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President's Malaria Initiative

# Tanzania Vector Control Scale-up Project: Spray Performance Report

October 2012–June 2013

Contract No. 621-A-00-10-00015-00  
March 9, 2010–March 8, 2015

Prepared for:  
U.S. Agency for International Development/Tanzania

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July 30, 2013

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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 3,700 provides research and technical services to governments and businesses in more than 75 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 testing and chemical analysis.

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# Table of Contents

Table of Contents .....	iii
List of Annexes.....	vi
List of Tables .....	vii
List of Figures .....	viii
List of Boxes.....	ix
List of Abbreviations.....	x
<b>I. Executive Summary .....</b>	<b>1</b>
<b>II. Country Background .....</b>	<b>2</b>
Intervention Areas .....	2
Zanzibar .....	2
Mainland Tanzania .....	3
Regions in the Lake Zone Area of Mainland Tanzania .....	4
Malaria Transmission in Zanzibar .....	5
Malaria Transmission in Mainland Tanzania.....	5
<b>III. IRS in the Context of Malaria Strategies in Zanzibar .....</b>	<b>6</b>
Malaria Medium-Term Strategic Plan for Zanzibar .....	6
Recent History of IRS in Zanzibar.....	7
IRS Strategic Design for Zanzibar .....	10
Zanzibar .....	10
Selection of Eligible Spray Areas.....	10
<b>IV. 2012–2013 IRS Preliminary Activities.....</b>	<b>13</b>
Assessing the Environment and Planning Mitigation Options for the Safer Use of Pesticides.....	13
Environmental Assessment.....	13
Insecticide Management and Environmental Mitigation Plan.....	14
Selection and Management of Insecticide for IRS.....	14
Insecticide Resistance in Zanzibar .....	14
Insecticide Resistance Mitigation Plan .....	14
Selection of Appropriate Insecticide .....	15
Assessing IRS Logistics .....	15
Selecting the Ideal Spray Period and Preparing the Operations Plan.....	16
Rationale for Selection of Spray Period in Zanzibar .....	16
Spray Season .....	16
Establish District IRS Management .....	17
Developing and Organizing the IRS Sites: Design and Phases .....	17
Insecticide Quantification, Procurement, Safe Transport, and Storage.....	19

Handling Equipment, Materials, and Vehicles .....	19
Managing Human Resources for IRS .....	19
Staff Training .....	21
Training Modalities .....	21
Types of Training .....	21
Training Tools .....	21
Informing and Mobilizing Communities .....	21
Implementation of Information, Education, and Communication Activities (IEC): IEC Design in 2012–2013 Spray Season .....	21
Organization of Interpersonal Communication in Zanzibar .....	21
Other IEC Supportive Activities .....	22
Printed IEC Materials .....	22
Monitoring the IRS Process .....	22
Monitoring of Training Activities .....	22
<b>V. Implementation of IRS Activities .....</b>	<b>22</b>
Quality Control of Spray .....	22
Monitoring Performances of Spray Teams and Use of Insecticide .....	24
Environmental Monitoring and Mitigation Activities .....	24
Monitoring and Evaluation .....	24
Logistics .....	26
Storage and Movement of Insecticide and Other Supplies .....	26
Provision of Transport for Operators and Supervisors .....	28
End of Spray Activities .....	28
Post-spray Environmental Compliance Inspections and Site Decontamination and Decommissioning .....	28
Solid Waste Disposal .....	28
End of Spray Inventory in Storage Facilities .....	29
<b>VI. IRS Results .....</b>	<b>29</b>
IRS Results—Zanzibar .....	29
Population and House Structures Found .....	29
Spray Results .....	30
Usage of ITNs .....	33
<b>VII. Monitoring Insecticide After Spray: Insecticide Decay Rate .....</b>	<b>34</b>
Monitoring Insecticide Decay by Using Cone Bioassay .....	34
<b>VIII. IRS in the Context of Malaria Strategies in Mainland Tanzania .....</b>	<b>36</b>
Malaria Medium-Term Strategic Plan for Mainland Tanzania .....	36
Recent History of IRS in Mainland Tanzania .....	36
Mainland Tanzania .....	36
IRS Strategic Design for Mainland Tanzania .....	42
Mainland Tanzania .....	42

Spray Seasons.....	42
Selection of Eligible Spray Areas.....	43
Mainland Tanzania .....	43
<b>IX.    2012–2013 IRS Preliminary Activities.....</b>	<b>46</b>
Assessing the Environment and Planning Mitigation Options for the Safer Use of Pesticides.....	46
Environmental Assessment.....	46
Insecticide Management and Environmental Mitigation Plan.....	46
Selection and Management of Insecticide for IRS.....	47
Insecticide Resistance in Mainland Tanzania .....	47
Insecticide Resistance Mitigation Plan .....	47
Assessing IRS Logistics.....	47
Selecting the Ideal Spray Period and Preparing the Operations Plan.....	47
Rationale for Selection of Spraying Period in Lake Zone.....	47
Setting the Structure Targets .....	50
Establish District IRS Management .....	50
Developing and Organizing the IRS Sites.....	51
Insecticide Quantification, Procurement, Safe Transport, and Storage.....	51
Handling Equipment, Materials, and Vehicles .....	51
Managing Human Resources for IRS .....	52
Informing and Mobilizing Communities .....	54
Advocacy to Local Government Authorities: Region, District, Division, Ward, and Village Levels .....	54
Implementation of Information, Education, and Communication Activities: IEC Design in 2012–2013 Spray Season .....	54
Managing Knowledge and Skills .....	56
IRS Teams Training in Lake Zone.....	56
Training of Trainers (ToT).....	56
IRS Teams.....	57
Monitoring the IRS Process .....	57
Monitoring of Training Activities.....	58
IRS Coverage and Use of Insecticides.....	58
Getting RTI Prepared to Support the IRS Process .....	58
Public-Private-Partnership (PPP) in IRS implementation in the Lake Zone .....	59
<b>X.    Implementation of IRS Activities .....</b>	<b>59</b>
Quality Control of Spray.....	59
Environmental Monitoring and Mitigation Activities .....	59
Logistics .....	60
Storage of Insecticide and Other Supplies .....	60
Provision of Transport for Operators and Supervisors .....	63

End of Spray Activities .....	63
Post-spray Environmental Compliance Inspections and Site Decontamination and Decommissioning .....	63
Solid Waste Disposal.....	63
End of Spray Inventory in Storage Facilities .....	63
<b>XI.    IRS Results—Mainland .....</b>	<b>64</b>
Population and House Structures Found .....	64
House Characteristics and Population Profile .....	64
Spray Results.....	65
Main Spray Indicators.....	65
Refusal and Houses Not Reached .....	67
Use of Insecticides .....	67
Population Protected.....	69
Community Sensitization Results .....	70
Source of Information .....	70
Perceived Advantages and Disadvantages from Previous IRS Rounds.....	72
Usage of ITNs .....	74
<b>XII.    Monitoring Insecticide Quantification After Spray, Insecticide Decay,     and Insecticide Resistance .....</b>	<b>75</b>
2013 Preliminary Results of Insecticide Decay Monitoring Using Cone Bioassay .....	75
Insecticide Resistance Monitoring in Lake Zone and Zanzibar .....	76
<b>XIII.    Lessons Learned.....</b>	<b>78</b>
<b>XIV.    Challenges .....</b>	<b>78</b>
<b>XV.    Recommendations .....</b>	<b>78</b>
<b>XVI.    IRS in Action .....</b>	<b>79</b>

## List of Annexes

Annex A.	Zonal Regional and District Targets: IRS Operational Sites, Ward/Shehia, Village, and Hamlets
Annex B.	Summary Operation Staff by District, Region, and Zone
Annex C.	Summary of Household Characteristics and Population by District, Region, and Zone
Annex D.	Summary of Spray Indicators by District, Region, and Zone
Annex E.	Population Protected by Broad Age Group, District, Region, and Zone
Annex F.	Net Usage per District, Region, and Zone
Annex G.	Reasons for No Spray by District (only Lake Zone)
Annex H.	Perceived Advantages and Disadvantages after IRS (only Lake Zone)
Annex I.	Source of Information (only Lake Zone)
Annex J.	Houses Sprayed by Type and Amount of Insecticide
Annex K.	Environmental Compliance Report

## List of Tables

Table 1.	Spray performance in Zanzibar (structures sprayed), 2006–2013.....	8
Table 2.	Strategic design for IRS implementation in Zanzibar .....	10
Table 3.	Zanzibar regional targets .....	17
Table 4.	Temporary staff recruited to support IRS operations .....	20
Table 5.	PPE Consumables Movements by Type and Warehouse .....	26
Table 6.	Selected PPE and spray equipment movement by type and warehouse .....	27
Table 7.	Vehicles hired during IRS operations.....	28
Table 8.	Characteristics of visited households.....	29
Table 9.	Population recorded during spray in visited households .....	29
Table 10.	Main spray indicators in Zanzibar .....	31
Table 11.	Use of insecticide .....	32
Table 12.	Population protected by spray zone.....	32
Table 13.	LLIN usage by region and zone by age group .....	33
Table 14.	Spray performance in Mainland Tanzania (structures sprayed), 2007–2013 .....	38
Table 15.	Number of eligible structures, previous rounds IRS, strategic phase, frequency of spraying, and insecticide class used in 2013 per district .....	44
Table 16.	Temporary staff recruited to support IRS operations .....	52
Table 17.	Proportion of temporary staff recruited during IRS campaign, by gender.....	53
Table 18.	Key IEC actors and targets by category.....	55
Table 19.	Insecticide movements by type and by warehouse .....	60
Table 20.	PPE consumables movements by type and by warehouse.....	61
Table 21.	Selected PPE and spray equipment movement by type and warehouse .....	62
Table 22.	Vehicles hired during IRS operations.....	63
Table 23.	Visited household characteristics.....	65
Table 24.	Population recorded during spray in visited households .....	65
Table 25.	Main spray indicators by area .....	66
Table 26.	Reasons for non-spray .....	67
Table 27.	Use of insecticide .....	68
Table 28.	Population protected by spray zone.....	69
Table 29.	IRS information and source by administrative level.....	71
Table 30.	Advantages and disadvantages cited by communities after IRS by administrative level.....	73
Table 31.	LLIN usage by region and zone by age group .....	74

Table 32. Summary of susceptibility levels of malaria vectors to insecticides using WHO susceptibility test kits.....	77
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## List of Figures

Figure 1. Map of Zanzibar showing Unguja and Pemba islands.....	3
Figure 2. Map of Tanzania showing regional boundaries, 2013.....	4
Figure 3. IRS Districts in the Lake Zone.....	5
Figure 4. Tanzania malaria prevalence in U5 children .....	6
Figure 5. Malaria morbidity for Unguja and Pemba Islands, 2011 MEEDS .....	12
Figure 6. <i>Shehias</i> targeted for one round in 2013 spray season, Unguja and Pemba .....	13
Figure 7. IRS teams organizational structure.....	18
Figure 8. Family size per district, Zanzibar.....	30
Figure 9. Spray coverage in districts of Zanzibar .....	31
Figure 10. Sachet per house structure ratio by district in Zanzibar.....	32
Figure 11. 2013 universal net coverage by district, Zanzibar.....	34
Figure 12. Bioassay results March 2013.....	35
Figure 13. Efficacy of bendiocarb at Shungi (Pemba) 30 days post spraying .....	35
Figure 14. Strategic design for IRS implementation in Mainland Tanzania.....	42
Figure 15. Spray seasons in Mainland Tanzania, November 2012–May 2013.....	48
Figure 16. Organizational structures for district IRS implementation teams .....	50
Figure 17. Types and number of storage facilities by levels and responsible TVCSP team .....	52
Figure 18. Organization of IEC/BCC from region to community level.....	54
Figure 19. IEC design in spray seasons, 2007–2013 .....	56
Figure 20. Cascade training model for IRS operation .....	57
Figure 21. 2012–2013 M&E Organogram .....	58
Figure 22. House walls characteristics by district in the Lake Zone .....	64
Figure 23. Spray coverage by districts of Lake Zone .....	66
Figure 24. Sachet per house structure ratio by district in the Lake Zone.....	69
Figure 25. Source of Information of IRS.....	72
Figure 26. Universal net coverage 2012 and 2013 by regions and zone.....	75
Figure 27. Insecticide decay on various surfaces up to week 29 after bendiocarb application in 2013 IRS campaign.....	76
Figure 28. Insecticide decay up to week 13 after deltamethrin application in 2013 IRS campaign.....	76

## List of Boxes

Box 1.	Criteria for selecting targeted areas in Zanzibar .....	11
Box 2.	Activities included in comprehensive logistics assessment .....	16
Box 3.	Criteria for IRS operators' selection .....	20
Box 4.	Monitoring inputs, process, and outputs .....	25
Box 5.	Inclusion and Exclusion Criteria for Targeted IRS Approach .....	46

## List of Abbreviations

ACT	artemisinin-based combination therapy
BCC	behavior change communication
CFR	U.S. Code of Federal Regulations
CS	capsulated suspension
DEMO	District Environmental Management Officer
DITC	District IRS Technical Committee
DITT	District IRS Technical Team
DMO	District Medical Officer
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
FAO	United Nations Food and Agriculture Organization
GGM	Geita Gold Mine
IEC	information, education and communication
IMCI	Integrated Management of Childhood Illness
IMVC	Integrated Malaria Vector Control
IPTp	Intermittent Preventive Treatment for Pregnancy
IRS	Indoor Residual Spraying
ITN	insecticide-treated net
LLIN	long-lasting insecticide-treated net
LSM	larval source management
M&E	monitoring and evaluation
MEEDS	malaria early epidemic detection system
MIS	Malaria Indicator Survey
MoHSW	Ministry of Health and Social Welfare
MOP	Malaria Operational Plan
NEMC	National Environment Management Council
NGO	nongovernmental organization
NIMR	National Institute for Medical Research
NMB	National Microfinance Bank
NMCP	National Malaria Control Programme
PEA	Preliminary Environmental Assessment

PMI	U.S. President's Malaria Initiative
PPE	personal protective equipment
PPP	public private partnership
SEA	Supplemental Environmental Assessment
SIM	Site IEC Mobilizer
SOP	standard operating procedure
THMIS	Tanzania HIV and Malaria Indicator Survey
ToT	training of trainers
TPRI	Tropical Pesticide Research Institute
TVCSP	Tanzania Vector Control Scale up Project
U5	under five years of age
USAID	United States Agency for International Development
VCO	vector control officers
WEO	Ward Executive Officer
WHO	World Health Organization
WHOPES	World Health Organization Pesticide Evaluation Scheme
WP	Wettable powder
ZMCP	Zanzibar Malaria Control Programme



# Section A: Overview and Background

## I. Executive Summary

In 2006, RTI International was awarded a Cooperative Agreement by the U.S. Agency for International Development (USAID) under the U.S. President's Malaria Initiative to implement indoor residual spraying (IRS) and other malaria control and prevention activities in Mainland Tanzania and Zanzibar. Between 2006 and July 2010, RTI conducted IRS in Zanzibar and Kagera Region in the Lake Zone in Mainland Tanzania. In 2010, IRS was expanded to cover two additional Lake Zone regions, Mwanza and Mara. Over the course of the 2010–2012 IRS spray season, a total of 18 districts in the Lake Zone (seven districts in Kagera Region, six districts in Mwanza Region, and five districts in Mara Region) and 10 districts in Zanzibar benefited from IRS.

Prior to conducting any spray activities in 2012–2013, many preparatory and foundational activities were carried out, such as the following in both Zanzibar and Mainland Tanzania:

- Select eligible spray areas based on national strategic priorities and logistic and epidemiological considerations;
- Conduct a preliminary logistics assessment to quantify eligible house structures, target population, spray equipment, insecticide, and spray teams, as well as identify suitable sites to host temporary storage and effluent waste-disposal facilities;
- To satisfy both USAID and Government of Tanzania environmental requirements, submit documentation for the shift from pyrethroids to carbamate insecticide;
- Refurbish existing IRS sites for temporary, proper storage of IRS equipment, insecticide, and effluent waste disposal facilities;
- Implement a plan for safer use of insecticide and institute an environmental mitigation plan, including safe transport and secure storage of insecticide, testing of female spray technicians for pregnancy, and training of clinicians on treatment of pesticide side-effects;
- Perform insecticide quality assurance tests;
- Introduce the Insecticide Quantification Kit for bendiocarb;
- Procure, transport, and store all necessary spray and personal protective equipment, insecticides, and consumables;
- Train spray teams in a variety of positions, including site managers, team leaders, spray operators, suit washers, site attendants, security guards, and water fetchers; and
- Promote acceptance of IRS in the targeted communities through information, education, and communication activities.

In Zanzibar, a total of 51,904 house structures were sprayed (96% of those eligible), with 250,505 people protected. This includes 5,703 pregnant women and 43,635 children under the age of five (U5). During this reporting period, about 5,082 (89%) of pregnant women and 39,222 (90%) of U5 children were declared to have slept under ITNs the previous night in the house structures visited.

