	1,024	911
Zambia[b]	N/A	N/A	N/A	N/A	N/A	N/A
Total	**3,254,885**	**3,558,171**	**13,347,732**	**14,475,575**	**13,792**	**13,777**

a. Indicator includes spray personnel such as spray operators, team leaders, supervisors, and clinicians. This indicator does not include data clerks, IEC mobilizers, drivers, washers, pump technicians, and security guards.
b. Abt Associates managed spray implementation in Zambia, and RTI managed the supply chain, environmental compliance, and capacity building in logistics and supply chain management.

4.2 M&E TOOLS FOR IRS OPERATIONS

RTI had developed M&E data collection tools under IRS 1. Nonetheless, as a best practice, project staff reviewed all tools during the annual national level stakeholders' planning meeting in each country to ensure that the data being recorded was sufficient and responsive for the needs of IRS 2 TO1 and the PMI and NMCP IRS indicators. In these meetings, in-country stakeholders would review the M&E tools and changes, if any, were agreed upon. In some countries (e.g., Mozambique) where the NMCP led IRS operations in non-PMI-supported districts, it was important to make sure that the data forms being used to collect data for the PMI IRS indicators included the data required for the nationally funded program. In countries where the PMI- funded IRS 2 project was the only IRS program (e.g., Senegal), it was still important to ensure the IRS data could be integrated into the country's health management information system and that the data being collected were both useful for NMCP and for monitoring and evaluating the operations.

Spray operator recording M&E data in Ethiopia.

The primary IRS data collection tool was the daily spray card used by spray operators. Spray operators used this form daily to collect demographic data for each structure they visited and record whether the structure had been sprayed. See ***Appendix C*** for an example of a daily spray card from Ghana.

The supervisor checklist was another M&E tool that was reviewed and revised each year. Supervisor forms were originally introduced to operations by RTI through IRS 1 as a best practice for M&E of field operations. In IRS 2 TO1, countries continued to use the form to assess spray operation teams and individual performance. During the national IRS planning meeting, each country reviewed and revised the form according to its own country context and included specific issues discussed during post-spray evaluation meetings from previous spray rounds. In this way, the IRS supervisor checklist served as an important feedback mechanism to track performance against previously noted areas for improvement. It was best practice for supervisors to provide feedback from supervision checklists to the spray teams at the start of each day so that areas for improvement would be fresh on their minds as they head out to spray. The supervisor checklist also provided information on the performance of each spray operator, which could be used to evaluate them for roles in future spray rounds.

Additional tools were developed and used for M&E under IRS 2 TO1. The following is the list of additional M&E tools and a summary of their purpose:

- IEC data form. Data collection form for IEC mobilizers to collect demographic data from each structure before the spray round.
- IRS structure card. Data card with a unique identification number distributed to each structure by IEC mobilizers and used to track the structure and its accompanying data in the database (see ***Figure 5***).
- IRS environmental compliance checklist. This checklist was used by trained environmental compliance inspectors to assess the level of readiness and compliance of IRS operations with host country environmental compliance regulations, WHO standards, and PMI IRS BMP.

The supervisor checklist captured spray operator performance data; sharing the checklist helped teams focus on areas of improvement on spray days.

Figure 5. Sample of IRS Structure Card

M&E System Development

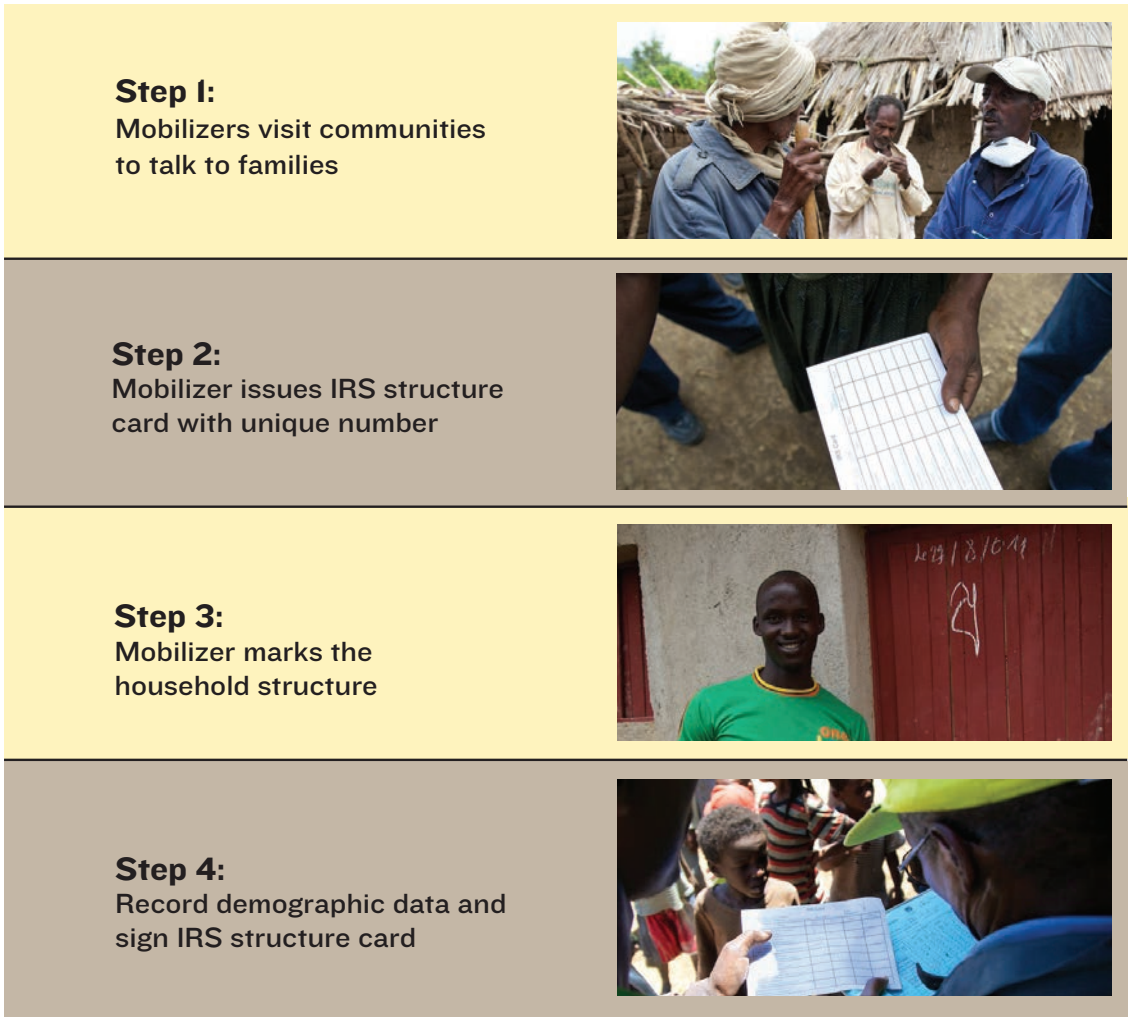
From 2005 to 2009 (IRS 1), RTI used simple electronic spreadsheets to record IRS data. In 2010, RTI adopted the use of a relational database to develop an IRS data entry and reporting system to manage IRS information. This aligned with RTI's emphasis on strong management of information and aimed to minimize the opportunities for error and infuse efficiency in the process of data entry and report generation. The database was used to collect, analyze, and report on IRS data from the field to USAID/PMI and local partners, including MOH/NMCP. This improved system was implemented in 11 countries.