In Mainland Tanzania, following the 2011–2012 IRS season, the USAID-funded Tanzania Vector Control Scale-up Project implemented changes to its IRS strategy such as scale down in Muleba, Karagwe, and Zanzibar, as well as an insecticide rotation to carbamate in these areas, as recommended by an expert panel working on the country's Insecticide Resistance Mitigation Plan. As a result, for 2012–2013, the TVCSP further shifted toward target spraying and insecticide rotation in the remaining districts in the Lake Zone. Due to the imminent scale-down of IRS, 30% of the eligible areas were excluded from spraying. A total of 773,929 house structures (95% of those eligible) were sprayed, of which 103,201 were sprayed twice in selected districts of Kagera, Mara, and Mwanza regions. Results showed that 4,052,354 people were protected, including 138,281 pregnant women and 841,451 children under the age of five. During this reporting period, 136,184 (93%) of pregnant woman and 818,455 (94%) of U5 children in the Lake Zone were declared to have slept under ITNs the previous night in the house structures visited.

In addition, entomological monitoring was conducted by the Zanzibar Malaria Control Programme in Zanzibar and the National Institute for Medical Research in Mainland Tanzania. The main parameters monitored included annual insecticide susceptibility in sentinel sites to determine the efficacy of insecticide and selection of the appropriate and cost-effective one, as well as cone bioassay to monitor duration of insecticide after IRS on different treated walls.

## II. Country Background

### Intervention Areas

The United Republic of Tanzania is located between longitudes 28°E and 40°E and latitudes 1°S and 12°S. The country has a total area of 947,480 km<sup>2</sup>, of which 883,349 km<sup>2</sup> constitute land; the remainder is made up of water bodies. Administratively, the country includes Mainland Tanzania and the archipelago of Zanzibar.

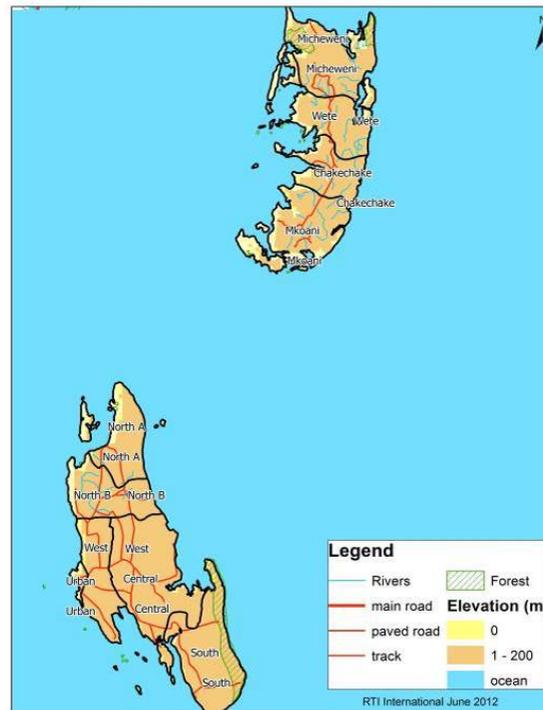
### **Zanzibar**

The Zanzibar archipelago consists of two main islands of Unguja and Pemba, together with several minor islands (see *Figure 1*). The total land surface area is 1,658 km<sup>2</sup>, with a population of 1,303,565 million (Tanzania National Bureau of Statistics 2012 census data). The administrative setup in Zanzibar includes five regions—three in Unguja and two in Pemba—10 districts, and 335 *shehias*<sup>1</sup>.

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<sup>1</sup> *Shehia* is the equivalent of a ward in Zanzibar's administrative setup.

**Figure 1. Map of Zanzibar showing Unguja and Pemba islands**



### ***Mainland Tanzania***

Mainland Tanzania is divided into seven zones (East, South, Southern Highlands, West, Central, Lake, and North). It has 30 regions (see **Figure 2**) and 132 local councils. Each council is divided into 4–5 divisions, which in turn are composed of 3–4 wards. Approximately 5–7 villages form a ward; each village is subdivided into hamlets (3–6 per village). There are approximately 10,496 villages and 9,362,758 households, with an average of 4.8 people per household in Mainland Tanzania. The country has an estimated population of 43.6 million (Tanzania National Bureau of Statistics 2012 census estimate), with an annual growth rate of 2.7%. Seventy-six percent of the population lives in rural communities. Twenty percent of the population is made up of children under five years of age (U5), 27% is 5–15 years old, and 20% of the population of women is of reproductive age (between 15 and 49 years of age).

**Figure 2. Map of Tanzania showing regional boundaries, 2013**



### ***Regions in the Lake Zone Area of Mainland Tanzania***

The Lake Zone area has a total population of 10,298,049. It is made up of five regions around Lake Victoria, with respective resident populations shown in parentheses—Kagera (2,458,023); Mwanza (2,772,509); Mara (1,743,830); Geita (1,739,530); and Simiyu (1,584,157).

In the Lake Zone area, two new regions were recently established, Simiyu and Geita, with a consequent redistribution of the administrative districts, surface area, and population. In this report, we use the administrative designations prior to this new rearrangement, made up of three regions along with their respective district. These regions are Kagera (Biharamulo, Bukoba DC, Chato, Karagwe, Missenyi, Muleba, and Ngara districts), Mara (Bunda, Musoma Rural, Rorya, Serengeti, and Tarime districts), and Mwanza (Geita, Kwimba, Missungwi, Magu, Sengerema, and Ukerewe). See **Figure 3** for a map of IRS districts in the Lake Zone.

The new geographic demarcations led to a slight reorganization of indoor residual spraying (IRS) advocacy meetings. Additional advocacy meetings for the newly formed region of Geita (including both areas of Geita rural and urban) and the new district of Busega, which contains a few villages that were previously in Magu District (which is now located in Simiyu Region) were conducted. Through these meetings, relevant authorities were informed about IRS in their areas of jurisdiction and their roles in supporting IRS.

**Figure 3. IRS Districts in the Lake Zone**



### **Malaria Transmission in Zanzibar**

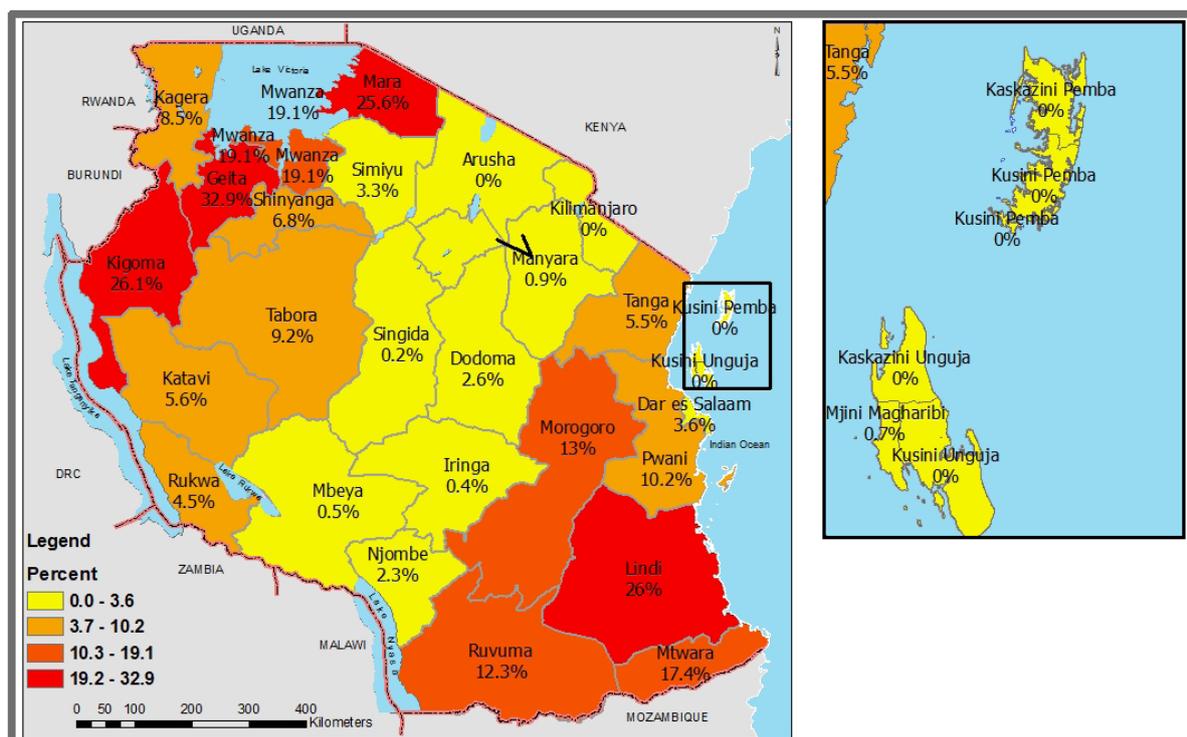
Malaria transmission in Zanzibar recorded in the recent national population-based survey data, using malaria rapid diagnostic tests (mRDTs), estimated malaria parasite prevalence among children aged 6–59 months tested at 0% in Pemba and Unguja.

### **Malaria Transmission in Mainland Tanzania**

Malaria transmission in Mainland Tanzania is highly variable, depending on geographic, climatic, and human settings. The most recent national population-based survey data (Tanzania HIV/AIDS and Malaria Indicator Survey [THMIS] 2011–12 of March 2013) show that 9% of children aged 6–59 months tested positive (using mRDTs) for malaria in Mainland Tanzania, in contrast to only 0% in each of the two islands of Pemba and Unguja in Zanzibar (see **Figure 4**). The data show marked regional variations, ranging from 0.9% in Arusha to 32.9% in Geita Region among U5 children in Mainland Tanzania. The Tanzania Vector Control Scale-up Project's (TVCSPP's) IRS target regions are among those with high malaria prevalence, with Mara estimated at 25.6%, Mwanza at 19.1%, and Kagera at 8.5%.

The THMIS 2011–12 shows that the intense, perennial malaria transmission is typical in the Lake Zone (upper northwest) and coastal belt (east and south), with a prevalence of more than 30% down to 8%, respectively. There is seasonal malaria transmission, with a prevalence between 0.2% and 2.6% in the Central Plateau. The low or mild seasonal transmission (shorter than three months per year) pattern is typical for the Southern and Northern Highlands, with a prevalence of lower than 0.4%. Dar es Salaam City has exceptionally low malaria transmission. In Mainland Tanzania, rural areas have a higher prevalence (11%) compared to urban areas (3%).

**Figure 4. Tanzania malaria prevalence in U5 children**



Source: THMIS 2011-12, published in March 2013.

## Section B: Zanzibar

### III. IRS in the Context of Malaria Strategies in Zanzibar

#### Malaria Medium-Term Strategic Plan for Zanzibar

The medium-term goal of the current Zanzibar Medium-Term Strategic Plan (2008–2013) is to assess the potentialities for malaria elimination and to reduce malaria-related morbidity and mortality in Zanzibar’s population to a level that the disease no longer poses a public health threat, especially among most vulnerable groups, such as U5 children, pregnant women, and the poor. The Zanzibar medium-term targets, which follow, are similar to those for Mainland Tanzania:

- 80% of malaria patients diagnosed and treated with effective antimalarial medicines, such as artemisinin-based combination therapy (ACT), within 24 hours of the onset of fever;
- 80% of all pregnant women receive two or more doses of intermittent preventive treatment (IPTp);
- 80% of people in malarious areas protected through the use of insecticide-treated nets (ITNs);
- 80% of people in target areas protected through IRS; and

- Early detection and containment of 80% of malaria epidemics within two weeks from onset.

However, Zanzibar has three additional targets for effective malaria epidemic preparedness and response:

- 100% of health facilities' weekly reports are submitted on time in order to detect any abnormal rise in malaria cases early on;
- Investigation of reported epidemics is initiated within 24 hours; and
- Medical supplies are at hand to mount a response, if necessary, within two weeks from the notification of the outbreak

Furthermore, the strategic plan includes a target to assess the potential for sustainable elimination of malaria from Zanzibar, using newly available data from surveillance and operational research, as well as experience from implementation of previous IRS rounds.

### **Recent History of IRS in Zanzibar**

The U.S. President's Malaria Initiative (PMI) has supported Zanzibar Malaria Control Programme (ZMCP) with its IRS program since 2006, contributing to the substantial drop in malaria transmission. Between June 2006 and June 2012, RTI International, in collaboration with ZMCP, conducted IRS in Zanzibar for six blanket rounds (see *Table 1*), two reactive focal spray initiatives (2008 in Bumbwini and 2011 in Tumbe), and one targeted spray round in select areas of nine districts of Zanzibar in 2012. About 200,000 structures were sprayed per blanket round, protecting almost 1.2 million people. The spray coverage was consistently over 90%. In 2013, RTI and ZMCP conducted another targeted round and a focal IRS in select areas of Zanzibar, as highlighted in *Table 1*. All spray rounds between 2006 and 2011 were done using pyrethroid insecticides. In the 2012 and 2013 targeted IRS campaigns, bendiocarb was introduced. This massive effort, together with other interventions, has contributed significantly to reducing malaria prevalence to less than 1% (see *Figure 4*) and advancing Zanzibar to a pre-elimination phase.

**Table 1. Spray performance in Zanzibar (structures sprayed), 2006–2013**

	Round 1	Round 2	Round 3	Focal Spray	Round 4	Round 5	Round 6	Focal Spray	Targeted Spray	Targeted Spray	Targeted Spray	Focal Spray
Location	2006	2007	2007	2008	2008	2010	2011	2011	2012	2012	2013	2013
<b>Unguja</b>												
Central	15,167 (92%)	15,258 (89%)	15,737 (95%)	—	13,897 (94%)	15,046 (89%)	14,883 (94%)	—	15,392 (93%)	4,536 (92%)	10,171 (95%)	—
North A	21,729 (98%)	21,575 (96%)	22,961 (100%)	—	22,097 (97%)	18,595 (88%)	21,524 (100%)	—	18,274 (93%)	—	3,102 (94%)	—
North B	11,829 (95%)	10,819 (93%)	11,737 (95%)	4,797	10,562 (93%)	10,397 (89%)	11,480 (97%)	—	11,294 (99%)	2,653 (95%)	8,288 (95%)	—
South	8,036 (99%)	8,871 (100%)	9,167 (99%)	—	9,417 (100%)	8,604 (88%)	8,472 (94%)	—	5,644 (93%)	1,840 (90%)	—	—
Urban	25,670 (92%)	23,764 (79%)	25,828 (88%)	—	27,464 (97%)	22,355 (78%)	23,127 (86.7%)	—	—	—	—	—
West	41,182 (92%)	37,370 (81%)	47,739 (98%)	—	43,053 (84%)	40,202 (88%)	40,422 (94.9%)	—	24,463 (90%)	3,065 (92%)	4,702 (96%)	—
<b>Pemba</b>												
Chakechake	16,211 (99%)	16,829 (100%)	16,637 (99%)	—	16,437 (96%)	16,280 (88%)	16,866 (94%)	—	8,682 (98%)	2,461 (93%)	1,406 (95%)	—
Micheweni	21,015 (100%)	20,824 (100%)	20,920 (100%)	—	18,164 (97%)	16,811 (87%)	20,305 (96%)	2,003	12,744 (98%)	7,230 (99%)	12,157 (99%)	501

	Round 1	Round 2	Round 3	Focal Spray	Round 4	Round 5	Round 6	Focal Spray	Targeted Spray	Targeted Spray	Targeted Spray	Focal Spray
Location	2006	2007	2007	2008	2008	2010	2011	2011	2012	2012	2013	2013
<b>Unguja</b>												
Mkoani	19,804 (100%)	20,067 (100%)	19,560 (98%)	—	18,653 (98%)	18,224 (98%)	18,267 (100%)	—	10,047 (100%)	1,497 (95%)	2,506 (99%)	—
Wete	21,376 (100%)	21,596 (100%)	22,371 (99%)	—	20,987 (98%)	19,532 (90%)	19,462 (93%)	—	8,318 (98%)	2,988 (98%)	7,308 (96%)	—
<b>Total</b>	<b>202,019 (96%)</b>	<b>196,973 (91%)</b>	<b>212,657 (97%)</b>	<b>4,797</b>	<b>200,731 (94%)</b>	<b>186,046 (88%)</b>	<b>194,808 (95%)</b>	<b>—</b>	<b>114,858 (95%)</b>	<b>26,270 (95%)</b>	<b>49,640 (96%)</b>	<b>501</b>

## IRS Strategic Design for Zanzibar

### Zanzibar

After completing the sixth round of blanket spraying in Zanzibar in 2011, the islands reached a stage where only targeted IRS application is used. The IRS strategic design is now linked and integrated with the following initiatives: (1) implementation of targeted IRS to complement the universal coverage of long-lasting insecticide-treated nets (LLINs); (2) implementation of focal spraying as a response to abnormal increases in malaria cases; (3) implementation of an aggressive behavior change communication (BCC) campaign that will promote the continuous use of LLINs; (4) consolidation and improvement of the malaria surveillance system, including active malaria case detection; and (5) effective use of entomological monitoring as part of surveillance (see *Table 2*).

**Table 2. Strategic design for IRS implementation in Zanzibar**

Spray phase	2006– 2007	2007– 2008	2008– 2009	2009– 2010	2010– 2011	2011– 2012	2012– 2013	2013– 2014	2014– 2015
Blanket	Yellow								
Targeted						Orange			
Focal								Red	

### Selection of Eligible Spray Areas

Over the past two years (2010–2011), a strong foundation was established for scaling up malaria surveillance, adopting a revised insecticide mitigation plan, and instituting multiple control interventions, such as LLIN universal coverage and larval source management (LSM), thereby enabling Zanzibar to shift its IRS strategy from blanket to targeted spraying.

Similar to 2012, the selection process for targeted spraying was deliberated by ZMCP and partners, who examined a number of criteria (including operational, epidemiological, entomological, and socioeconomic, as shown in *Box 1*). They subsequently selected specific criteria selected based on evidence to determine high- and low-risk areas from which eligibility could be obtained.

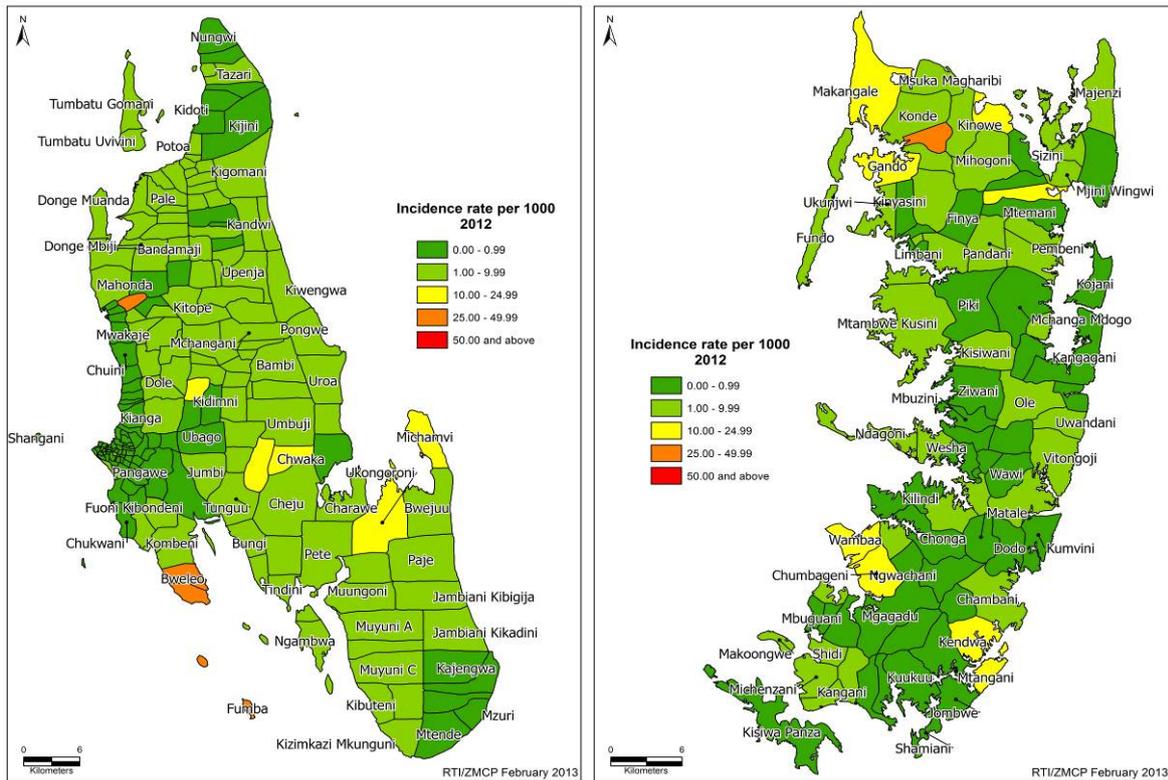
## Box 1. Criteria for selecting targeted areas in Zanzibar

- ◆ Operational: This criterion considers the established number of structures that ZMCP will be targeting for IRS. According to the PMI 2012 Malaria Operational Plan (MOP), funding was provided for focal spraying of 50,000 structures out of the eligible 220,000 in Zanzibar. The implication is that approximately 168,000 structures (78% of the population) will be excluded.
- ◆ Socio-demographic indicators: This indicator considers the type of housing and population density.
- ◆ Malaria transmission risk: Factors that can induce higher (or lower) transmission patterns—such as precipitation levels, house characteristics (specifically type of wall surfaces), as well as urban or rural settings—should be considered for inclusion or exclusion of IRS.
- ◆ Epidemiological factors: According to retrospective reference data, such as the malaria early epidemic detection system (MEEDS), malaria epidemiology is highly seasonal, peaking after the rainy periods, with inter-peak caseload lower than what it was in 2008 and before. Stratification of cases shows they come from a specific location in certain districts, which can be targeted for IRS.
- ◆ Costs: This criterion overlaps with operational costs, whereby the cost of the currently used carbamate pesticide (US\$12) is four times the price of previously used lambda-cyhalothrin. However, this should not be a major concern, given that other operational costs are optimized through experience and improved efficiency.
- ◆ Malaria control coverage: This criterion considers other control interventions (specifically LLIN coverage and LSM) that can be compared across districts and other areas to prioritize IRS in places where exposure to multiple interventions is low.
- ◆ Insecticide selection and duration: This criterion considers the period of residual effect on treated walls for the currently used insecticide (carbamate) and its relation to the frequency of spray rounds to optimize the duration of effectiveness in sprayed areas.
- ◆ Entomological factors: This criterion has a number of key parameters (such as vector density in urban versus rural areas) that can be useful in decision making for target spraying. Unfortunately, lack of timely data limits the use of this criterion.
- ◆ Insecticide resistance: By rotating a different class of insecticide and spraying across the regions, it is possible to reduce mutations in mosquitoes and counter resistance. This criterion can be specifically applied to areas where there is resistance to pyrethroid and are considered for IRS.
- ◆ BCC: This criterion is important to consider, because it has implications on the population excluded from IRS. A BCC strategy must be developed in a well-defined, properly understood manner to address concerns or questions of the public within and outside the target area for spraying

Using the weekly aggregated cases from health facilities, an extensive analysis was done by stratifying the malaria morbidity at defined catchment areas comprising *shehias* for each allocated health facility. This approach gives a more specific variance of morbidity, thereby giving a more precise result in decision making when considering eligible targeted areas.

Malaria morbidity for Unguja (see **Figure 5, left**) illustrates the variance in different areas in and within the districts. Malaria morbidity for Pemba also illustrates varying morbidity at the defined catchment areas in the four districts (see **Figure 5, right**).

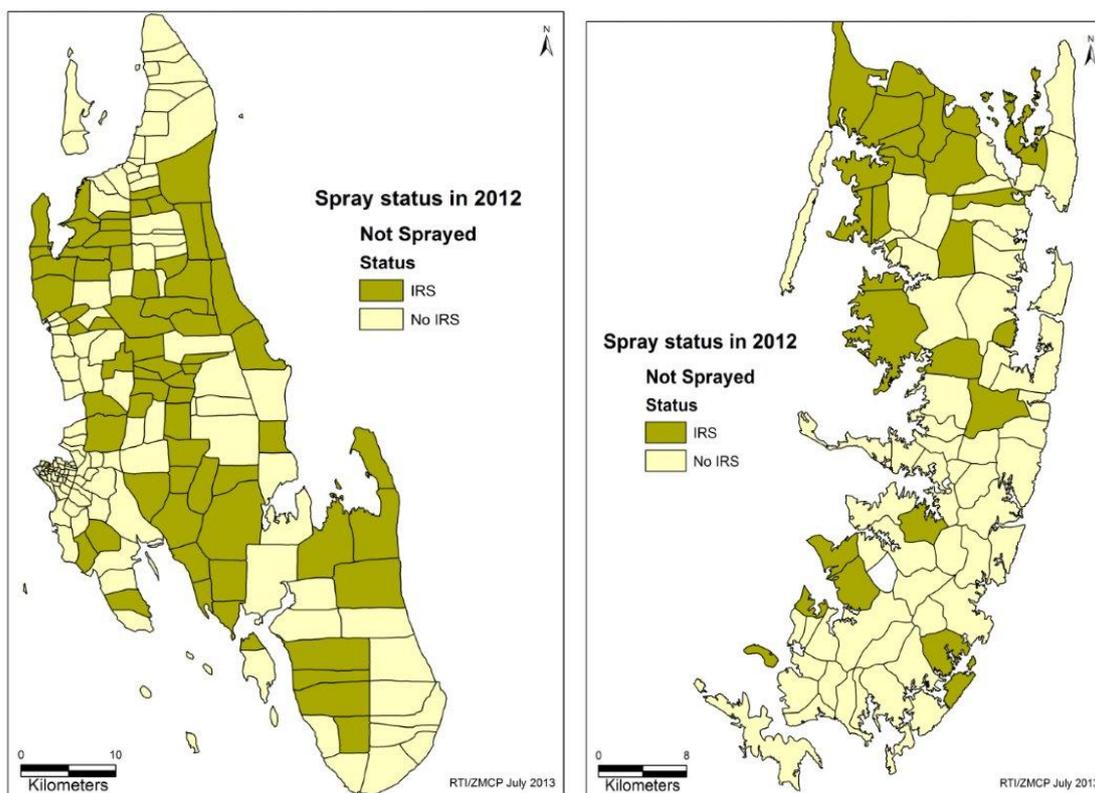
**Figure 5. Malaria morbidity for Unguja and Pemba Islands, 2011 MEEDS**



Using the annual morbidity rate of 1,000 persons for each of the allocated health facility catchment area, around 50,000 houses were selected to be sprayed in a single round of IRS (rate >2 per 1000 population)

Areas that received IRS and those that were excluded are illustrated in **Figure 6**.

**Figure 6. *Shehias* targeted for one round in 2013 spray season, Unguja and Pemba**



## IV. 2012–2013 IRS Preliminary Activities

### Assessing the Environment and Planning Mitigation Options for the Safer Use of Pesticides

#### *Environmental Assessment*

RTI, in collaboration with ZMCP, prepared and sent to USAID a justification letter report (see *Annex K*) to inform them of the status of environmental management in IRS, as stipulated in Tanzania Supplemental Environmental Assessment (SEA) of 2010, and in compliance with the U.S. regulation 22 CFR 216. The letter included the environmental risk mitigation actions undertaken by TVCSP and the rationale for shifting from one class of insecticide to another, according to the insecticide rotation management to mitigate the insurgence of resistance. After USAID approved the letter, RTI started the procurement process for bendiocarb insecticide for the upcoming IRS round. In order to comply with Programmatic Environmental Assessment (PEA) requirements, RTI—in collaboration with ZMCP—sought an insecticide importation permit from the Zanzibar Food, Drugs and Cosmetics Board in December 2012.

### ***Insecticide Management and Environmental Mitigation Plan***

TVCSPP prepared environmental mitigation guidelines and standard operating procedures (SOPs) for spray operators and pump technicians, including on use of triple-rinsing for pump cleaning at the end of the spray day, inspection of pumps for leakage and their general maintenance, as well as disposal of washouts and solid waste. Before the start of operations, all spray teams were trained on all aspects of environmental compliance. During operations, spray teams were supervised to maintain protection and safety measures for themselves and for residents, as well as emergency preparedness in case of insecticide adverse reactions and accidental exposure to insecticide.

In addition, to manage insecticide stocks, a control system was instituted that included bin cards, ledgers, issue vouchers, and daily/weekly trackers. Measures for strictly tracking the movement of insecticide sachets from the temporary storage facilities to the spray teams were meant to prevent pilferage and potential misuse, to promote safer use of insecticide, and to protect the environment and human health. At the end of every spray day, empty sachets were returned by spray operators and counted. All observed discrepancies were reported and investigated. SOPs guided the disposal of solid waste, including empty sachets, according to best management practices.

Pregnancy tests were given to all female IRS staff before spray operations began, and medical attendance forms were available for monitoring undesirable and adverse reactions to insecticides for all IRS staff.

## **Selection and Management of Insecticide for IRS**

### ***Insecticide Resistance in Zanzibar***

In 2010, malaria vector resistance to pyrethroids was reported in Pemba for the first time. Since the reintroduction of IRS in Zanzibar in 2006, the program has relied entirely on the use of a pyrethroid. This is the same class of insecticide used to treat LLINs. The continuous use of the same class of insecticide for IRS and LLIN, as well as for agriculture, has been associated with the evolution of resistance.

### ***Insecticide Resistance Mitigation Plan***

To mitigate vector resistance to pyrethroid insecticide, RTI, in collaboration with ZMCP, hired a consultant to develop an insecticide resistance mitigation plan. In addition, an expert consultative meeting was convened in August 2011 to deliberate (1) the process of formulating an insecticide resistance mitigation plan and (2) immediate interim measures to mitigate resistance pressure in the country. The meeting attendees recommended that ZMCP and the Mainland Tanzania National Malaria Control Programme (NMCP) consider replacing a pyrethroid with a carbamate for IRS in a rotational strategy for at least two years until new formulations become available. Carbamate was recommended to be introduced immediately in the areas where pyrethroids were used for several years in Zanzibar. The panel also recommended the intensification of monitoring insecticide susceptibility in the areas where IRS is conducted.

In July 2012, NMCP, ZMCP, RTI and the World Health Organization (WHO) met to explore a comprehensive plan for resistance mitigation in Tanzania. A one-week workshop was convened in Zanzibar, drawing local experts from diverse institutes (e.g., research and academic institutions, as well as NMCP, ZMCP, and WHO). Among other conclusions, the workshop recommended the adoption of an interim plan for insecticide resistance mitigation while the comprehensive plan is finalized. The idea was presented and approved by various partners, including NMCP, ZNMCP, RTI, and USAID. The long-term insecticide resistance mitigation plan is awaiting ratification and is expected to be completed in 2013.

### ***Selection of Appropriate Insecticide***

Selection of an IRS insecticide for a public health intervention is usually based on (1) approval by the World Health Organization Pesticide Evaluation Scheme (WHOPES); (2) approval by Zanzibar Food, Drugs and Cosmetics Board; (3) availability of a good profile on vector susceptibility in Zanzibar; and (4) expected longer residual duration compared to decreases in the frequency of spraying and reductions in cost.

RTI—in collaboration with ZMCP—selected bendiocarb (FICAM® wettable powder [WP]), an insecticide of the carbamate class, for the applications in Zanzibar

### ***Assessing IRS Logistics***

In Zanzibar, this activity was conducted in collaboration with ZMCP and district authorities in February 2013. The reassessment involved collecting updated information to facilitate the planning, designing, budgeting, implementation, and monitoring and evaluation (M&E) of IRS operations (see **Box 2**). An RTI Environmental Compliance Officer visited all IRS operational sites and temporary district storage facilities to determine the needs for repairs and refurbishment.

## Box 2. **Activities included in comprehensive logistics assessment**

### **Data collected by logistics reassessment teams**

- ◆ Updated demographic statistics
- ◆ Changes in administrative setup
- ◆ Updated meteorological indicators
- ◆ Updated epidemiological malaria data
- ◆ Estimate of average sprayable surface for insecticide quantification

### **Tasks performed by logistics reassessment teams**

- ◆ Selection of target areas suitable for IRS implementation, according to strategic option (blanket or targeted spraying)
- ◆ Identification of new main regional warehouse
- ◆ Identification of refurbishment needs for IRS sites
- ◆ Redefinition of catchment areas and population for the respective IRS substations
- ◆ Calculation of total insecticide required per district and substation
- ◆ Quantification of human resources requirements per district and substation
- ◆ Realignment of the operational organogram
- ◆ Quantification of consumables and replacement/repair of spraying equipment and personal protective equipment (PPE)
- ◆ Setup of stakeholder teams, technical committees, and operations teams (e.g., logistics, advocacy and health education, vector control, M&E)
- ◆ Meetings with relevant partners/stakeholders; definition of roles and responsibilities
- ◆ Definition of a preliminary time frame for activities
- ◆ Tentative budget for the operation

Important considerations for the application of residual insecticides included the number of structures to be sprayed, as well as their type, location, number of eligible sprayable surfaces of different substrates, and accessibility.

## **Selecting the Ideal Spray Period and Preparing the Operations Plan**

### ***Rationale for Selection of Spray Period in Zanzibar***

Malaria cases in Zanzibar tend to occur at higher rates between May and August. This is a result of higher-than-average precipitation, resulting from seasonal rainfall between early April and late May. As such, ZMCP and TVCSP decided to start IRS by mid-March to enable the insecticide residual effect to cover this period, thereby reducing transmission and eventually the number of cases than anticipated.

### ***Spray Season***

In Zanzibar, RTI, in collaboration with ZMCP, conducted the eighth round of IRS (second targeted round) in 9 out of 10 districts. The spray period was selected based on the same logistical and entomological rationale described above and timed for a minimal overlap with the previous round of implementation in order to optimize the

use of insecticide. Unlike 2012, only one spray round was conducted in all eligible areas to cover the May–August peak transmission period. It is hoped that the second spray round, scheduled for September–October 2013, will be conducted using a different class of insecticide as part of mitigating resistance to insecticide in the island. **Table 3** shows the regional targets for 2013 IRS.