Piloting the Pre-Entry of IRS Structure Information

To improve IRS data collection, RTI piloted an IRS data pre-entry system in Benin, Mali, Rwanda, and Mozambique. The system reduces the data collection burden on spray operators by using mobilizers to collect essential demographic data from the households before the spray launch, allowing spray operators to focus on conducting efficient and high-quality spraying. The system worked well in the four countries and proved to be an effective process for future IRS spray rounds.

The pre-entry system began with mobilizers visiting communities to talk to families about IRS (discussing key messages on households' responsibilities before, during, and after spraying) and provide the spray dates. Once IRS acceptance was established, the mobilizer issued the IRS structure card to each sprayable household structure. She/he would then record the unique number that identifies the household and record the name of the household head and the number of eligible structures associated with household. Next, the mobilizers collected and recorded all of the relevant demographic characteristics of each eligible structure on the mobilizer register. The information collected corresponds to the core indicators of IRS: the number of structures found, number of people residing in the structure identified, number of children U5, number of pregnant women residing in the structure, number of mosquito nets, number of brochures issued, and IRS acceptance. Mobilizers then marked each eligible structure with the unique number from the IRS structure card using chalk. Finally, the mobilizers signed the IRS structure card to confirm mobilization occurred and submits their daily/weekly reports to their team leaders to verify that data are complete. Each day, the data collected by IEC mobilizers are entered into the IRS database by data clerks in preparation for the spray round.

Figure 6. IRS Pre-entry System - Data Collection and Entry Process



Use of Mobile Technology and Geographical Information System (GIS) for IRS M&E

RTI developed and implemented pilot programs to test the use of mobile technologies and GIS for data collection and reporting for IRS in two IRS 2 TO1 countries—Senegal and Ethiopia. Each pilot program was unique and provided lessons learned for future use of mobile technology in IRS. In Senegal, personal digital assistants (PDA) were purchased by IRS 2 TO1 and used to collect primary IRS data. Additional details on the Senegal PDA pilot can be found in the 2011 *Senegal IRS Spray Performance Report*.

In Ethiopia, cell phones and SMS technology were used for data entry as a pilot program in five districts of Oromia Regional State. The results were positive and showed that the system worked well, despite inconsistent wireless phone service in the area. (See text box for more details on the use of SMS technology in the Ethiopia IRS project.)

Ethiopia has also mapped and geo-coded IRS operations. Mapping and geo-coding was used to update population and sprayable surface area data for each district for the purpose of proper targeting of IRS operations and for procurement. The system used population data collected using PDAs and structured questionnaires. Each house was geo-coded with reference points using GPS.

M&E Program Management

Each IRS country office included a full-time M&E officer committed to providing M&E oversight for the program. The M&E officer worked closely with the COP, district health personnel, NMCP and the IRS regional office M&E manager to ensure that data from indicator tracking was shared in a timely manner and that all stakeholders were trained in the IRS M&E system so that responsibilities could be turned over once capacity was adequately built and human resources were available at the national or district level.

At the district level, in all countries, the IRS program supported a number of data clerks, usually one or two per district, who were responsible for entering the data from the spray operator cards into the database daily during the spray round. Data clerks were trained by the M&E officer and/or the IRS regional M&E manager in use of the M&E database, data security, and data verification processes. In most cases, the data clerks were hired to work in the districts they were from. This was a key strategy to ensuring that M&E capacity exists at the district level for future rounds.

Use of short message service (SMS) Technology in Ethiopia

In 2011, IRS 2 TO1 in Ethiopia piloted a new system for data entry using cell phones and SMS technology in five districts of Oromia Regional State. The SMS Data Collection System was designed to reduce the delay between IRS data collection, data entry, and transmission of results, helping to guide operations and alert personnel to problems in real-time. Following the roll-out of the SMS-based system in Oromia, data were typically received within 24–48 hours. A total of 13,512—or 85%—SMS successfully reached the database. Data analysis indicated that squad leaders were receptive to using SMS and, despite challenges with network availability, the system worked well.

Spray team leader collecting data in the field in Ethiopia.

4.3 LESSONS LEARNED IN M&E

- Computer literacy capacity must be assessed before rolling out more advanced M&E systems. Although the migration from a simple spreadsheet database system to a relational database system was successful in most countries, IRS 2 TO1 staff struggled to implement the change in Angola. The found that the data clerks were not experienced using the relational database system and training proved to be too time consuming. For Angola, the spreadsheet system was retained for use during the spray round instead of adopting the new system.
- The main challenge for spray operators in using the spray operator daily forms was to understand the definition of structure and learning how to accurately count structures. This topic was covered in depth during spray operator training and frequently during morning meetings before the spray day began.
- Reviewing and standardizing tools across IRS countries ensures consistency and increases quality in data recording and reporting.
- A country IRS M&E systems should ideally be built upon the national (MOH or NMCP) system to eliminate duplication and reduce the burden on all parties concerned.
- To successfully facilitate SMS data reporting deployment, countries need equipment, materials, and adequate controls in place for implementation.
- For proper implementation of the pre-entry system, structure count and mobilization activities should start early, at least a month before the spray campaign, to ensure that a complete structure register/baseline count is ready.
- Given the importance of motivation and morale in IRS operations, it is important that supervisors use the supervisor checklist consistently and accurately to provide feedback and recognition to spray operators. Whether positive or negative, it is important that spray operators receive feedback and feel noticed.
- Quality checks are instrumental in enhancing the quality of data collected and the quality of spraying.
- It was beneficial to assign data clerks with experience in particular geographic areas because they could easily identify errors in village and family names and locate teams in the field.

Entomology technician in Rwanda determines species of a mosquito caught in the field.

4.4 ENTOMOLOGICAL MONITORING AND EVALUATION

In IRS 2 TO1, RTI provided direct support and technical assistance to NMCPs to expand and systematize entomological monitoring and surveillance activities in all IRS 2 TO1 countries where local capacity was unavailable. As a result, NMCPs and PMI had accurate and timely data to evaluate IRS operations' effectiveness and quality and select the insecticide class for use in IRS operations. Many countries had local capacity through centers of excellence, including Senegal, Mali, Ghana and Benin. In those countries, RTI played a supporting role in ensuring entomological monitoring data were integrated into the larger M&E system; promoting the use of data by NMCP for selecting insecticide class; and in some cases, supplying financial resources to the local institution through subcontract agreements.

Technician working in the insectary in Ethiopia.

Entomological Monitoring Achievements

The following is a list of entomological monitoring achievement areas under the IRS 2 TO1:

- Consistent use of wall bioassays to test for residual efficacy of the insecticide and operations' quality of spraying. If a country did not have adequate human resources available, IRS 2 TO1 engaged STTA to conduct wall bioassays at key points post-spray, (e.g., directly after spraying, four months after spraying, and eight months after spraying).
- Timely insecticide susceptibility testing provided NMCP, PMI and in-country stakeholders evidenced-based data, which informed insecticide class selection. As seen in ***Figure 3***, in 2011, the IRS project procured more carbamates because of increasing resistance to pyrethroids. (Susceptibility data by country are presented in ***Table 6***.)
- Various countries conducted training for NMCP and entomology technicians to strengthen their local entomological monitoring capabilities. As mentioned in ***Section 5***, many countries, including Mozambique, Ethiopia, Rwanda, and Angola, carried out entomology technician trainings, either through formal training programs or through learning by doing with IRS 2 TO1 STTA. IRS 2 TO1 staff also trained technicians in insectary management and proper mosquito breeding technique. As a result, capacity now exists in country to evaluate the quality and effectiveness of IRS.
- IRS 2 TO1 supported the rehabilitation of many insectaries and microbiology laboratories and procured needed equipment to ensure proper functioning of these facilities.
- Building on achievements from the IRS 1 project, during IRS 2 TO1, there were remarkable improvements in the consistent availability of residual efficacy data post spray in most countries where RTI was supplying technical assistance in entomology. The project strived to ensure that NMCPs' capacity continued to increase to promote sustainability of entomological monitoring locally. Remarkable improvement was noted in Mozambique, Ghana, Rwanda, Liberia, and Angola in the availability of monthly data on wall bioassays and annual data on susceptibility.
- In several countries, including Angola, Mozambique, and Rwanda, access to adequate numbers of susceptible vector colonies was a key challenge during IRS 2 TO1. PMI, NMCP, and RTI worked together to develop IRS work plans that included activities that would build entomological monitoring infrastructure and staff capabilities to sustain IRS entomological monitoring. In some countries, work that began under IRS 1 was completed in IRS 2 TO1, and in others work began under IRS 2 TO1. Support for infrastructure strengthening included constructing or rehabilitating the physical premises of the insectaries or procuring needed supplies and equipment. Countries that carried out these activities under IRS 2 TO1 included Ghana, Ethiopia, Liberia, Angola, Mozambique, and Rwanda. In Mozambique, beyond supporting the establishment of two insectaries (i.e., in Cabo Del Gado and Quelimane), IRS TO1 also supported the rehabilitation of a microbiology laboratory in Maputo.

- The IRS 2 TO1 project ensured timely access of WHO susceptibility kits to PMI IRS countries by procuring strategic quantities of kits and storing them in Kenya. Kenya served as a central repository to deliver stocks to other countries, which allowed timely delivery and consistent access for the country programs. Moreover, the IRS 2 TO1 project popularized both the use of the WHO and CDC mosquito susceptibility testing methodologies and promoted their use concurrently depending on availability.

Table 5 provides an overview of field entomological monitoring activities by country during IRS 2 TO1.

Table 5. Overview of IRS 2 Entomological Monitoring Activities by Country

Countries	Entomological Monitoring
Angola	Provided STTA to conduct susceptibility tests and post-spray wall bioassays
Benin	Supported CREC for carrying out entomological monitoring in the districts targeted by IRS operations
Burkina Faso	Funded Centre Muraz to support the training for entomological activities
Ethiopia	Supported expert consultants from local universities for carrying out entomological monitoring in districts targeted by IRS operations
Ghana	Provided support to NMIMR for entomological monitoring in the districts
Liberia	Collaborated with NMCP and the Integrated Vector Management (IVM) project to provide technical assistance for entomological monitoring field work
Madagascar	Provided support and technical assistance for entomological monitoring post IRSw
Mozambique	Supported an entomology staff position that provided oversight to NMCP field technicians in entomological monitoring Provided STTA and additional technical assistance to develop an entomological monitoring plan and for the provision of quality assurance and assessment of newly trained field technicians in Mozambique
Nigeria	Provided technical assistance for entomological monitoring through residual efficacy and susceptibility testing as well as vector species identification
Rwanda	Provided STTA to assist NMCP technicians conduct routine wall bioassays and susceptibility testing

Entomological Monitoring Results

Under IRS 2 TO1, RTI collaborated with NMCPs and field technicians to monitor the effectiveness and quality of IRS operations.

The key entomological monitoring indicators tracked under IRS 2 TO1 included

- Mosquito mortality rates from wall bioassays at monthly intervals after IRS was completed
- Insecticide susceptibility test results
- Outdoor/indoor resting rates and densities
- Species identification

Table 6 summarizes data on species identification and susceptibility data collected during IRS 2 (2010 and 2011) for countries where RTI managed entomological monitoring activities.

Table 6. IRS Entomology Summary Results

Country	Year	Species Identified	Susceptibility Data
Angola	2010	*An. gambiae, An. coustani*	Deltamethrin (PY) 100% Bendiocarb (C) 95%
	2011	*An. gambiae, An. coustani*	Deltamethrin (PY) 92%–100%; Bendiocarb (C) 88.5%–95.37%
Benin	2010	*An. gambiae sl* was the major vector species identified	Deltamethrin (PY) 67% Bendiocarb (C) 100% DDT (OC) 23%
	2011	*An. gambiae sl*	Bendiocarb (C) 85% –93%
Burkina Faso	2010	*An. gambiae*	Deltamethrin(PY) 89% Bendiocarb (C) 89% Malathion (OP) 99%
	2011	*An. gambiae* (major vector), *An. funestus* (minor vector)	Results not provided by entomology partner
Ethiopia	2010	*An. arabiensis* minor vectors; *An. pharoensis, An. funestus,* and *An nili*	DDT (OC) 79%, Bendiocarb (C) 99–100% Propoxur (C) 99–100 % Malathion (OP) 80–100% Fenitrothion (OP) 97-100% Deltamethrin (PY) 34–100% Lambdacyhalothrin (PY) 30–94%
	2011	*An. arabiensis; An. pharoensis, An. funestus, An nili*	DDT 0-32% Deltamethrin (PY) 21%-88% Lambdacyhalothrin (PY) 3–82% Malathion (OP) 66%–94% Fenitrothion (OP) 68%–100% Bendiocarb (C) 80%–100%
Ghana	2010	*An. gambiae* (87%), *An. funestus* (12%), and other anophelines (1%)	Malathion (OP) 100%; deltamethrin (PY) 96%; DDT (OC) 63%; propoxur (C) 90.3%; permethrin (PY) 90%; cyfluthrin(PY) 99%; Lambdacyhalothrin (PY) 99%
	2011	*An. gambiae An. funestus,*	Deltamethrin (PY) 84.6%–100% Malathion (OP) 95% Lambdacyhalothrin (PY) 76.7%–95% Bendiocarb (C) 96.7%–100% Alphacypermethrin (PY) 95%– 96.7% Fenitrothion (OP) 100%

Table 6. IRS Entomology Summary Results (cont.)

Country	Year	Species Identified	Susceptibility Data
Liberia	2010	*An. gambiae, An. funestus*	Deltamethrin (PY) 82–100% Bendiocarb (C) 92–100%
	2011	*An. gambiae, An. funestus*	Lambdacyhalothrin (PY) 82%–93% Bendiocarb (C) 85%–100% Fenitrothion (OP) 98%–100% Bendiocarb (C) 85%
Madagascar	2010	*An. gambiae, An rufipes, An. mascariensis*	Deltamethrin (PY) 100% Bendiocarb (C) 99–100% DDT (OC) 92–99% Fenitrothion (OP) 98–100% Lambdacyhalothrin (PY) 94–100%
	2011	32.6% *Anopheles gambiae sl,* 0.4% *Anopheles funestus,* 3.6% *Anopheles mascariensis*	Deltamethrin (PY) 100% Bendiocarb (C) 99%–100% DDT 92%–99% Fenitrothion (OP) 98%–100% Lambdacyhalothrin (PY) 94%–100%
Mali	2010	*An. gambiae sl*	Deltamethrin (PY) 17–63% Bendiocarb (C) 83–100% DDT (OC) 51% Lambdacyhalothrin (PY) 34%
	2011	*An. gambiae sl*	Data Unavailable
Mozambique	2010	*An. gambiae, An funestus*	DDT (OC) 100% Deltamethrin (PY) 100% Bendiocarb (C) 100%
	2011	*An. gambiae sl., An. funestus, An. natalensis.*	DDT 100%, Bendiocarb (C) 100% Fenitrothion (OP) 100% Lambdacyhalothrin (PY) 100%
Rwanda	2010	*An. gambiae, An. ziemani,*	Deltamethrin 100%
	2011	*An. gambiae, An. ziemani,*	DDT - 51% - 100%, Lambdacyhalothrin (PY) 98.2% - 100%, Deltamethrin (PY) 88.3%–100%, Bendiocarb (C) 90.6%–100%, Permethrin (PY) 83%–100%, Fenitrothion (OP) 100%
Senegal	2010	*Data managed by another partner*	Deltamethrin (PY) 16–100%, Lamdbacyhalothrin(PY) 8–100%, Permethrin (PY) 7–100%, DDT (OC) 6–97%, Fenitrothion (OP) 95–100%,