**Table 3. Zanzibar regional targets**

Region/Zone	Unguja	Pemba	Zanzibar
Eligible household	30,087	23,868	53,955
Eligible population	122,338	127,265	249,603
# Sites	6	4	10
# Wards ( <i>shehia</i> )	72	36	108
Ward ( <i>shehia</i> ) per site	12	3	11
Village/site	N/A	N/A	N/A
# Districts	5	4	9

### Establish District IRS Management

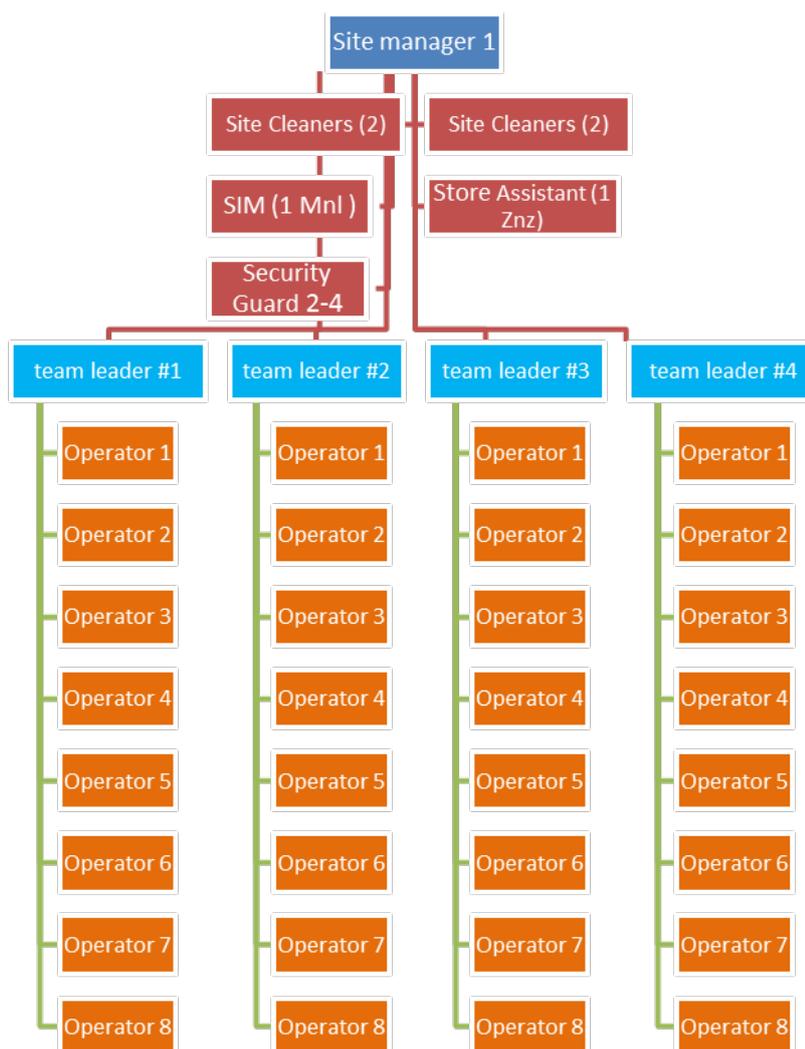
In Zanzibar, the functional IRS management and implementation units make up the District IRS Technical Team (DITT). The DITT is located at the zonal level in the two ZMCP offices in Zanzibar, in Unguja and in Wete, in Pemba. The DITT is chaired by the District Medical Officer (DMO) with support from Zonal Medical Officer. Members include the District Health Officer, District Administrative Secretary, and four more district technical staff. RTI supported the DITT through initial training in IRS implementation and by allocating supervisors and consultants during IRS operations for further on-the-job training team and mentoring.

Implementation teams (sub-units) for advocacy and health education, vector control, and M&E met daily during the IRS operations, while the DITT was scheduled to meet weekly.

### Developing and Organizing the IRS Sites: Design and Phases

RTI continued to maintain an IRS delivery model initiated in 2006. This model involves extensive use of human resources and deployment logistics. The program requires a high degree of organization and capacity (see **Figure 7**).

**Figure 7. IRS teams organizational structure**



The general TVCSP IRS design is based on the operation site. Each site has an operation target, ranging from 5,000 to 10,000 houses. The operation site receives adequate infrastructure for effluent waste disposal, sanitary accommodations for operators, and storage facilities. The operation site effort is led by a site manager supported by an average of four spray teams (ranging 2–8 persons per team) and 4–8 site attendants, depending on the size of the site. Time of operation per site, number of operation days, and allocated resources (e.g., human resources, insecticide, equipment, and consumables) are calculated based on targets. The TVCSP decided to select an average duration of operation of about 11 days per site.

There are seven operators per team in Zanzibar, with an average of 54 spray operators per site. Each team is headed by a team leader. The team leaders and spray operators are selected from the targeted communities. The operation site manager is assisted by support staff who maintain spray equipment, wash suits, clean the site, fetch water, and handle security. A level of effort of 10 sprayed houses per operator per day is used to develop the spray schedule and to monitor progress. An average of 30 liters of

water per each operator per day was calculated. Water for charging spray pumps was provided by households as operators moved from one house to the other.

The 2012–2013 IRS season covered a total of 10 operation sites in Zanzibar (one site per district and one site for the targeted Uzi satellite islands). All sites were refurbished/renovated before the start of the operations to comply with international and local environmental impact and mitigation measures for safe pesticide use, storage, and sound effluent waste disposal. The sites therefore complied with the Pesticide Storage and Stock Control/User Guidelines of WHO and the United Nations Food and Agriculture Organization (FAO).

### **Insecticide Quantification, Procurement, Safe Transport, and Storage**

The TVCSP technical team, in collaboration with the ZMCP, quantified the required bendiocarb insecticide during the logistical assessment after establishing the sizes and numbers of structures to be sprayed. The calculations were based on the dosage range 0.1–0.4 g active ingredient/m<sup>2</sup> for bendiocarb WP. All insecticides, PPE, and other equipment were procured according to USAID and RTI policy. Insecticide samples received from the supplier were sent to Tropical Pesticide Research Institute (TPRI) and Zanzibar Food, Drugs and Cosmetics Board-designated reference laboratories to be analyzed for quality. Results from the analysis indicated a sufficient active potency level of the active ingredient for bendiocarb.

Insecticides and other IRS supplies were stored at the main warehouse in Zanzibar and distributed, as needed, to district sites when IRS was conducted.

### **Handling Equipment, Materials, and Vehicles**

The central RTI IRS unit provided quantification and procurement of insecticide, IRS equipment, PPE, and consumables. The quantification included the reconciliation of available supplies in the warehouses, replacement requirements, and coverage of new areas.

The RTI IRS unit also quantified vehicles for operator transport for each district and site. A total of 55 vehicles and 1 boat were needed to transport operators from IRS operational sites to targeted villages and to the islands of Zanzibar. All vehicles were inspected and certified by competent road and marine authorities. All vehicle drivers and boat captains were instructed on environmental mitigation measures during and after the end of spray operations.

### **Managing Human Resources for IRS**

Active IRS operations require a large number of temporary operational IRS field staff and other technical, coordination, mobilization and supervisory support staff. RTI, in collaboration with district authorities, recruited 866 temporary staff that were directly involved in the implementation of IRS in Zanzibar (see *Table 4* and *Annex B*). The selection process was led by local government authorities and supervised by the delegated DITT and RTI personnel (see *Box 3* for the selection criteria). Broad and equal opportunity representation from targeted communities was sought.

**Table 4. Temporary staff recruited to support IRS operations**

	Unguja	Pemba	Zanzibar
Spray operators	315	294	<b>609</b>
Tem leaders	45	42	<b>87</b>
Site managers	6	4	<b>10</b>
Drivers	49	42	<b>91</b>
Pump technicians	12	12	<b>24</b>
Cleaners	5	4	<b>9</b>
Suit washers	13	12	<b>25</b>
Watchmen	10	8	<b>18</b>
Water fetchers	12	8	<b>20</b>
Storekeepers	5	4	<b>9</b>
Assistant storekeepers	6	5	<b>11</b>
Total IRS staff	<b>478</b>	<b>435</b>	<b>913</b>

**Box 3. Criteria for IRS operators' selection**

- ◆ Age: 18–40 years
- ◆ Gender: Either (50% or more women)
- ◆ Education: Standard 7 and above and efficient in reading and writing Kiswahili
- ◆ Possession of a valid National Microfinance Bank (NMB) personal account
- ◆ Acceptance in the community
- ◆ Good enough health to carry pumps and walk long distances and negative pregnancy test results among women
- ◆ Physical and mental fitness
- ◆ Residence in the service area
- ◆ Possession of M-Pesa account with Vodacom mobile network

Mechanisms were set up to guarantee a transparent and fair process. However, even though gender balance was set as a selection criterion, only around 18% of the temporary laborers selected by the community were female.

The selected staff provided personal details, a photograph, medical certificate of good health, and bank account details. The RTI finance team transferred compensation for temporary staff to their personal bank accounts at regular intervals of two weeks.

The respective RTI offices filed all documents and provided an identity card. The selected individuals also signed a consent form. All staff were subjected to medical and physical examination. In addition, all female operators were tested for pregnancy prior to enrollment. Those found medically unfit and females who tested positive for pregnancy were excluded for medical safety reasons.

## **Staff Training**

### ***Training Modalities***

Before IRS operations in Zanzibar, training was conducted for all cadres involved in the operation using the cascade mode. Through this approach, training of trainers (ToTs) were conducted first and then ToTs went to train the lower cadres. This training took place between January and March 2013.

### ***Types of Training***

ToT as well as training for spray operators, store keepers, site managers, and training for clinicians on insecticide poisoning management were conducted prior to IRS operations.

### ***Training Tools***

The staff trainings were performed using IRS modules developed by RTI in collaboration with ZMCP and FAO/WHO guidelines on insecticide storage and management.

## **Informing and Mobilizing Communities**

### ***Implementation of Information, Education, and Communication Activities (IEC): IEC Design in 2012–2013 Spray Season***

IEC is an essential component for successful delivery of IRS at the community level. The ultimate purpose of this component is to inform and mobilize all residents in IRS-eligible areas to ensure their active participation in IRS activities and to increase the level of acceptance. In previous IRS rounds, interpersonal communication was used effectively to convey messages and information to the communities. The component also targets various stakeholders, including government leaders at regional, district, *shehia*, village, and hamlet levels.

During the 2012–2013 campaign, a cascade of events were initiated to reach every single household. The main actors of the IEC component were identified as the *shehas*, 4 *shehia* mobilizers, and a local councilor. The program approached these community leaders in a systematic way, facilitated by local government authorities to whom they were responsible.

### ***Organization of Interpersonal Communication in Zanzibar***

In Zanzibar, district authorities organized and supervised IEC. Three categories of mobilizers were identified at national, district, and *shehia* levels. A total of 34 district mobilizers were trained and responsible for supervising the respective *shehia*'s

mobilizers. Each *shehia* in the IRS eligible areas recruited five mobilizers to inform communities about IRS through house-to-house visits. At the national level, an IEC campaign was supervised by four health educators, two in Pemba and two in Unguja. Their role was to coordinate central (ZMCP) and district IEC activities. Apart from the house-to-house approach, the IEC campaign included audio programs, using radio and community announcements, that were broadcast through megaphones. Over 214,691 people (102,976 in Pemba and 111,715 in Unguja) were reached through such IEC efforts, of which 105,450 (49%) were males, and the remaining 109,241 (51%) were females. The spray schedule was planned in advance, in collaboration with *shehia* leaders, and shared with mobilizers at all levels.

### ***Other IEC Supportive Activities***

For IRS, interpersonal communication is the primary vehicle for communication in IEC. Interpersonal communication is supplemented with other routes of message delivery, including fact sheets, TV spots, radio spots, and mass meetings.

### ***Printed IEC Materials***

Approximately 150,000 fact sheets were distributed, targeting different groups who either used the materials: (1) for reference while educating others; or (2) to get more clarity on and reinforce messages previously communicated from other sources. Also, banners were provided for display at each of the 10 IRS operational sites

## **Monitoring the IRS Process**

### ***Monitoring of Training Activities***

Before implementation of IRS, field trainings were conducted for various cadres in Zanzibar. The M&E unit at ZMCP was primarily responsible for tracking the number of people trained in different capacities in each of their respective districts. Training tools, such as enrollment sheets and summary sheets, were utilized with the help of the facilitators at every training. Trainees recorded their names and signatures on a sign-in form, and the number of participants were aggregated at the end of training sessions. M&E officers summarized the training outcomes, including the number of participants by gender, in pre-designed electronic MS Excel templates, which captured the number of trainees in each district by gender and cadre.

## **V. Implementation of IRS Activities**

### **Quality Control of Spray**

A major challenge to conducting a successful IRS program is ensuring an acceptable quality of spray and that a large number of spray operators adhere to SOPs and best practices in their spray technique. Quality control of spraying is an integral part of IRS implementation. Quality control was maintained by conducting appropriate training supported by multilevel supervision of spray personnel.

The key personnel implementing quality control on the ground were the district supervisors (or the District Vector Control Officers [DVCO]), site managers, and team leaders, who are the immediate supervisors of the spray operators. During the 2012–2013 spray seasons, a number of innovations, which follow below, were introduced to facilitate their duties:

- Rigorous selection process to identify qualified candidates for the role of team leaders;
- Comprehensive training of team leaders;
- Development of an original protocol for daily operators' follow up on quality of spraying during operations;
- Introduction of quality assessment tools with a score system;
- Empowerment of site managers to adopt disciplinary action in case of deviation from SOPs; and
- Introduction of segregation of duties for vector control officers to alleviate them from other management duties and enable them to be dedicated to quality control.

DVCOs were tasked to perform full-time field supervision of team leaders and spray operators. Each team leader was tasked with intensively supervising four spray operators per day. The team leader assessed the operators and awarded performance scores. At the end of the day, he/she completed the summary form with recommendations on corrective measures.

Daily feedback to all operators was provided in the morning by site managers and team leaders after compiling the previous day's reports.

Feedback concerning spray supervision was provided in the following areas:

- Compliance with use of PPE;
- Compliance with preparations of the household and general environmental protection prior to spraying;
- Compliance with spray techniques (insecticide dilution, pump pressure, speed of movement, distance from the wall, and overlapping);
- Coverage of eligible sprayable surfaces (e.g., rooms, corridors and ceiling);
- Uniformity of insecticide concentration at all levels of spray surfaces (e.g., upper, middle, and lower);
- Coverage of households targeted in the hamlet and in the village;
- Documentation of the correct information/education messages delivered to members of the sprayed households;
- Appropriate recording of all indicators monitored; and
- Good customer-service practices.

The newly developed system provided an action-oriented approach at IRS operational levels. Each site could evaluate each day's performance and could take action on the

eventual gaps found. The district was able to access IRS quality reports through the VCO at weekly meetings.

### **Monitoring Performances of Spray Teams and Use of Insecticide**

The daily performance and output of every spray operator, team leader, and supervisor was tracked daily using data sheets (e.g., daily spray cards, team leader, and supervisor cards).

The data sheets reflected the number of structures sprayed per sachet of insecticide used. Through this method, the monitoring teams were able to detect operational problems. Recommendations were put in place immediately, as needed, to support the spray operations and to improve the quality of data on the IRS project.

The insecticide used was monitored by store keepers at the site store at district, regional, and zonal levels, with close collaboration from the environmental officers. The insecticides used were tracked using insecticide control books and forms. Other IRS supplies and equipment were tracked using books, such as store ledgers.

### **Environmental Monitoring and Mitigation Activities**

During IRS operations in Zanzibar, pre- and mid-spray environmental compliance inspections were conducted by the RTI Environmental Team in the respective districts. A total of three inspections were conducted at different stages of the operations. First round pre-environmental compliance inspections in Zanzibar were conducted in January 2013. Mid-spray compliance inspections for Zanzibar were conducted in March 2013 (see *Annex K* for environmental compliance reports).

### **Monitoring and Evaluation**

With IRS ongoing concurrently at several sites in multiple districts, systematic monitoring was established to follow up on the inputs, processes, and outputs (see *Box 4*).

The RTI M&E unit in conjunction with the SME unit at ZMCP was constantly involved in the collection and utilization of data before, during, and after spray operations. Relevant indicators were utilized to monitor performances, measure results, and ultimately maintain and/or improve the management of IRS. Daily monitoring was established during operations to ensure that processes and outcomes were tracked, allowing timely detection of gaps and constraints in order to trigger adequate responses, accordingly.

#### **Box 4. Monitoring inputs, process, and outputs**

##### **Inputs**

- ◆ Inputs—such as quantification of materials, PPE, and insecticide for procurement—as well as fuel consumption of vehicles—were tracked mainly before the start of IRS.

##### **Processes**

- ◆ The RTI M&E unit monitored spray performances, along with other indicators related to sensitizing communities before IRS despite being the most demanding component of the monitoring process. The training process for IRS staff was also monitored.

##### **Outputs**

- ◆ Output indicators—such as spray management, safety procedures used by operators, and house structures visited and sprayed—were also tracked consistently.

ZMCP and RTI supervised operations and facilitated the collation and collection of IRS data in the field. During spray campaigns, operators interviewed respondents of visited households and collected the required information on Spray Operator Forms. These were then aggregated by the team leaders in their respective Team Leader Forms. Eventually, the site manager followed the same process of aggregating the team leaders' entries on specially designed Site Manager Forms.