Lessons Learned in Entomological Monitoring

A primary challenge in the majority of the countries was the low level of existing capacity or available personnel to conduct entomological monitoring. As discussed earlier, the project systematically built capacity by providing technical assistance, engaging STTA support, and training. Key lessons learned are included in the list below.

- Skill building and human resource capacity building is essential to building entomological monitoring capability in any insecticide-based vector control intervention. There was insufficient local capacity (human and infrastructure) initially to conduct entomological monitoring in some countries, including Liberia, Rwanda, Angola, and Mozambique. Implementing partners must be able to provide practical training, technical assistance in developing clear entomological monitoring plans, insectary resources, and in some cases human resources, in order to ensure entomological monitoring for IRS is done correctly and consistently.
- The amount of in-country anopheline mosquito colonies was insufficient to conduct large-scale susceptibility and residual efficacy testing or wall bioassays in some countries (e.g., Liberia, Nigeria, Angola, and Ethiopia). Countries where IRS is implemented must have access to an insectary to breed susceptible mosquitos and conduct consistent and effective entomological monitoring.
- In several countries where insectaries were established or rehabilitated under IRS 1 and 2, RTI recognized the need to update the skills of insectary staff in addition to ensuring the insectary was completed. Insectary staff should be assessed and retrained if necessary to ensure insectaries are effectively and efficiently producing mosquitos. Conducting baseline data collection and analyses are key components to making informed decisions on insecticide selection.
- Insecticide resistance, especially to pyrethroids, was observed in the majority of countries between 2009 and 2011 (see Table 6 above). Although it was initially challenging to build support among stakeholders to adhere to insecticide resistance management policies, engaging NMCPs and building their capacity to conduct entomological monitoring and assessments facilitated advocacy for evidence-based decision making. As a result, NMCPs championed the development and adherence to insecticide resistance strategies.
- Information sharing among stakeholders involved in insecticide-based vector or pest control interventions is vital in strategizing about insecticide resistance management.
- Use of in-country centers of excellence and research institutions allowed for more timely and consistent entomological monitoring, and usually led to more data being available.

Photo of the microbiology laboratory that the program supported for refurbishment in Maputo Mozambique.

A family in Ethiopia removes their household belongings in preparation for spraying.

COMPONENT 5 – CAPACITY BUILDING

capacity of NMCP and other host country authorities to plan, implement, and manage an IRS program. PMI through IRS 1 laid the foundation and built basic local capacity in conducting IRS since most NMCPs had not implemented IRS in decades. IRS 1 focused on ensuring operations were carried out according to best practice and emphasized evidence-based decision making by ensuring comprehensive M&E of activities. In IRS 2 TO1, RTI continued emphasizing the correct and safe application of IRS, but also expanding capacity of NMCPs and other in-country authorities to gradually transfer responsibilities. PMI and RTI designed each component of IRS 2 TO1 (i.e., M&E, IEC, entomology, environmental compliance, and spray operations) to be centered on capacity building at the core. Within the 12 countries supported by IRS 2 TO1, there was a range of exist ing IRS program capacity from limited (e.g., in the post-conflict countries) to strong (e.g., Ethiopia, which had implemented IRS operations since the mid-1950s). RTI developed a sustainability index tool to determine the maturity and sustainability of the country s IRS program (see ***Appendix B***). Each 2011 work plan included the sustainability index along with a short analysis of the country s position along the spectrum. Starting with this analysis, IRS COPs worked with the NMCP representatives to identify activities to graduate to the next stage in capacity and sustainability. Below is an overview of key activities that were carried out in various countries to build capacity and promote sustainability of IRS.

TOT participants practicing spray technique in Angola.

5.1 LEARNING BY DOING

The principle strategy for building capacity at the district and national level for IRS 2 TO1 was learning-by-doing or on-the-job training. RTI IRS staff worked seamlessly with district- and national-level counterparts throughout the planning and implementation periods to transfer knowledge and skills in management of IRS. COPs worked in collaboration with NMCP leadership and other national authorities—such as MOH, MOE, and MOA—to develop and use tools (e.g., implementation plans, countdown calendars, etc.); provide technical guidance on insecticide selection criteria, timing of the spray round, and target area. This was done through partner planning meetings, technical steering meetings, and informal IRS strategy meetings. IRS 2 TO1 staff also encouraged joint field supervision trips to expose senior level officials to implementation challenges in the field, effective problem solving, and the importance of supportive supervision.

IRS program logistics managers were assigned to work with district coordinators, who were often times staff from the subnational health offices (e.g., district health offices [DHO]). Through real time learning by doing, logistics managers transferred skills to these cadres in warehousing for IRS, stock management, IRS equipment maintenance, transportation logistics, and IRS site safety. In all countries, storekeepers were recruited locally and were trained by the IRS 2 TO1 staff in how to maintain IRS stores so these cadres can be engaged by NMCP or DHO for managing stores in future operations. RTI IRS environmental compliance officers conducted most inspections alongside MOE staff that they trained by providing them real-time exposure to the environmental compliance checklist and the process of carrying out a pre- and mid-spray inspection.

5.2 TRAINING OF TRAINERS (TOT)

A cornerstone of RTI's IRS 2 TO1 operational management strategy was the subnational level TOT program. IRS 2 TO1 supported TOT workshops in each country to assist NMCPs develop a cadre of qualified trainers who can deliver future trainings on IRS operations and continue to build local capacity. In the 10 countries for which RTI managed spray operations, RTI provided logistical and financial assistance for TOTs and provided training manuals to guide instructors and participants. IRS 2 TO1 either engaged STTA to deliver TOT sessions or previously certified TOT leaders to provide refresher training to a small group of TOT participants. Often the TOT leadership included IRS 2 project staff, trainers from the local insecticide distributor, district health staff and/or NMCP, which worked well at fostering growth of capacity for host country NMCP and DHO leadership. With the exception of Angola, all PMI-supported IRS 2 TO1 countries successfully delivered the TOT by using local host country expertise, including IRS project staff.

5.3 IRS TRAINING MANUAL

The IRS training manual developed by RTI under IRS 1 is based on RTI's SOPs for IRS and PMI's IRS BMP as well as WHO standards for IRS. It provides thorough explanations for IRS operational protocol so that the participants not only learn the practical technique, but also understand the theory. Key concepts covered in the RTI IRS manual include spray technique, spray equipment, mixing of insecticide, personal and environmental safety and compliance, IEC messaging, data collection, criteria for selection of spray operators, IRS data recording tools, and supervision of spray operations. During the training the participants were made familiar with the associated tools such as data collection forms, supervision forms, and IEC materials.

5.4 SPRAY OPERATOR TRAINING

Certified TOT leaders delivered the training for general IRS cadres. RTI provided quality assurance and oversight and also developed and provided an IRS training curriculum to guide the general IRS training. Each participant received an IRS training manual that could be used during training and referenced later for a refresher. Post-training tests were conducted in all countries, and only participants who received passing scores were eligible to serve as spray operators.

In IRS 2 TO1, since most countries had already implemented at least two spray rounds and had sufficiently trained cadres of spray operators, RTI conducted refresher training in those districts. In so doing, the training program was reduced by an average of two days, which resulted in cost savings for IRS 2 TO1. It should be noted that spray operators without previous experience did undergo the full training to ensure a solid knowledge of technique and safety for conducting IRS.

Table 7 summarizes the outcome of training activities conducted under IRS 2 TO1.

Table 7. IRS Spray Personnel Trained with PMI Support[a]

Country	2010	2011
Angola	834	884
Benin	459	560
Burkina Faso	172	315
Ghana	4,049	4,125
Ethiopia	572	536
Liberia	437	673
Madagascar	1,612	1,224
Mali	549	730
Mozambique	1,996	1,584
Rwanda	2,088	2,235
Senegal	1,024	911
Zambia	N/A	N/A
Total	**13,792**	**13,777**

a. Data only include personnel trained to conduct spray operations; data do not include IEC personnel or auxiliary personnel such as wash persons and pump mechanics.

5.5 POISON MANAGEMENT TRAINING FOR CLINICIANS

Because of the risks involved with using insecticides, capacity building activities for IRS 2 TO1 included the continued support for poison management training of MOH staff. In IRS 1 TO2, RTI developed a poison management handbook; and in IRS 2 TO1, RTI continued to support MOHs in this area by publishing and distributing the handbook as a resource with new IRS countries as well as by providing financial and logistical support for refreshing and training staff at the district level in preparation for IRS.

5.6 CAPACITY BUILDING IN IEC

The IRS project supported refresher training of IEC mobilizers in the majority of IRS countries. From lessons learned in IRS 1, it was evident that a full one-week course for IEC was not necessary in countries that had sprayed multiple times in the same geographic areas. In 2010, a standardized IEC mobilizer training guide was developed in English and translated into French and Portuguese for use during IEC mobilizer trainings. IRS 2 TO1 collaborated with MOH's health communications unit and successfully leveraged connections to integrate IRS messages with ongoing public health efforts and mobilize existing available personnel to support IRS. Because of the availability of existing systems to tap into and personnel with transferrable skills, IRS 2 TO1 was able to transfer IEC responsibilities to local authorities in many countries. By 2011, out of the 10 countries where RTI supported IEC, 8 were being led by MOH through subnational health offices.

5.7 CAPACITY BUILDING IN M&E

To coincide with IRS project's migration to a more customized M&E database, RTI supported training sessions for M&E data clerks and M&E managers as well as district M&E authorities in many countries in 2010 and 2011. The majority of countries trained at least two data clerks per district to ensure adequate capacity would be available for the current round and in the future. Data clerks were also trained on data security measures to ensure data were safe from theft, loss, or natural disaster.

RTI's experience with IRS was that most of the mistakes in M&E data were due to errors in data recording in the field more than entry by the data clerks, though errors were introduced at both stages. To combat this challenge, IEC, spray operator and TOT curricula included sections on data recording with an emphasis on definitions and counting. As a result, all IRS operations cadres (e.g., spray operators, supervisors, team leaders, IEC mobilizers and district operations managers) were trained on the use of M&E data recording tools and given practical exercises.

5.8 CAPACITY BUILDING IN ENTOMOLOGICAL MONITORING

Considering the importance of entomological monitoring in IRS, NMCPs often requested training for field entomology technicians and support for insectary refurbishment. Through IRS 2 TO1 staff, regional entomology consultant network, and subcontracted centers of excellence, IRS 2 TO1 supplied technical assistance through training in field work and the provision of insectary management and refurbishment increase the capacity of NMCPs to monitor vector susceptibility, behavior, density, and residual efficacy of insecticide on the walls after spraying.

Capacity Building in Entomological Monitoring Management in Mozambique

Mozambique had relatively high capacity (personnel and infrastructure) to conduct entomological monitoring. The NMCP and the National Institute of Health (INS) both have responsibilities for certain activities related to IRS monitoring. NCMP and INS recognized challenges in process flow and divisions of responsibility between the two entities, which caused some bottlenecks in conducting entomological monitoring evaluations. CDC, PMI, and RTI worked together with the NMCP and INS to develop an entomological monitoring plan that presented guidelines on timing and roles and responsibilities to improve coordination.

The following countries received support in the area of entomology: Angola, Benin, Burkina Faso, Ethiopia, Ghana, Liberia, Mozambique, Nigeria, and Rwanda. In Benin, Burkina Faso, Ethiopia, Ghana, Mozambique, and Nigeria, and although local technical capacity existed, resources to fund activities were scarce. In these cases, the project provided financial support for training to be conducted through either subcontracting a local center of excellence or by supporting labor costs of local experts. See text box for an example of how RTI provided capacity building to Mozambique in entomological monitoring. In other countries where local expertise was not available, RTI supplied technical assistance directly through regional STTA.

In many countries IRS 2 TO1 supported upgrading of insectaries and laboratory facilities so that countries were able to efficiently breed and raise mosquito colonies for use in susceptibility evaluations and wall bioassays. In so doing, the project enhanced the entomological monitoring program for many countries. Three countries began or completed insectary refurbishments under IRS 1—Rwanda, Ghana, and Mozambique. Under IRS 2 TO1, project staff continued to support insectary establishment or refurbishment in Mozambique, Ethiopia, Liberia, and Angola. See text box for more details on capacity building in entomology in Rwanda. ***Table 8*** provides an overview of entomological monitoring capacity building activities for each country.

Table 8. Entomological Monitoring Capacity Building Activities by Country

Country	Entomology Training	Insectary Refurbishment
Angola	Provided technical assistance through a regional consultant to train field entomology technicians and develop an entomological monitoring program for Angola.	IRS Angola COP worked with IVM to provide support to NMCP to lay the groundwork for an insectary to be built in Viana, Angola.
Benin	Supported CREC, a local center of excellence, to support the training on entomological monitoring activities.	Not in SOW
Burkina Faso	Funded Centre Muraz to support training on entomological monitoring activities	Not in SOW
Ethiopia	Supported expert consultants from local universities to train technicians in entomological monitoring.	The IRS project supported the refurbishment of an insectary in Adama.
Ghana	Collaborated with Noguchi Memorial Institute for Medical Research (NMIMR) through a subcontract to train entomological monitoring technicians.	Started under IRS 1 and completed under IRS 2, RTI supported the refurbishment of an insectary in Tamale and purchased equipment.
Liberia	Training was supported by IVM.	In collaboration with IVM, IRS 2 TO1 supported the construction of an insectary.
Madagascar	Entomology activities not included in RTI SOW.	
Mali	Entomology activities were not included in RTI's SOW.	
Mozambique	Supported capacity building activities by hiring a full-time local entomologist in charge of training and managing IRS entomological monitoring activities in Mozambique. The Regional IRS Entomology Specialist also provided STTA for training entomological monitoring and insectary technicians in Zambezia.	Under IRS 1, RTI began work on refurbishment and purchase of equipment for two insectaries (one in Cabo Del Gado and one in Zambezia) and a molecular biology laboratory (Maputo). The work on these was completed under IRS 2.
Nigeria	Provided technical assistance for training in entomological monitoring also susceptibility, baseline, etc. in cooperation with Jos University's Department of Entomology.	Not in SOW.
Rwanda	Provided technical assistance to NMCP through regional entomology consultants who led training programs for entomology field technicians and insectary technicians. Additional STTA was provided to boost insectary output.	An insectary refurbishment was completed under IRS 1. Under IRS 2, the IRS project provided support through a regional entomology consultant that improved the functioning of KHI insectary through training, reorganizing the layout, and performing and recommending maintenance and the purchase of vital equipment to maximize output.
Senegal	Entomology activities not included in RTI SOW.	