At the end of each operation day, completed hard copies of spray forms were then delivered to the central data unit in ZMCP offices in Pemba and Unguja. These forms were sorted, filed, and then entered electronically in the IRS templates. The data entry team entered the Site Manager Spray Forms and the Team Leader Spray Forms into separate electronic IRS database templates.

These electronic templates generated reports on key spray performance indicators on a daily basis, which were used for interpretation and action by the IRS technical team, along with the district teams.

The technical team monitored the daily performances up to the site level in IRS districts. Among the numerous information collected, the number of structures sprayed (and not sprayed) was assessed against the daily target. The number of structures sprayed per day was also captured. Insecticide consumption and stock for each day was also captured and monitored. Feedback on performances was periodically relayed to site managers and supervisors, as well as DMOs and the District Commissioners Office to assess progress and respond to gaps, if any, in a timely manner.

In addition, vehicle and fuel usage, equipment and consumable stocks, training, quality of spray, and compliance measures were tracked in a timely manner.

After the completion of IRS, RTI produced summary tables, charts, and maps for dissemination to partners and stakeholders on progress and results achieved.

## Logistics

### ***Storage and Movement of Insecticide and Other Supplies***

Insecticide and other IRS supplies were stored at the warehouses provided by the Ministry of Health and Social Welfare (MoHSW) at regional level and district levels. TVCSP rents a district warehouse only in North A District. Zonal and district storage sites are managed by RTI staff while district and subsite stores are managed by temporary hired staff, who work as district store keepers and site managers for the site substores. A total of 14,122 sachets (1,765 kg) of FICAM were used out of the 27,323 sachets (3,415 kg) initially in balance leaving a balance of 13, 201 sachets (5,181 kg). **Tables 5** and **6** show the movement of IRS items—such as PPE, which includes gloves, masks, boots, and overalls, as well as spray pumps—according to the number of spray personnel on the ground during IRS operations.

**Table 5. PPE Consumables Movements by Type and Warehouse**

Warehouse	Gloves			Mask		
	Initial	Used	Remaining	Initial	Used	Remaining
Zanzibar	2,165	1,400	765	7,216	6,400	816
Total	2,165	1,400	765	7,216	6,400	816

**Table 6. Selected PPE and spray equipment movement by type and warehouse**

Warehouse	Spray Pumps Hudson Expert					Overall					Boots				
	Initial	Received	Remaining	Intact	Worn out	Initial	Received	Remaining	Intact	Worn out	Initial	Received	Remaining	Intact	Worn out
Zanzibar	790	0	790	790	0	2,277	0	2,277	2,277	0	1,007	0	1,007	1,007	0
Total	790	0	790	70	0	2,277	0	2,277	2,277	0	1,007	0	1,007	1,007	0

## Provision of Transport for Operators and Supervisors

During IRS operations, numerous vehicles were hired to transport operators at district levels. Supervisors at national and district levels were provided with fuel to run official transport used for IRS. The operators were transported by vans; where not feasible, 4-wheel drive vehicles or trucks were used. On the islands, both operators and supervisors were transported daily by hired boats. Operators were transported from IRS operational sites to targeted villages located 5–15 km away. Efficient transportation arrangements increased the operations' effectiveness by reducing travel time. This also provided the ideal controlled situation for transporting spray equipment and insecticide. Transportation for supervisors (average two per district) was provided daily to reach different locations with ongoing IRS operations. **Table 7** indicates the number of cars and boats hired during the last IRS round.

**Table 7. Vehicles hired during IRS operations**

		Zanzibar	Total
Vehicles	Operators cars	46	46
	Supervisor cars	9	9
	Boats	1	1
	Total vehicles	56	56

## End of Spray Activities

### ***Post-spray Environmental Compliance Inspections and Site Decontamination and Decommissioning***

RTI Environmental Compliance Officers conducted post-spray environmental compliance inspections in all IRS sites of Zanzibar. IRS site decontamination and decommissioning was carried out by making sites and storage areas safe for the surrounding community. After the inspections, the IRS operational sites were handed over to the local authorities for safe custody until the next IRS operation.

### ***Solid Waste Disposal***

After the end of IRS operations, all insecticide-contaminated waste were transported back to the zonal warehouse for storage to await disposal in a proper incinerating facilities that met international disposal requirements for contaminated insecticide. RTI in collaboration with ZMCP continued incinerating insecticide- contaminated wastes stored in the zonal warehouse using a project incinerator located at Kivunge Hospital in North A District. To date, approximately 600 kgs of IRS waste from this and previous rounds has been incinerated.

### ***End of Spray Inventory in Storage Facilities***

End of spray inventory was conducted at three levels—site sub-store, district, and zonal stores. The inventory process guides the tasks of equipment maintenance and repair, accounting for losses, and forecasts procurement for the following round.

## **VI. IRS Results**

### **IRS Results—Zanzibar**

#### ***Population and House Structures Found***

##### *House Structure Characteristics and Population Profile*

In Zanzibar, 53,955 were visited. In a typical house structure in Zanzibar, the wall surface area was 86 m<sup>2</sup> and 54 m<sup>2</sup> in Unguja and Pemba, respectively (see **Table 8**).

**Table 9** presents the population breakdown of households visited in Zanzibar. The family size was 4.8 per household in Zanzibar. **Figure 8** shows the family size breakdown for each of the IRS districts. In total, 259,899 people were recorded during spray operations, of which 20% were high-risk groups (pregnant women and U5 children).

A summary of household characteristics and population by district, region, and zone is presented in **Annex C**.

**Table 8. Characteristics of visited households**

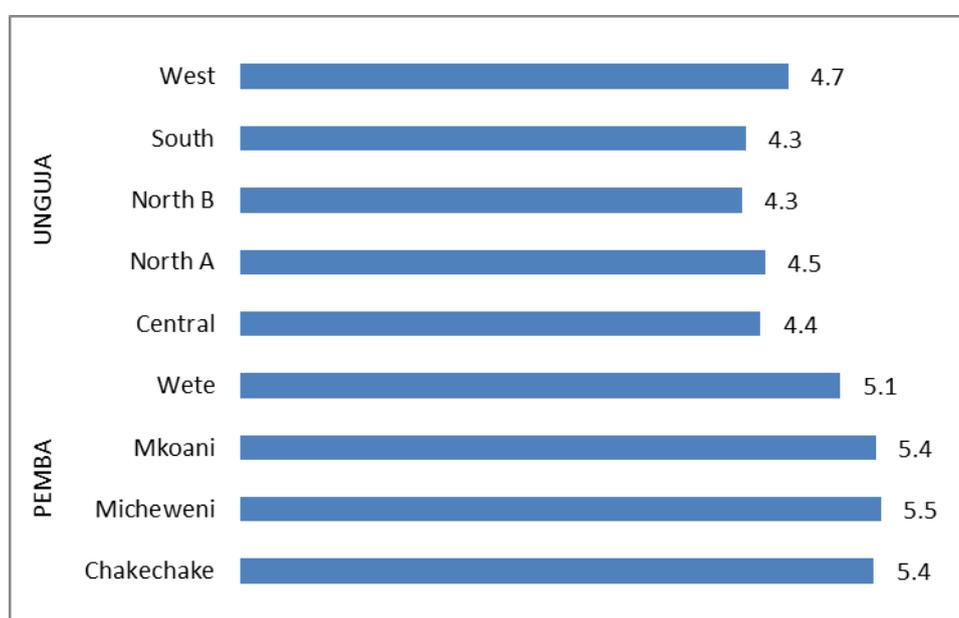
	Unguja	Pemba	Zanzibar
House structures found	30,087	23,868	53,955
Average # of rooms per house structure	4.7	5.0	4.9
Average house structure size (sqm)	86	54	70

**Table 9. Population recorded during spray in visited households**

	Unguja	Pemba	Zanzibar	
Population visited	Total	132,634	127,265	259,899
Average Family size	4	5	5	

		Unguja	Pemba	Zanzibar
Risk group	U5 (%)	20,919 (16%)	24,289 (19%)	45,208 (17%)
	Pregnant women (%)	2,874 (2%)	3,039 (2%)	5,913 (2%)
Five years and above	Male (%)	54,340 (41%)	51,110 (40%)	105,450 (41%)
	Female (%)	54,501 (41%)	48,827 (38%)	103,328 (40%)

**Figure 8. Family size per district, Zanzibar**



## Spray Results

### Main Spray Indicators

All eligible houses were visited in Zanzibar (see **Table 10**). Spray coverage reflects the houses that were visited and sprayed out of those targeted (i.e., eligible). This coverage was estimated at 96% (see **Figure 9**).

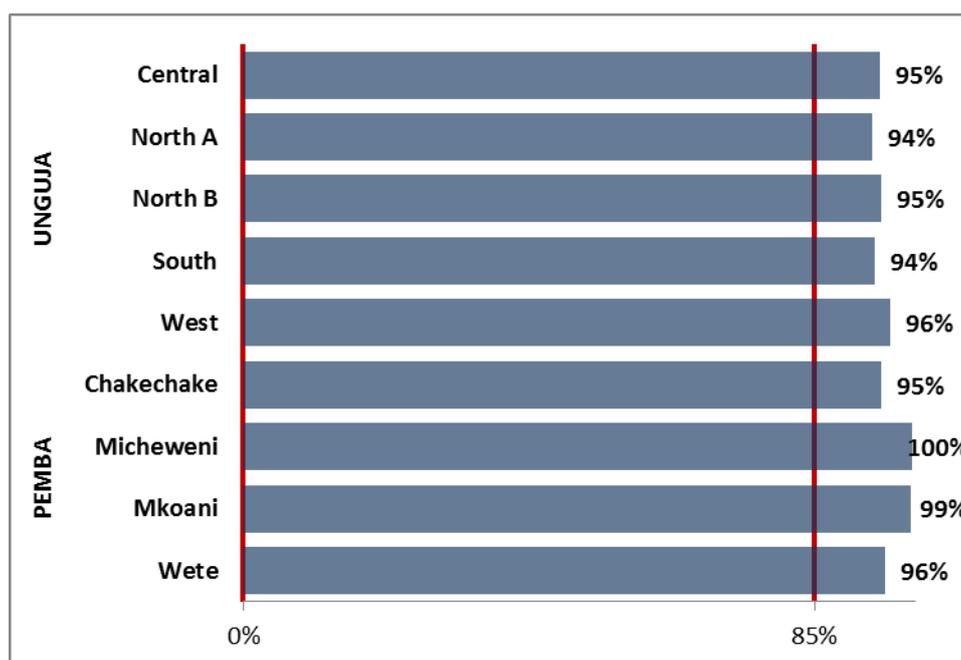
In Zanzibar, the range was between 94% (North A District in Unguja Island) and 100% (Micheweni District in Pemba Island).

A summary of spray indicators by district region and zone are reported in **Annex D**.

**Table 10. Main spray indicators in Zanzibar**

House structures	Unguja	Pemba	Zanzibar
Eligible	30,087	23,868	53,955
Visited	30,087	23,868	53,955
Visited %	100%	100%	100%
Sprayed	28,527	23,377	51,904
Visited and not sprayed	1,560	491	2,051
Not reached	-	-	-
Spray coverage	94.8%	97.9%	96.2%

**Figure 9. Spray coverage in districts of Zanzibar**

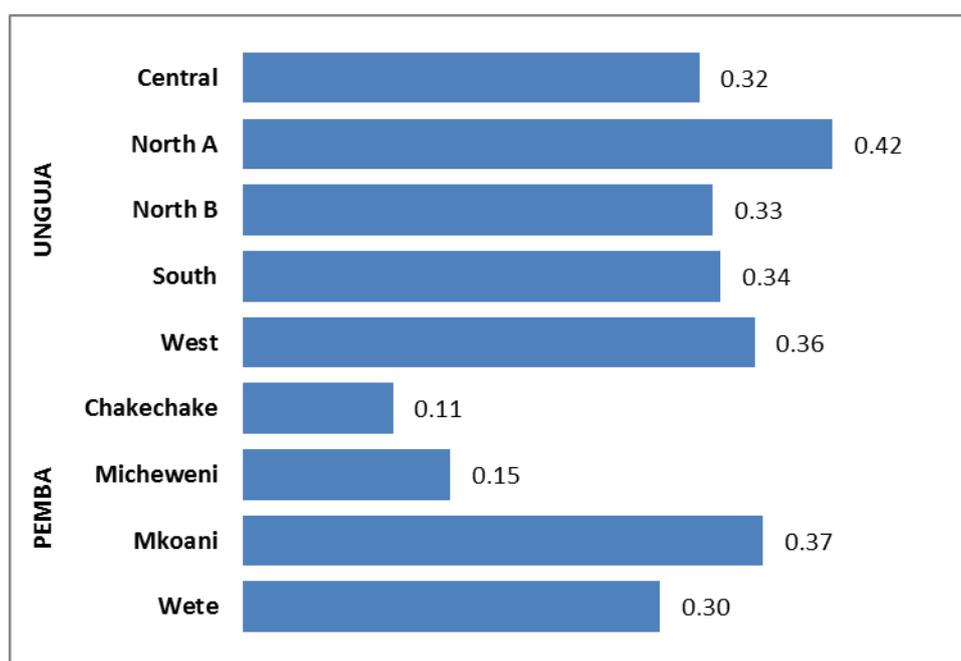


*Use of Insecticides*

Over 14,000 sachets were used, with an average consumption of 0.29 sachets per house structure in this round of IRS in Zanzibar (see *Table 11* and *Figure 10*).

**Table 11. Use of insecticide**

	Unguja	Pemba	Zanzibar
Bendiocarb sachets used	9,847	5,035	14,882
Total kgs used	1,231	629	1,860
Sachets per house structure	0.35	0.22	0.29

**Figure 10. Sachet per house structure ratio by district in Zanzibar****Population Protected**

A total of 250,505 people were protected with IRS in Zanzibar. The estimated number of pregnant women and U5 children protected by IRS<sup>2</sup> was 5,703 and 43,635, respectively (see **Table 12** and **Annex E**).

**Table 12. Population protected by spray zone**

Population protected	Unguja	Pemba	Zanzibar
U5	19,843	23,792	43,635
Pregnant women	2,725	2,978	5,703
Five years and above male	51,552	50,093	101,645

<sup>2</sup> As per PMI's definition, the protected risk groups are those living in houses that have been sprayed.

Population protected	Unguja	Pemba	Zanzibar
Five years and above female	51,673	47,850	99,523
Five years and above all	103,225	97,943	201,168
Eligible Population	132,634	127,265	259,899
Population Protected	125,793	124,712	250,505
Percent Protected	95%	97%	96%

### Usage of ITNs

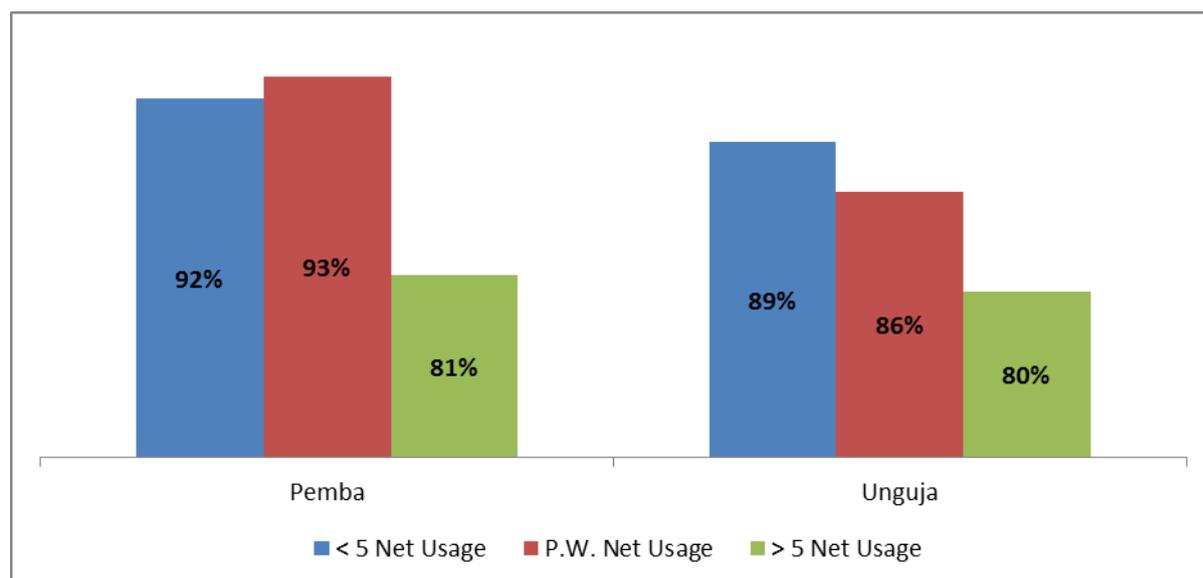
In Zanzibar, about 5,082 (89%) of pregnant women and 39,222 (90%) of U5 children were declared to have slept under ITNs the previous night in the house structure visited during this reporting period (see **Table 13** and **Annex F**).

**Figure 11** illustrates ITN usage in Pemba and Unguja among pregnant women, U5 children, and the population above five years of age.