5.9 IRS TOOLS FOR TRAINING

Under IRS 1, RTI developed tools for use in training NMCP and implementing IRS operations. Building on the lessons learned under IRS 1, IRS 2 TO1 continued to develop training and operational tools for building capacity and improving quality and efficiency of IRS operations and technical components, such as environmental management and entomology. Below is a list of training tools developed under IRS 2.

- *Standard Curriculum on the Indoor Residual Spraying for Malaria Control Program* – Used in tandem with the below mentioned Trainers Guide, the Standard Curriculum tool guides the trainer through essential content and provides presentation tools and training plans for each module included in the IRS training program.
- *Trainers Guide* – Used as a companion piece to the Standard Curriculum on the Indoor Residual Spraying for Malaria Control Program, the Trainers Guide provides a roadmap for trainers on how to present the IRS curriculum and tools for delivering an effective training program. They contain a series of topical modules on such subjects as spraying, environmental compliance, community mobilization, and more.
- *Taking Stock of M&E Lessons: Successes, Challenges, and Innovations* – Presents the challenges and lessons learned from IRS 1 TO 1 and the solutions and innovations used to address them in IRS 2 TO 1 and beyond. It describes the evolution of the IRS database, indicator standardization, innovations in data gathering, compiling and analysis including SMS reporting, and operationalizing data quality/data integrity measures into the M&E systems for IRS.
- *Procurement Assessment Capacity Tool* – Tool to assist NMCP procurement departments to assess strengths and weaknesses in procurement operations.

IRS Building Capacity for Increased Functionality of Insectaries

In Rwanda, NMCP and PMI recognized the need for technical assistance in boosting the mosquito colonies reared at the Kigali Health Institute (KHI) for use in IRS entomology evaluations. The IRS 2 TO1 project supported the STTA of a technical consultant from Kenya to travel to Rwanda in September 2011 to build the capacity of KHI technicians and to provide the insectary with supplies to support mass rearing of mosquitoes. Working closely with NMCP the consultant led a training for staff and assessed the insectary to determine maintenance and equipment needed to improve the functioning. She successfully worked with the KHI team to resolve issues and supplied detailed recommendations for improving the insectary.

5.10 EVALUATION MEETINGS

After each spray round a spray performance evaluation meeting, supported by the IRS 2 TO1, was held to discuss results, challenges and lessons learned. Participants in most countries included representatives from NMCP, MOH, MOE, district health offices, PMI, and other implementing partners. In many countries, district level evaluation meetings were held as well where local leaders and civil society groups as well as spray team personnel could participate. The objective of these meetings is for participants to leave having a better grasp of the key challenges and recommendations that came out of the spray round in order to better plan and implement in the future. They provided a forum for participants to voice their concerns, share information and think critically on ways to improve IRS.

5.11 IRS COST STUDY

Under IRS 2 TO1, RTI carried out a cost analysis[8] to analyze the costs associated with PMI-supported IRS operations in 12 countries from 2008 to 2010. Results from the cost study are intended to help guide decision makers such as PMI, NMCP, and MOH leadership in allocating resources for IRS; analyze trends in costs within a country and across cost categories over time; and determine if economies of scale apply. Key findings include the following:

- Program size matters. At the country level, large IRS programs are less costly than small programs.
- IRS program costs are declining over time. Measured by mean costs per structure sprayed and per person protected, costs have declined steadily in these countries by about 25% from 2008 to 2010.
- Some economies of scale accrue as large programs expand. This was observed for spray operations costs (technical efficiency).
- Distribution of IRS program costs is consistent across time.

5.12 LESSONS LEARNED IN CAPACITY BUILDING FOR IRS

- Data recording should be emphasized during spray operator training to ensure spray operators have a solid understanding of definitions and counting structures. This should be incorporated as part of standard annual training/refresher courses.
- It is important for NMCPs to designate representatives to the TOT that will be able to participate and lead the TOT in future rounds. In some countries, RTI had to lead the TOT each year because trainers were not able to participate for various reasons.
- Entomological capability is a prerequisite to conducting IRS. If capacity does not exist in country, external expertise must be engaged until capacity is built, which can be a large expense.
- Information sharing and evaluation meetings contribute to capacity building

8. An Economic Analysis of the Costs of Indoor Residual Spraying in 12 PMI Countries, 2008–2010. http://www.pmi.gov/technical/irs/IRS_economic_analysis.pdf

- Often, countries do not have district-level environmental representatives, which presents a challenge for transferring capacity for environmental compliance inspections. Since the national MOE representatives are not always available, a specialist at the district level should be appointed to build capacity.
- It is beneficial for MOH representatives at the national level to participate in IRS M&E training to understand role/requirements to conduct supportive supervision.
- MOH/NMCP must allocate resources to support IRS management positions at both the district and national levels in order to promote skills transfer and sustainability.
- For IEC, most countries have sufficient capacity to lead and manage IEC. However, the implementing partner should ensure close coordination of such efforts with IRS operations.
- In some cases, capacity in country exists in technical components such as entomology and environmental compliance. However, assistance is needed to develop processes and timelines so that work can progress.
- In positions that record data, such as IEC and spray operators, basic literacy is required and must be included as a criteria for recruitment.
- Engaging MOH and NMCP leadership in all stages of planning is instrumental in transferring skills and knowledge in IRS planning and management. This includes budgeting and human resource planning. It is important that national leadership understand the costs involved as well as the technical and operational management knowledge.
- Capacity building must be an objective in and of itself with measurable benchmarks. Field staff often concentrate the majority of their efforts on performance results. It is important that all staff are reminded consistently that they are also responsible for building the capacity of host country counter parts. Instead of only implementing, they should be assigned to one or more people either at the national or district level that they are in charge of training. IRS 2 TO1 held project staff accountable for capacity building, as well as spray performance/environmental compliance.

Appendix A: IRS 2 TO1 Results by Year 2010–2011

Country	Structures Sprayed		IRS Coverage		People Protected		Personnel Trained*	
	2010	2011	2010	2011	2010	2011	2010	2011
Angola	135,856	145,264	96%	98%	650,782	689,668	834	884
Benin	166,910	145,247	99%	94%	636,448	426,232	459	560
Burkina Faso	33,897	33,832	99%	99%	118,691	110,064	172	315
Ethiopia	646,870	858,657	96%	98%	2,064,389	2,920,469	4,049	4,125
Ghana	342,876	354,207	97%	92%	849,620	926,699	572	536
Liberia	48,375	89,710	98%	96%	420,532	834,671	437	673
Madagascar	576,320	502,697	96%	92%	2,895,058	2,585,672	1,612	1,224
Mali	127,273	202,821	97%	97%	440,815	697,512	549	730
Mozambique	618,290	660,064	98%	99%	2,945,721	2,825,648	1,996	1,584
Rwanda	303,659	358,804	99%	99%	1,365,949	1,571,625	2,088	2,235
Senegal	254,559	240,770	97%	98%	959,727	887,315	1,024	911
Zambia**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	3,254,885	3,592,073			13,347,732	14,475,575	13,792	13,777

*Indicator includes spray personnel such as spray operators, team leaders, supervisors, clinicians. This indicator does not include data clerks, IEC mobilizers, drivers, washers, pump technicians, and security guards.

**Abt Associates managed spray implementation in Zambia; RTI managed supply chain, environmental compliance, and capacity building in logistics and supply chain management.

Appendix B - Sustainability Index Tool

	Stage I	Stage 2	Stage 3	Stage 4
Program Characteristics	• Program with poor sustainability prospects • Poorly functioning policy, planning, and leadership functions • Budget allocation does not adequately fund program development or operations • No national policy on malaria control and no plan of action exist • Little or no collaboration or coordination among national partners, little multisectoral coordination, and weak participation in regional partnerships (e.g., RBM)	• Weakly sustainable program • National policy, guidelines, planning, budgeting, and systems/tools for IRS established but are not functioning effectively • Government's open budget line for malaria control includes IRS • Weak coordination among national partners and across sectors, and in regional partnerships	• Relatively sustainable program • Adequate policies, planning, and leadership functions • Multi-year budget exists and is sufficient to fund IRS activities described in strategic plans • IRS systems/tools established and functional but not integrated into national systems • Functioning coordination and collaboration among national partners and across government sectors • Country participates in regional RBM partnerships	• Strong, mature, and sustainable program • Adequate planning, well-led and well-organized, evidenced-based programming • Multi-year budget and approved budget allocation • Strategic plans address proper scaling (e.g., blanket, targeted, and focal spraying properly used) • IRS operational systems/ tools in place and well-functioning • Active national partnerships, multi-sectoral collaboration and regional RBM participation
Illustrative Remedial Program	• Establish policy framework for IRS and include IRS in national malaria control strategy • Prepare budget projections • Address vacancies in leadership positions • Determine prevalence and define IRS target areas • Conduct geographical reconnaissance of IRS target areas • Identify stakeholders and create coordination/ collaboration plan • Develop capacity building plan and initiate activities	• Strengthen foundation for implementation of policies and plans • Strengthen leadership at all levels • Establish IRS systems and tools, including monitoring and evaluation (M&E) • Strengthen health education and community mobilization for IRS • Investigate potential for coordination and integration with other programs • Develop framework for proper scaling of IRS interventions • Strengthen capacities at all levels	• Scale programs geographically and expand complementary interventions • Build capacity for implementation (e.g., conduct environmental and entomological training) • Refine implementation framework; identify areas of remaining disease and possible reemergence • Intensify prevention strategies towards effective control and pre-elimination • Establish/strengthen cross-border and regional relationships • Integrate M&E for IRS into the national malaria M&E system	• Continue properly scaled use of IRS as required for disease control with regular reporting and reviews • Strengthen public-private partnerships • Continue health education programs to promote positive behavior change • Continue program development toward long-term elimination
Illustrative Advocacy	• Advocate for national malaria control strategy • Advocate for funding from government and development partners/donor organizations • Create national forums for national collaboration • Institutionalize participation in regional partnerships	• Conduct community-level advocacy • Build coalitions with other malaria and disease control programs • Provide regular data and program achievements to program partners and stakeholders	• Document successes to sustain and increase government ownership and commitment • Learn from and build on best practices and successes from other health programs • Expand focus beyond health sector to include environment and education	• Ensure inclusion of IRS in national health policies to avoid resurgence • Continue dissemination of IRS best practices and successes among national and international stakeholders
	Less sustainable		**More sustainable**	

Appendix C - Sample Daily Spray Card from Ghana

INDOOR RESIDUAL SPRAYING PROGRAMME
DAILY SPRAY CARD

NORTHERN REGION _____ DISTRICT _____ SUBDISTRICT _____ ZONE _____ COMMUNITY _____

NAME AND NUMBER OF SPRAY OPERATOR _____[_____] TEAM NUMBER [_____] DATE_____

SACHETS RECEIVED_____ FULL SACHETS RETURNED_____ EMPTY SACHETS RETURNED____

Unique N°	Name of House/ Landlord	Eligible Structures										Eligible Rooms		Mosquito nets		
			Sprayed				Unsprayed									
		Total Found (enter tally)	# Sprayed	Total Pop	Children < 5 yrs	Preg women	# Not sprayed	Total Pop	Children < 5 yrs	Preg women	Reason	Found	Sprayed	Total	Preg women sleeping in	< 5 sleeping in
Total											*					

Reason for Not sprayed: *1 = Sick* *2= Locked* *3=Funeral* *4=Denied* *5=Other*

**** = Most common Reason***

Team Leader comment: _____ data verified: Yes ☐ No ☐ Date of verification _____ Signature_____

☐ TICK IF MOP UP

** Where mop up takes place, no new records should be created in the database but old record edited by (unique number/village) deleting that record from unsprayed, adding it to eligible structures sprayed and deleting the reason for being unsprayed.*

Appendix C - Sample Daily Spray Card from Ghana

INDOOR RESIDUAL SPRAYING PROGRAMME
Team Leader's Daily Record

NORTHERN REGION _____ DISTRICT _____ SUBDISTRICT _____ ZONE _____ COMMUNITY _____

NAME AND NUMBER OF SPRAY OPERATOR _____[_____] TEAM NUMBER [_____] DATE_____

Spray operators Name	Eligible Structures											Eligible Rooms		Mosquito nets			Sachets			
	Total Found (enter tally)	Sprayed				Unsprayed						Found	Sprayed	Total	Preg women slee-ping in	< 5 slee-ping in	Recei-ved	Returned	Emp-ties	Used
		# Structure sprayed	Total pop	Children < 5 yrs	Preg women	# Structure not sprayed	Total Pop	Children < 5 yrs	Preg women	Rea-son										
Total											*									