**Table 13. LLIN usage by region and zone by age group**

Group		Unguja	Pemba	Zanzibar
U5	Slept under LLIN/ITN previous night	17,741	21,481	39,222
	Net usage %	(89%)	(92%)	(90%)
Pregnant women	Slept under LLIN/ITN previous night	2,305	2,777	5,082
	Net usage %	(86%)	(93%)	(89%)
Five years and above	Slept under LLIN/ITN previous night	79,236	76,405	155,641
	Net usage %	(80%)	(81%)	(80%)

Figure 11. 2013 universal net coverage by district, Zanzibar

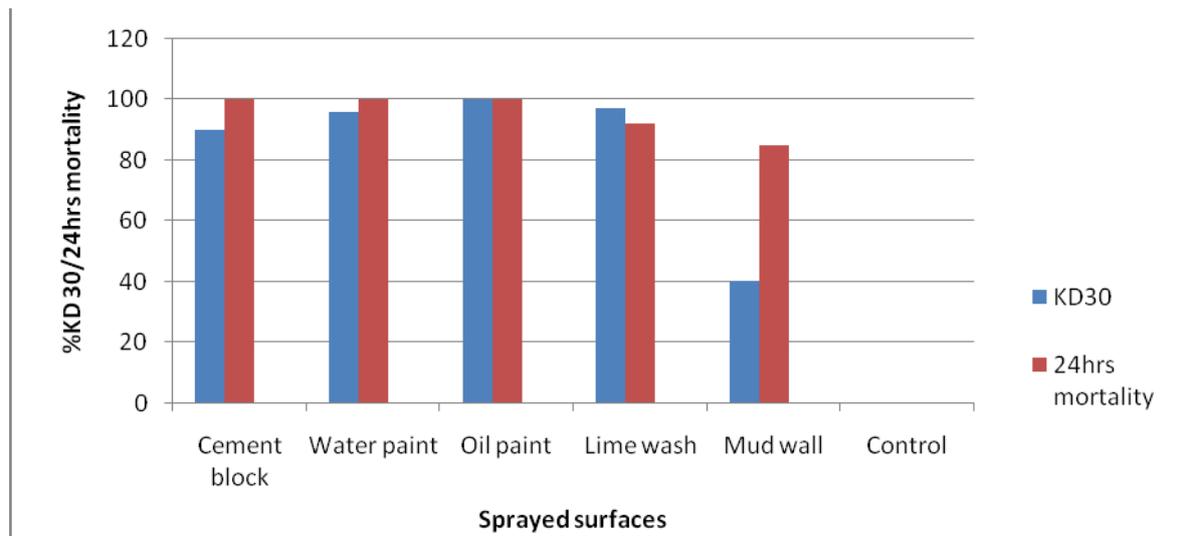


## VII. Monitoring Insecticide After Spray: Insecticide Decay Rate

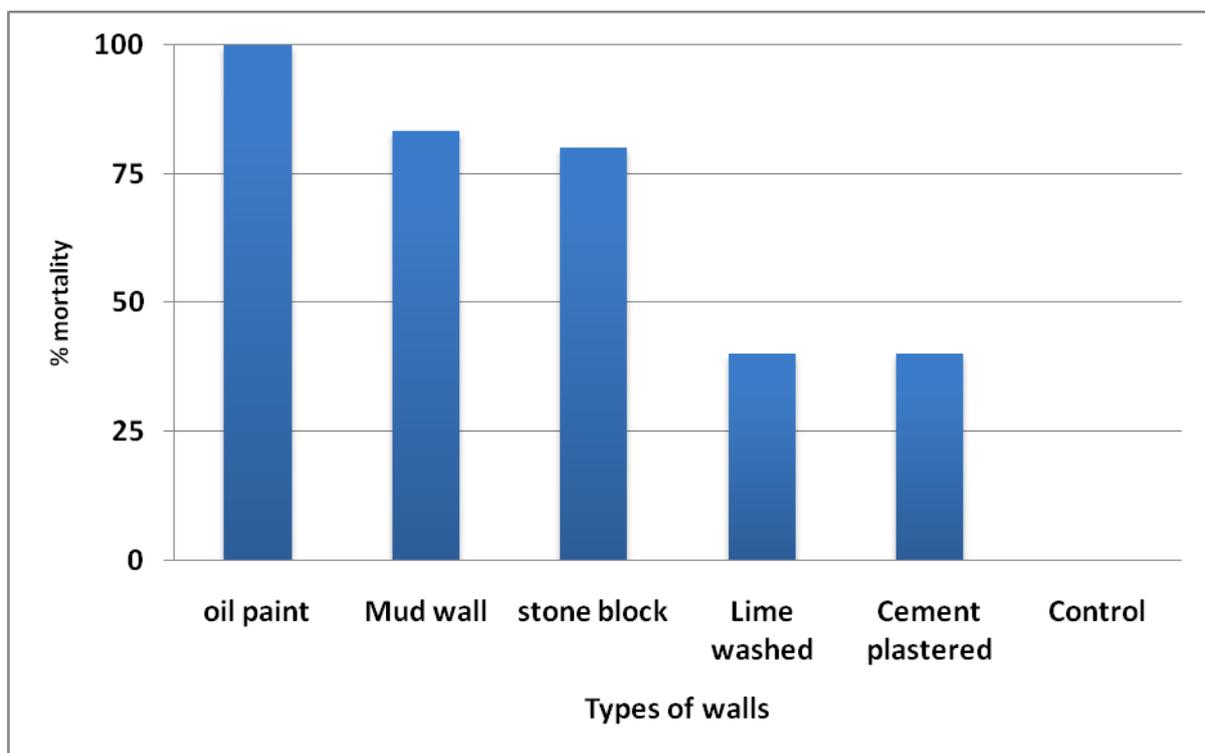
### Monitoring Insecticide Decay by Using Cone Bioassay

In Unguja, the bioassay results after 13 and 30 days following spraying various surfaces with bendiocarb (see *Figures 12* and *13* below) showed compelling residues on all surfaces (84%) except for mud surfaces, which were a bit low (40% knock down and 82% 24-hour mortality). The low residues could be attributed to the fact that the soil has a high absorption capacity. However, in Pemba, mortality rates among mosquitoes exposed to treated surfaces varied according to the type of walls on which insecticide was applied. There was a significant difference in mortality between oil-painted surfaces and other treated surfaces. However, there is a rapid decline in effectiveness in cement and lime wash. Special considerations must be taken where ever these types of structures are increasingly developed.

**Figure 12. Bioassay results March 2013**



**Figure 13. Efficacy of bendiocarb at Shungi (Pemba) 30 days post spraying**



## Section C: Tanzania Mainland

### VIII. IRS in the Context of Malaria Strategies in Mainland Tanzania

#### **Malaria Medium-Term Strategic Plan for Mainland Tanzania**

In Mainland Tanzania, the goal of the second 2008–2013 Medium-Term Strategic Plan is to reduce malaria prevalence by 50% by the end of 2013. The main targets are as follows:

- 80% of malaria patients diagnosed and treated with effective antimalarial medicines, such as ACT, within 24 hours of the onset of fever;
- 80% of all pregnant women receive two or more doses of IPTp;
- 80% of people in malarious areas protected through the use of ITNs;
- 80% of people in target areas protected through IRS; and
- Early detection and containment of 80% of malaria epidemics within two weeks from onset.

The current plan aims to rapidly scale up the levels of coverage for the main interventions and includes a comprehensive array of activities such as IRS, LLIN distribution, improved case management, as well as strengthening malaria surveillance systems to inform decision makers and institutes, timely preventive measures.

#### **Recent History of IRS in Mainland Tanzania**

##### ***Mainland Tanzania***

In its 2008–2013 Medium-Term Strategic Plan, the NMCP targets IRS scale up from 1 district in 2007 to cover about 60 districts by 2013, protecting 50% of the country's population. This scale-up will be implemented through the NMCP's Integrated Malaria Vector Control (IMVC) strategy, which includes malaria preventive methods such as ITNs and LLINs, LSM in large urbanized areas, and effective environmental management.

PMI began supporting IRS in Mainland Tanzania in 2007. PMI first contracted RTI to provide technical support to the MoHSW in controlling malaria outbreaks in the malaria-unstable areas of Karagwe and Muleba districts in Kagera Region. In 2009, IRS operations were scaled up in Kagera to cover the remaining stable and high-transmission areas covering the other five districts (Biharamuro, Bukoba Rural, Chato, Misenyi, and Ngara). In 2010, IRS operations were scaled up to cover 11 districts of Mara and Mwanza regions (see *Table 14*). In 2012, a second IRS round was conducted in five and six districts of Mara and Mwanza Regions respectively,

while a third round took place in five districts of Kagera Region. In Muleba District, a targeted spray was initiated in 2012; in Karagwe District, another blanket spray was conducted. Pyrethroids (lambda-cyhalothrin) were used for IRS in the area from 2007. In the 2011–2012 IRS season, bendiocarb was introduced in Muleba and Karagwe districts.

**Table 14. Spray performance in Mainland Tanzania (structures sprayed), 2007–2013**

Houses eligible, sprayed, and percent covered										
Region/ Districts		2006–2007	2007–2008	2008–2009	2009–2010	2010–2011	2011–2012	2012–2013		
<b>Kagera Region</b>										
Biharamulo	Sprayed	—	—	—	31,382	38,032	40,331	—	13,548	—
	Visited (coverage)	—	—	—	32,253 (97.3%)	40,304 (94.4%)	44,510 (91%)	—	14,768 (92%)	—
					Blanket	Blanket	Blanket		Target	
Bukoba R	Sprayed	—	—	—	55,183	60,548	58,925	—	16,708	18,235
	Visited (coverage)	—	—	—	57,783 (95.5%)	62,730 (96.5%)	61,312 (96%)	—	17,159 (97%)	18,303 (99%)
					Blanket	Blanket	Blanket		Target	Target
Chato	Sprayed	—	—	—	56,233	60,571	58,319	—	20,514	—
	Visited (coverage)	—	—	—	57,972 (97.0%)	62,337 (97.2%)	61,259 (95%)	—	21,604 (95%)	—
					Blanket	Blanket	Blanket		Target	
Karagwe	Sprayed	—	59,177	103,631	111,047	115,669	109,102	—	52,331	30,073
	Visited (coverage)	—	60,078 (98.5%)	107,057 (96.8%)	111,270 (99.8%)	115,972 (99.7%)	117,277 (93%)	—	55,930 (94%)	30,791 (98%)
			Selected	Blanket	Blanket	Blanket	Blanket		Target	Target
Missenyi	Sprayed	—	—	—	36,891	37,698	37,580	—	11,319	11,582
	Visited (coverage)	—	—	—	38,751 (95.2%)	40,135 (93.9%)	40,813 (92%)	—	11,595 (98%)	11,871 (98%)
					Blanket	Blanket	Blanket		Target	Target

Houses eligible, sprayed, and percent covered										
Region/ Districts		2006–2007	2007–2008	2008–2009	2009–2010	2010–2011	2011–2012		2012–2013	
Muleba	Sprayed	34,745	36,371	81,586	86,163	101,394	52,312	37,874	16,692	16,287
	Visited (coverage)	36,612 (94.9%)	36,850 (98.7%)	85,163 (95.8%)	86,336 (99.8%)	101,491 (99.9%)	56,148 (93%)	39,946 (95%)	17,738 (94%)	17,766 (92%)
		Selected	Selected	Blanket	Blanket	Blanket	Target	Target	Target	Target
Ngara	Sprayed	—	—	—	48,219	46,264	46,069	—	13,126	—
	Visited (coverage)	—	—	—	54,118 (89.1%)	54,578 (84.8%)	54,066 (85%)	—	15,600 (84%)	—
					Blanket	Blanket	Blanket		Target	
<b>Mara Region</b>										
Bunda	Sprayed	—	—	—	—	45,811	54,744	—	39,519	8,238
	Visited (coverage)	—	—	—	—	51,710 (88.6%)	57,457 (95%)	—	41,731 (95%)	8,750 (94%)
						Blanket	Blanket		Target	Target
Musoma	Sprayed	—	—	—	—	60,363	73,157	—	53,549	8,861
	Visited (coverage)	—	—	—	—	70,597 (85.5%)	79,401 (92%)	—	54,981 (97%)	11,430 (78%)
						Blanket	Blanket		Target	Target
Rorya	Sprayed	—	—	—	—	47,200	70,218	—	28,867	—
	Visited (coverage)	—	—	—	—	49,306 (95.7%)	74,665 (94%)	—	30,587 (94%)	—
						Blanket	Blanket		Target	

Houses eligible, sprayed, and percent covered										
Region/ Districts		2006–2007	2007–2008	2008–2009	2009–2010	2010–2011	2011–2012		2012–2013	
Serengeti	Sprayed	—	—	—	—	58,993	51,761		39,952	
	Visited (coverage)					59,366 (99.4%)	55,614 (93%)	—	43,277 (92%)	—
						Blanket	Blanket		Target	
Tarime	Sprayed	—	—	—	—	53,136	74,645		42,621	
	Visited (coverage)					54,838 (96.9%)	82,363 (91%)	—	43,764 (97%)	—
						Blanket	Blanket		Target	
<b>Mwanza Region</b>										
Geita	Sprayed	—	—	—	—	127,075	123,196		75,199	
	Visited (coverage)					127,454 (99.7%)	130,475 (94%)	—	80,305 (94%)	—
						Blanket	Blanket		Target	
Geita Town	Sprayed	—	—	—	—	—	18,206		20,830	
	Visited (coverage)						20,193 (90%)	—	22,374 (93%)	—
Kwimba	Sprayed	—	—	—	—	52,718	57,467		39,272	6,441
	Visited (coverage)					58,180 (91.7%)	61,348 (94%)	—	40,372 (97%)	7,186 (90%)
						Blanket	Blanket		Target	Target
Magu	Sprayed	—	—	—	—	65,462	75,218	—	48,463	8,301

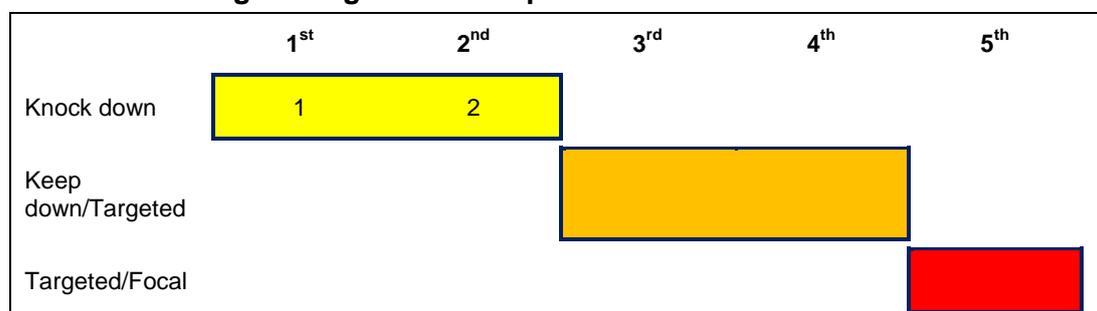
Houses eligible, sprayed, and percent covered										
Region/ Districts		2006–2007	2007–2008	2008–2009	2009–2010	2010–2011	2011–2012		2012–2013	
	Visited (coverage)					78,767 (83.1%)	81,228 (93%)		52,356 (93%)	9,468 (88%)
						Blanket	Blanket		Target	Target
Missungwi	Sprayed Visited (coverage)	—	—	—	—	38,693 43,839 (89.3%)	45,385 49,154 (92%)	—	32,184 33,243 (97%)	6,765 6,866 (99%)
						Blanket	Blanket		Target	Target
Sengerema	Sprayed Visited (coverage)	—	—	—	—	84,558 87,134 (97.0%)	86,065 91,547 (94%)	—	63,197 64,721 (98%)	
						Blanket	Blanket		Target	
Ukerewe	Sprayed Visited (coverage)	—	—	—	—	50,436 52,859 (95.4%)	53,520 55,229 (97%)	—	31,255 33,300 (94%)	
						Blanket	Blanket		Target	
<b>Total</b>	<b>Sprayed (coverage)</b>	<b>34,745 (94.9%)</b>	<b>95,548 (98.6%)</b>	<b>185,217 (96.3%)</b>	<b>425,118 (96.2%)</b>	<b>1,144,621 (94.5%)</b>	<b>1,224,095 (93%)</b>		<b>659,146 (95%)</b>	<b>114,783 (94%)</b>

## IRS Strategic Design for Mainland Tanzania

### *Mainland Tanzania*

In the NMCP 2008–2013 Medium-Term Strategic Plan, IRS is envisaged as being used in various settings and in an integrated manner, with other vector control interventions, mainly LLINs. The current strategic design for IRS is oriented with consideration of the geographic and climatic diversity in Mainland Tanzania and the consequent variation in the malaria situation. The strategic design for IRS is expected to provide a rapid “knock-down” effect (generally over a 1–2 year period of blanket spraying) on malaria transmission and prevalence. The knock-down phase should, at least, halve the malaria cases, ideally reducing them by up to 75%. After this initial knock-down phase, IRS will contribute to the maintenance phase (or “keep-down” phase, which involves another one to two years of targeted spraying in large geographic areas) to keep the area at its anticipated low endemic level. Following the introduction of appropriate surveillance and a strategy to maintain high coverage of LLINs, IRS will be scaled down to cover selected areas (through an additional two years of IRS campaigns). After achieving the above milestones, IRS will be implemented on a targeted basis to preempt or contain focal transmission in identified hot spots to prevent malaria resurgence (see *Figure 14*). This ultimate step requires establishing effective surveillance and epidemic preparedness and response systems.

**Figure 14. Strategic design for IRS implementation in Mainland Tanzania**



Since the inception of IRS in Muleba and Karagwe districts of Kagera Region in 2007 and 2008, respectively, the intervention has expanded to cover all 18 districts of the Lake Zone. Currently, all districts have transitioned from knock-down to targeted spraying. While knock down was implemented as blanket spraying, keep-down envisages targeting areas in which malaria reduction has not reached 75% from the pre-IRS levels.

### **Spray Seasons**

IRS operations in the Lake Zone were conducted in two seasons (see *Figure 15*)—December 2012–March 2013 (season one) and May–June 2013 (season two). Within the seasons, IRS operations are organized in phases. The two approaches, seasons and phases, provide the following advantages (1) provide ideal logistics for the operations

(minimal rainy days) and (2) maximize human protection during the transmission peaks, and (3) optimize the use of human resources for training and supervision. **Figure 15** shows the timing of IRS in relation to precipitation and malaria transmission for the Lake Zone. It also illustrates the type of insecticide and estimated decay rate, which was used during this round in the respective districts.

## **Selection of Eligible Spray Areas**

### ***Mainland Tanzania***

Selection of eligible areas for IRS in 2012–2013 was influenced by a number of factors, such as MOP targets, changes of IRS from blanket spraying to targeted spraying among all three regions in the Lake Zone, and change of insecticides as means of resistance mitigation plan. The MOP for 2012–2013 allocated 800,000 house structures to be sprayed. This was lower by 400,000 when compared to the 2011–2012 target of 1,200,000.

The other factor considered was insecticide resistance mitigation. Prior to IRS in 2012–2013, NMCP in collaboration with partners developed an interim plan for insecticide resistance mitigation intended to guide implementation of IRS for 2012–2013. The interim plan provided gradual change from pyrethroids to other insecticide classes, such as carbamates, as shown in **Table 15**.

**Table 15. Number of eligible structures, previous rounds IRS, strategic phase, frequency of spraying, and insecticide class used in 2013 per district**

Region/District	Eligible Structures targeted	# of previous IRS rounds	IRS strategic phase	Type of Spray	Proportion of eligible structures	Frequency of spray	Insecticide class used
<b>KAGERA</b>							
Missenyi, Chato, Biharamulo, Ngara, Bukoba	159,208	3	Keep down ----- Insecticide resistance management	Targeted	66%	Once or twice depending on transmission pattern	Carbamate
Muleba, Karagwe	65,765	4-6	Outbreak control ----- Insecticide resistance management	Targeted / Focal	33%	Twice	Carbamate
<b>Total KAGERA</b>	<b>224,973</b>						
<b>MWANZA</b>							
Kwimba, Missungwi, Magu, Geita, Sengerema, Ukerewe	238,710	2	Keep down	Targeted	80%	Once	Pyrethroid

Region/District	Eligible Structures targeted	# of previous IRS rounds	IRS strategic phase	Type of Spray	Proportion of eligible structures	Frequency of spray	Insecticide class used
Kwimba, Missungwi, Magu, Geita, Sengerema, Ukerewe	120,503	2	Keep down <hr/> Insecticide resistance management	Targeted	75%	Once or twice depending on transmission pattern	Carbamate
<b>Total MWANZA</b>	<b>359,213</b>						
<b>MARA</b>							
Bunda, Musoma Rural, Rorya, Tarime, Serengeti	168,753	2	Keep down	Targeted	80%	Once	Pyrethroid
Bunda, Musoma Rural, Rorya, Tarime, Serengeti	85,188	2	Keep down <hr/> Insecticide resistance management	Targeted	75%	Once or twice depending on transmission pattern	Carbamate
<b>Total MARA</b>	<b>253,941</b>						
<b>Total Lake Zone</b>	<b>838,127</b>						

Based on the interim resistance management plan, RTI in collaboration with beneficiary districts developed and employed criteria for selection of eligible house structures for spraying (see **Box 5**). The criteria included malaria incidence at the village level (the main criteria), possession of LLINs, and rural urban setting (the urban settings were strictly excluded).

The process of stratification included data collection from 844 health facilities among which 341 were from Mwanza, 265 from Kagera, and 238 from Mara. MTUHA Book 2<sup>3</sup> was used as a source of malaria cases. Names and total population of services area per health facility were collected. Furthermore, names of catchment areas per health facility and geolocation of each health facility were collected.

#### **Box 5. Inclusion and Exclusion Criteria for Targeted IRS Approach**

##### **Inclusion Criteria**

- ◆ The higher the malaria incidence, the higher likelihood it is to be included
- ◆ Malaria incidence was also used to allocate insecticide with carbamate allocated in areas with highest incidence
- ◆ The lower the LLIN coverage, the higher likelihood it is to be included

##### **Exclusion Criteria**

- ◆ Urban areas
- ◆ Low malaria incidence (<10%)
- ◆ Small highlands with high percentage on non-sprayable structures

## **IX. 2012–2013 IRS Preliminary Activities**

### **Assessing the Environment and Planning Mitigation Options for the Safer Use of Pesticides**

#### ***Environmental Assessment***

As was the case in Zanzibar (see *Section Environmental Assessment* under *Section B—Zanzibar*), RTI in collaboration with NMCP complied with PEA requirements by seeking an insecticide importation permit from TPRI in December 2012. This fulfilled the Plant Protection Act of 1997, which regulates importation of insecticides in Tanzania.

#### ***Insecticide Management and Environmental Mitigation Plan***

The process of insecticide management and environmental mitigation measures in Mainland Tanzania were almost similar to Zanzibar (see *Insecticide Management and Environmental Mitigation Plan* under *Section B—Zanzibar*), with the exception

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<sup>3</sup> Mfumo wa Taarifa za Uendeshaji wa Huduma za Afya (MTUHA) is part of the HMIS, which collects the main parameters of different diseases within the health facilities, including malaria.

of the storage facility levels, which had four levels: (1) zonal (two permanent warehouses); (2) regional (three warehouses); (3) district (18 temporary stores); and (4) and IRS sites (129 temporary IRS sub-stores). A total of 129 effluent waste disposal structures and temporary storage and sanitation facilities were repaired/refurbished in preparation for IRS operations.

## **Selection and Management of Insecticide for IRS**

### ***Insecticide Resistance in Mainland Tanzania***

Pyrethroid resistance was once again reported in several districts in Mainland Tanzania in 2012. NIMR and Malaria Prevention Trial (PAMVERC) reported important insecticide resistance to pyrethroids in anopheline mosquitoes in Muleba District. There is evidence that continuous use of the same class of insecticide for IRS and LLIN, as well as for agriculture, may be associated with the observed evolution of resistance.

### ***Insecticide Resistance Mitigation Plan***

In order to mitigate the vector resistance to pyrethroid insecticide, RTI, in collaboration with NMCP, embarked on developing an insecticide resistance mitigation plan (see *Insecticide Resistance Mitigation Plan* under *Section B—Zanzibar*). The interim plan recommends replacing pyrethroids with carbamates for IRS in a rotational strategy for at least two years until new formulations become available. Meanwhile monitoring vectors for their susceptibility to a range of insecticides was intensified. With the above considerations, a selection of bendiocarb (FICAM<sup>®</sup> WP) and deltamethrin (K-Othrine) were chosen for the operations.

The insecticides used were a carbamate with a residual effect of 2–4 months, per IQK data collected in Karagwe and Muleba districts. The other insecticide was deltamethrin, which has an anticipated residual time of 3–6 months. Based on these data and onset of rainfall, some areas sprayed with carbamate in December–February 2013 were re-sprayed again with the same class of insecticide in May 2013. These districts included Karagwe, Muleba, Missenyi, and Bukoba in Kagera Region; Magu, Kwimba, and Misungwi in Mwanza Region; and Bunda and Musoma in Mara Region.

## **Assessing IRS Logistics**

In November 2012, RTI and NMCP staff, in collaboration with regional and district authorities, conducted a logistics reassessment in all IRS districts in the Lake Zone. The process followed similar steps as in Zanzibar (see *Assessing IRS Logistics* under *Section B—Zanzibar*).

## **Selecting the Ideal Spray Period and Preparing the Operations Plan**

### ***Rationale for Selection of Spraying Period in Lake Zone***

See Rationale for *Selection of Spraying Period* under *Section B—Zanzibar*.

**Figure 15. Spray seasons in Mainland Tanzania, November 2012–May 2013**

Determinant	Insecticide	Duration (months)	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	Start Date	End Date	Districts	
Precipitation																		
Vector Abundance																		
Malaria Incidence																		
Kagera Season 1	Bendiocarb	2 to 6			X					May-13					4 Dec	20 Dec	Karagwe	
Kagera Season 2						X				May-13					21 Jan	2 Feb	Bukoba, Muleba, Missenyi	
Zanzibar									X									
Kagera Season 2b					Dec 13		X									11 Feb	22 Feb	Ngara, Biharamulo
Kagera Season 3									X							27 Feb	12 Mar	Chato
Mwanza Season 1						X					May 13					24 Jan	15 Feb	Kwimba, Magu, Missungwi
Mwanza Season 2					Dec 13				X							25-Feb	28-Mar	Geita, Sengerema, Ukerewe
								X				May				24-	12-	Bunda,

Determinant	Insecticide	Duration (months)	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	Start Date	End Date	Districts
Mara Season 1										13					Jan	Feb	Musoma
Mara Season 2					Dec 13		X								11-Feb	28-Feb	Serengeti
Mara Season 2b					Dec 13			X							11-Mar	28-Mar	Rorya, Tarime
Mwanza Season 1	Deltamethrin	3 to 6				X									24-Jan	15-Feb	Kwimba, Magu, Missungwi
Mwanza Season 2								X							25-Feb	28-Mar	Geita, Sengerema, Ukerewe
Mara Season 1						X									24-Jan	12-Feb	Bunda, Musoma
Mara Season 2								X							11-Feb	28-Feb	Serengeti
Mara Season 2b										X					11-Mar	28-Mar	Rorya, Tarime

## Setting the Structure Targets

Based on the targeted IRS approach, eligible household targets for the Lake Zone were captured from household registers, which were established in the last IRS round, as well as actual performance data captured on spray cards. Using these two sources, the targeted house structures and population were then updated accordingly for this IRS season for each of the regions, districts, wards, and villages.

## Establish District IRS Management

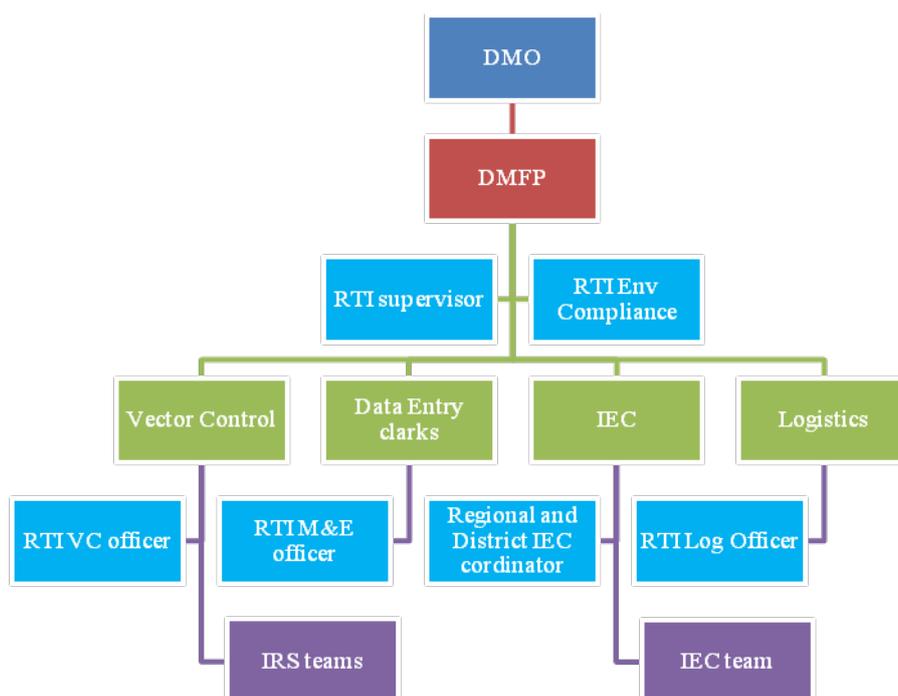
In Mainland Tanzania, the basic IRS management and implementation unit is the DITT. Under the DITT, 18 District IRS Technical Committees (DITCs) were established, one in each district.

In IRS campaigns conducted in 2012–2013, the DITT composition remained the same as 2011–2012, and it was chaired by the District Medical Officer (DMO). Other members included five main staff positions: (1) Malaria Integrated Management of Childhood Illness (IMCI) focal person, (2) vector control specialist, (3) data manager, (4) logistics officer/storekeeper, and (5) health education focal persons (see *Figure 16*).

The Malaria IMCI focal person was selected as the overall IRS coordinator and was responsible for the day-to-day implementation of the activities.

RTI teamed with DITT during the initial training and appointed supervisors and consultants during IRS operations for further on-the-job training and mentoring. In addition, an overall RTI supervisor from the RTI zonal or regional office was appointed for each district.

**Figure 16. Organizational structures for district IRS implementation teams**



## **Developing and Organizing the IRS Sites**

RTI continued to maintain the IRS delivery model initiated in 2006. This model involves extensive use of human resources and deployment logistics. The program requires a high degree of organization capacity (*see **Developing and Organizing the IRS Sites: Design and Phases** under **section B—Zanzibar***).

Following this delivery model, the 2012–2013 IRS season covered a total of 167 operation sites in Mainland Tanzania—six less than in the previous season due to the scale-down in a number of areas within the three regions of the Lake Zone.

## **Insecticide Quantification, Procurement, Safe Transport, and Storage**

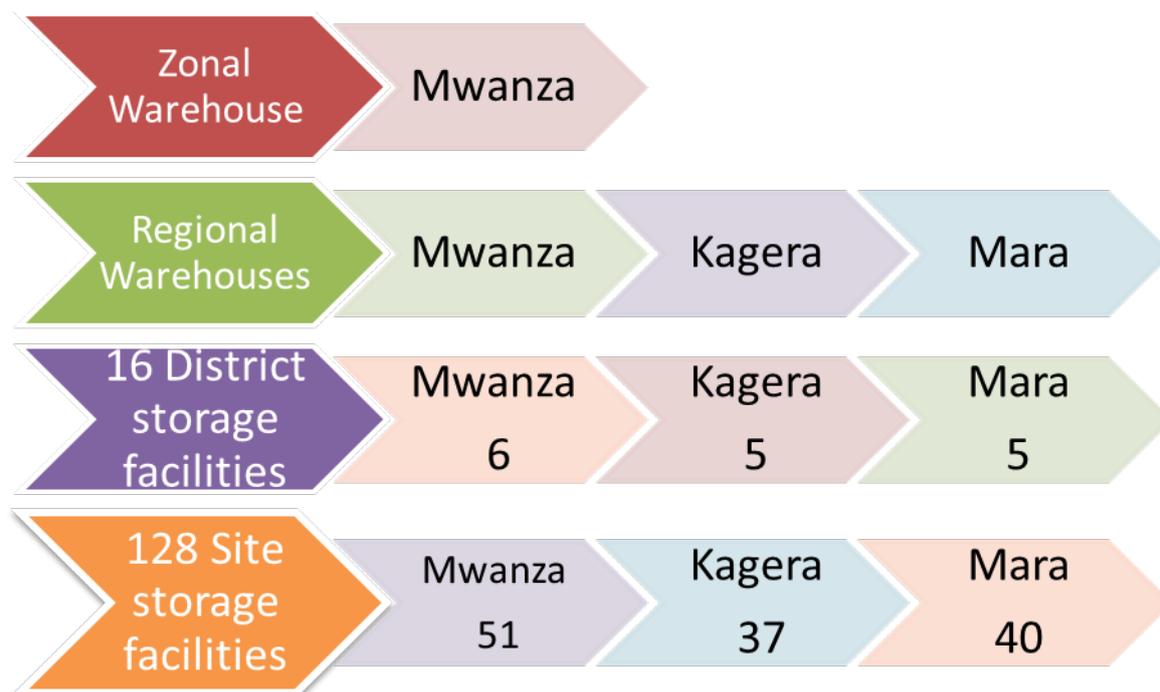
The TVCSP technical team, in collaboration with the NMCP, quantified the deltamethrin and bendiocarb requirements during the logistical assessment and after establishing the sizes and numbers of structures to be sprayed. The quantifications of calculations were based on the dosage range 0.02–0.03 g active ingredient/m<sup>2</sup> for deltamethrin (CS) and 0.1–0.4 g active ingredient /m<sup>2</sup> for bendiocarb WP. The logistics assessment anticipated a total of around 840,000 structures to be sprayed in Mainland Tanzania. Based on the above assumptions, 11,199 liters of K-Othrine<sup>®</sup> WP and 23,686 kg of FICAM<sup>®</sup> WP were quantified and procured and then transported from Dar es Salaam to the zonal warehouse in Mwanza and Bukoba regional warehouses.