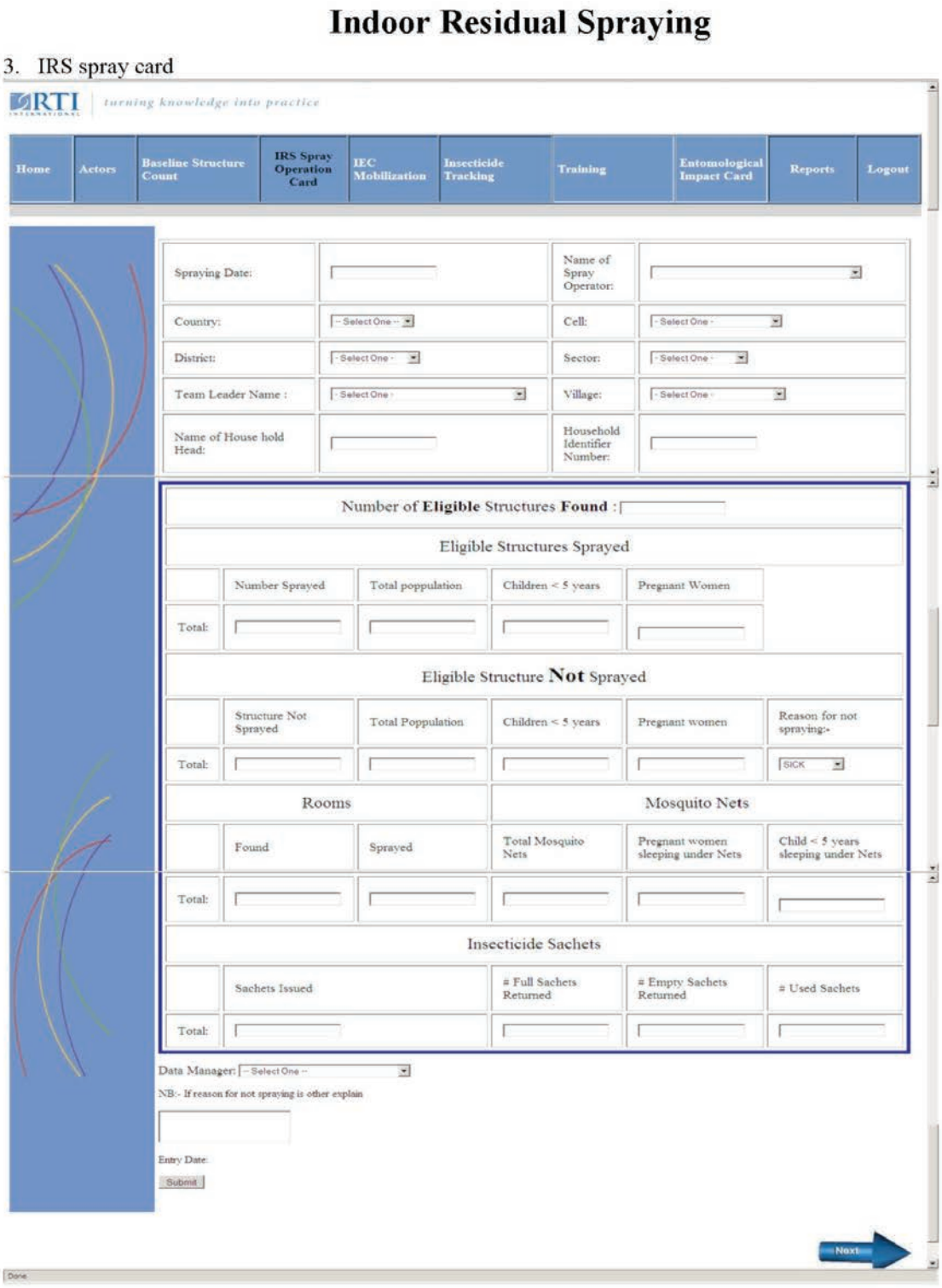
*Most common reasons for not spraying: 1…… 2 …… 3 ……..…..

Data Entry Clerk comment: _____ data verified: Yes ☐ No ☐ Date of verification _____ Signature_____

☐ Tick if MOP UP

** Where mop up takes place, no new records should be created in the database but old record edited by (unique number/village) deleting that record from unsprayed, adding it to eligible structures sprayed and deleting the reason for being unsprayed.*

Appendix D - Sample M&E Database from Rwanda



Appendix E – Sample Implementation Plan for Rwanda

Component	Activity	Person/Partner Responsible	Key Milestones											
			A	M	J	J	A	S	O	N	D	J	F	M
Start-up Activities and Development of Work Plan	Recruit, train, and deploy district operations coordinators, sector co-ordinators, supervisors, logistics and finance assistants, data entry clerks, and storekeepers in all districts	RTI			X	X							X	X
	Establish/reopen satellite office in districts and sectors	RTI			X	X								
	Work plan submitted.	RTI	X											
Planning and Assessment	Conduct preliminary discussions on target areas for Round 6 operations	RTI, NMCP, PMI	X	X	X									
	Discuss implementation timeline and RTI's scope of work and schedule needs assessments with PMI and NMCP	RTI, NMCP	X	X	X									
	Discuss upcoming spray operations, IRS scope of work, and program objectives with NMCP and district authorities	RTI , PMI, NMCP	X	X	X	X								
	Conduct logistics needs assessment and environmental assessment [8] Conduct impact assessment for previous three IRS rounds	RTI RTI and NMCP	X	X X	X	X								
Procurement and Logistics	Deliver insecticide, PPE, and equipment to targeted districts	RTI			X	X								
IEC Development and Implementation	Review IEC strategy	PSI		X	X									
	Review/adapt IEC materials and submit for review by PMI Rwanda Team, NMCP, PSI, and HCC within the MOH	RTI and ISC			X	X								
	Recruit and train IEC implementers at community level	PSI, RTI, NMCP, and HCC			X	X								
	Disseminate IEC messages via print media, radio, mobile vans, and interpersonal communication	RTI, NMCP, and HCC				X	X	X						
	Conduct briefing meetings with district mayors	RTI and NMCP				X	X							
	Conduct IEC in coordination with IRS	PSI, NMCP, and RTI				X	X	X	X					
Spray Operations	Conduct training of trainers for district health authorities, environmental officers, sector coordinators, and supervisors	RTI and NMCP				X								
	Recruit spray operators	RTI and NMCP			X	X								
	Conduct medical evaluations for spray operators	RTI and NMCP			X	X								
	Train spray operators, store keepers, and data entry clerks	RTI and NMCP				X	X							
	Conduct spray operations	RTI						X	X	X				
	Conduct inventory and operational assessment	RTI	X	X				X	X	X	X			

Component	Activity	Person/Partner Responsible	Key Milestones											
			A	M	J	J	A	S	O	N	D	J	F	M
Monitoring & Evaluation	Conduct entomological survey at selected districts/sectors	RTI and NMCP	X	X	X									
	Conduct entomology surveillance													
	Conduct post-IRS entomology surveillance	RTI and NMCP								X	X	X	X	X
	Conduct internal inspection to determine compliance with the environmental assessment **pre-spray** operations	RTI		X	X									
	Conduct internal inspection to determine compliance with the environmental assessment during spray operations						X	X	X					
Capacity Building	Deliver regional IRS SEA training for NMCP participants	RTI and NMCP			X									
Post-Spray Operations	Hold closing ceremony	RTI and NMCP							X					
	Demobilize spray team	RTI and NMCP							X	X				
	Collect and maintain equipment	RTI							X	X				
	Conduct inventory assessment	RTI								X	X			
	Dispose of empty sachets	RTI										X	X	X
	Conduct district and regional post-evaluation meetings	RTI								X				
	Demobilize short- term district personnel	RTI							X	X				
Reporting	Submit Spray Performance Report										X			
FY 2011 Round 6 Planning and Assessment	Initial planning visit to discuss IRS target areas	RTI and NMCP										X		
	Discuss IRS scope of work (SOW) and target areas for spraying with PMI Rwanda and Washington Teams											X	X	X
	Discuss implementation timeline and RTI's SOW and schedule needs assessments with the NMCP, USAID, and PMI	RTI											X	X
	Discuss upcoming spray operations with district authorities	RTI , PMI, and NMCP											X	X
Other Activities: Supporting national capacity for entomological monitoring and surveillance	Train data managers of sentinel sites and laboratory	RTI and NMCP							X	X				
Other Activities: Supporting national capacity for entomological monitoring and surveillance	Enhance/establish insectary/laboratory	RTI and NMCP	X	X	X	X	X							