## **Handling Equipment, Materials, and Vehicles**

With the exception of determining quantities, the process of equipment, material, and vehicle handling was similar to Zanzibar (*see **Handling Equipment, Materials, and Vehicles** under **Section B—Zanzibar***). A total of 455 vehicles were needed to transport operators from IRS sites to targeted villages in both the first and second cycles of IRS. Insecticide and other IRS supplies were stored and distributed at four levels (*see **Figure 17***)—from zonal to regional warehouses under the control of the TVCSP logistics team and from district to temporary storage facilities of IRS staging sites under the management of the TVCSP technical team. Special transport was provided for distribution at all four levels.

The logistics for insecticide storage and other IRS materials was organized by four levels. The highest level is the zonal warehouse, which receives supplies from domestic and international suppliers and serves three regions of Mwanza, Kagera, and Mara. From the zonal level, supplies are distributed to regional warehouses one month before IRS; from the regional warehouses, supplies are distributed to 18 districts stores (six in Mwanza, seven in Kagera, and five in Mara). Two weeks before IRS operations, supplies are transported from the district stores to the 128 IRS sites stores, where IRS activities are conducted on a day-to-day basis. Throughout, distribution is guided by quantification needs at each level.

**Figure 17. Types and number of storage facilities by levels and responsible TVCSP team**



### Managing Human Resources for IRS

TVCSP in partnership with the DITT recruited 7,222 temporary staff who were directly involved in the implementation of IRS (see *Table 16*). The selection process was led by local government authorities and supervised by the delegated DITT and RTI personnel. Criteria for selection of seasonal staff was similar to Zanzibar (see *Managing Human Resources for IRS* under *Section B—Zanzibar*).

Overall figures show that 70% of staff involved in operations was male, although RTI and DITT always make strong efforts to improve the target for female involvement in IRS operations and to meet the USAID target (50%-50%). *Table 17* presents a breakdown of temporary staff recruited by gender.

**Table 16. Temporary staff recruited to support IRS operations**

	Kagera Region	Mara Region	Mwanza Region	Total Lake Zone
Spray operators	1,522	1,524	1,827	<b>4,873</b>
Tem leaders	189	191	228	<b>608</b>
Site managers	59	48	60	<b>167</b>
Drivers	94	94	115	<b>303</b>
Pump technicians	96	48	80	<b>224</b>

	Kagera Region	Mara Region	Mwanza Region	Total Lake Zone
Cleaners	58	48	60	166
Suit washers	58	48	60	166
Watchmen	116	96	120	332
Water fetchers	102	120	161	383
Storekeepers	-	-	-	-
Assistant storekeepers	-	-	-	-
Total IRS staff	2,294	2,217	2,711	7,222

**Table 17. Proportion of temporary staff recruited during IRS campaign, by gender**

	Staff cadre	Male	Female
IRS field staff	Team leaders and site managers	72%	28%
	Drivers	100%	0%
	Spray operators and site attendants	67%	33%
	<b>IRS teams total</b>	<b>69%</b>	<b>31%</b>
District staff	Clinician trainer of trainers	–	–
	Clinician	71%	29%
	Data management specialists	56%	44%
	DITT	76%	24%
	Master trainers, IEC	50%	50%
	Master trainers, IRS	70%	30%
	Storekeepers	84%	16%
	<b>Field and District IRS staff total</b>	<b>70%</b>	<b>30%</b>

## Informing and Mobilizing Communities

### **Advocacy to Local Government Authorities: Region, District, Division, Ward, and Village Levels**

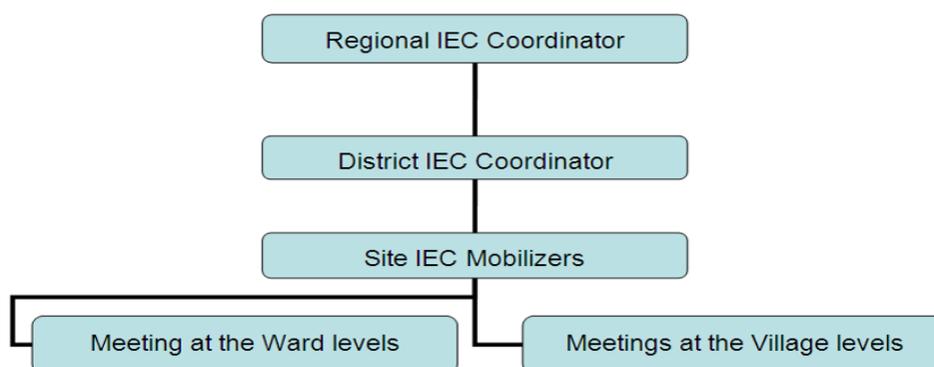
In implementing IRS in 2012–2013, IEC/BCC continued to be an essential component for successful delivery at all levels of influence such as regional, district, division, ward, and the community levels (i.e., village and hamlet levels). As part of this component’s scope, the TVCSP technical team identified local government authorities (regional and district local authorities and ward and village executive officers) to serve as key actors in leading IEC activities (see **Table 18**).

TVCSP staff in collaboration with the respective DITT sensitized local government authorities and mobilized them to provide needed support for the implementation of IRS. Regional and district IRS advocacy committee meetings were organized in all 3 regions and 18 districts. In all, 600 participants attended regional-, district-, and ward-level meetings.

### **Implementation of Information, Education, and Communication Activities: IEC Design in 2012–2013 Spray Season**

The ultimate purpose of this component is to inform and mobilize decision makers and all residents in IRS-eligible areas to increase the level of acceptance and ensure their active participation in IRS activities. IEC/BCC was conducted vertically from the regional level to the household (see **Figure 18**). The major route of communication was interpersonal communication through hamlet leaders to family members

**Figure 18. Organization of IEC/BCC from region to community level**



The cascade illustrated in **Figure 18** involved 3 regions, 18 districts, 457 wards, 1,294 villages and 7,536 hamlets. Through this cascade, TVCSP’s IRS message reached an estimated 3 million people. The key actors and targets involved in this BCC approach are listed in **Table 18**.

**Table 18. Key IEC actors and targets by category**

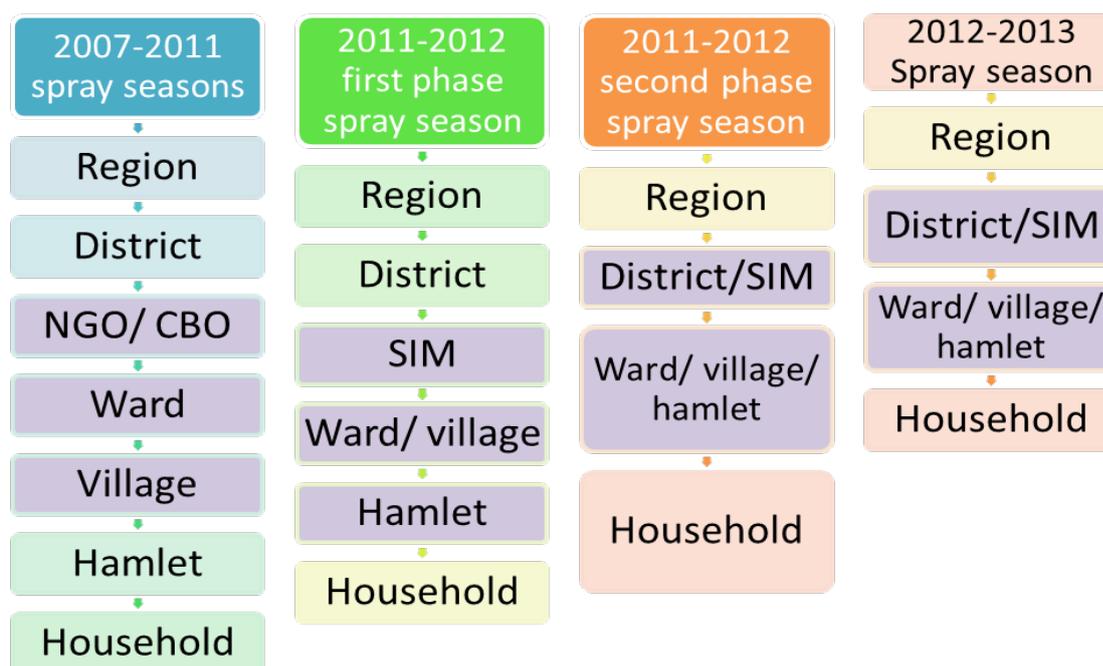
IEC/BCC Actor	Targeted Level	Number of People Targeted
Regional IEC coordinator	3 regional IRS advocacy meetings	60
District IEC coordinator	18 District advocacy meetings	540
Site IEC Mobilizers	Ward and village authorities	457 ward 1,294 village authorities
Hamlet leaders	Household members (5yrs and above)	3,018,935

In addition to person-to-person communication, other means of communication that supported IEC/BCC for IRS included the following:

- Radio programs: Four national and local stations were hired to air 42 radio spots that propagated IRS messages. These radio stations include RFA in Mwanza, Radio FADECO in Karagwe, Radio Kasibante in Bukoba District, and Radio Kwizera in Ngara District.
- Use of megaphones: SIMs used megaphones in communities to announce the date of IRS a particular village.
- Use of tear-off sheets: Tear-off sheets were produced and included simple message such as what actions household members should take before, during, and after IRS. These were distributed during IEC campaigns for IRS.

TVCSPP maintained the same IEC design that was introduced in the second phase of the 2011–2012 IRS campaign. The cascade of events to reach the households was modified to simplify and shorten the messaging from seven steps to four. Also, the primary IEC delivering partners shifted from local authorities, NGOs, and CBOs to the more community-based IRS SIMs (see *Figure 19*). This design led to significant cost reduction in implementation of IEC activities.

**Figure 19. IEC design in spray seasons, 2007–2013**



## Managing Knowledge and Skills

### *IRS Teams Training in Lake Zone*

Prior to implementing IRS in 2012–2013, RTI in collaboration with NMCP, Centre for Educational Development in Health, Arusha, The Nelson Mandela African Institute of Science and Technology, and Muheza Vector Control Training Institute conducted a National IRS Core Facilitator Training course. Participants included Regional and District Malaria Focal Persons, two NMCP representatives, one representative from the MoHSW Vector Control Unit, and one Vector Control Officer from the Tanzania People’s Defence Force (TPDF). The training covered IRS management and other supportive aspects of IEC, logistics planning and management, M&E, and environmental compliance at all levels. The training consisted of 14 modules developed prior the training. In turn, trainees of this course facilitated other trainings to field IRS teams. These trainings were conducted in a cascade fashion to manage the large number of trainees located across a large area of more than 100km<sup>2</sup> (see *Figure 20*). In the Lake Zone, a total of 9,070 (6,197 and 2,873 male and female, respectively) staff were trained before IRS operations. Among them, 7,222 were personnel directly involved in the implementation of IRS; the remaining 1,848 were temporary staff involved at different capacities to support IRS, such as SIMS, clinicians, as well as other regional, district, ward, and village authorities facilitating supervision and IEC sensitization at the respective levels.

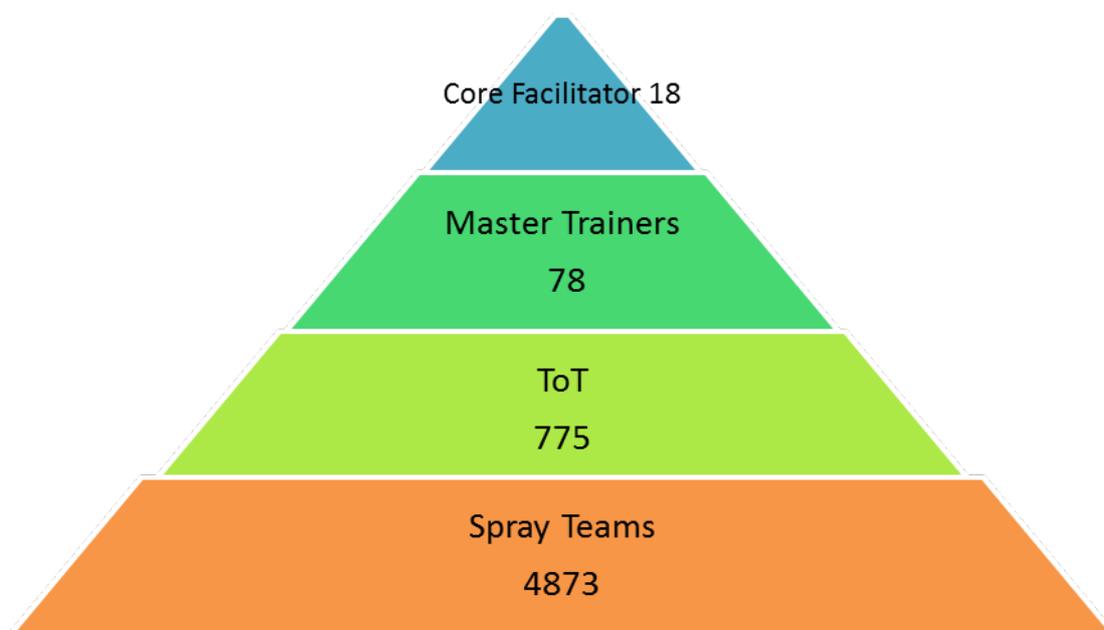
### *Training of Trainers (ToT)*

As stated in the previous section, National IRS Core Facilitators were mandated to organize and conduct ToT sessions in their respective districts. The ToT targeted site managers and team leaders. A total of 775 participants were trained, with female trainees totaling 28% of participants.

### **IRS Teams**

TVCSP provided different trainings for new and returning IRS staff. A total of 4,873 spray operators and site attendants were trained in 137 training sessions, with an average of 35 participants per session. Among the trainees, 33% were female. **Figure 20** shows the cascade model of training from the core facilitators down to the spray operator level.

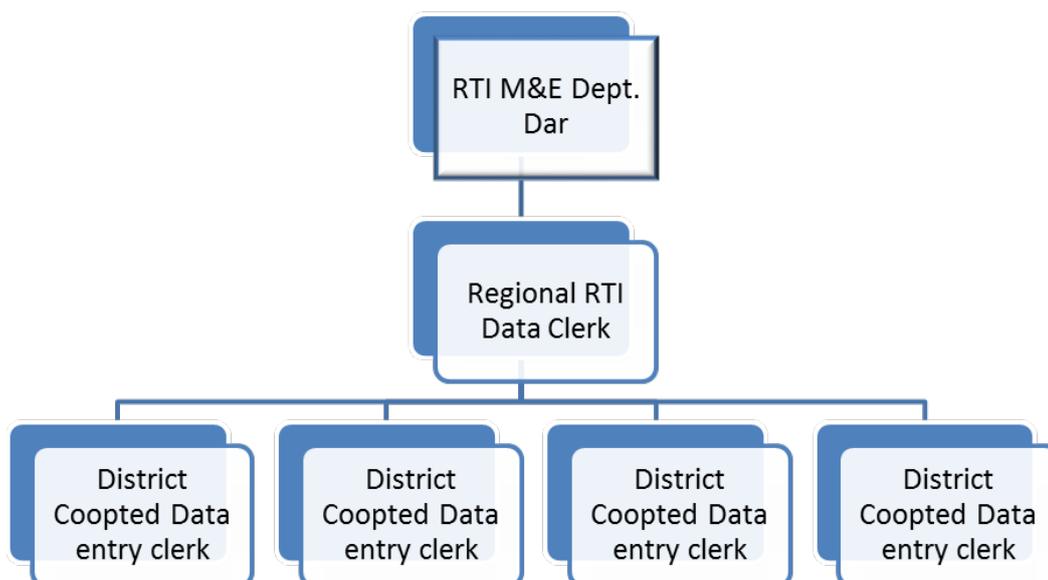
**Figure 20. Cascade training model for IRS operation**



### **Monitoring the IRS Process**

Monitoring of IRS is performed by the TVCSP M&E unit in collaboration with partners at the district level (see **Figure 21**). Monitoring involves collection of information, storage, processing and informing the implementer of rational decision along the course of IRS implementation. Tools used included computers at RTI central and regional offices and DMOs offices, templates for handling collected data, various forms for data collection. Components that are monitored include trainings, IRS coverage, insecticide usage, and other IRS supplies.

**Figure 21. 2012–2013 M&E Organogram**



### ***Monitoring of Training Activities***

Like in Zanzibar, (see monitoring of training activities under *Monitoring of Training Activities* under *Section B—Zanzibar*), RTI and the DITT were primarily responsible for tracking the number of people trained in different capacities in each of their respective districts.

### ***IRS Coverage and Use of Insecticides***

This component measured inputs, processes, and outputs more effectively. It involved collection of information by spray operators that covered type and size of sprayed structure, protected people categorized as children  $< 5$  and  $\geq 5$  and pregnant women, and use of nets against mosquito bites. Team leaders compiled the collected information for every eight spray operators; site managers aggregated the data for entire IRS sites to reflect performance for each operation day. These data were sent to the DMOs' offices, where the information was processed and analyzed using pre-designed MS Excel templates. The processed information was regularly used by IRS supervisors to monitor the progress of the implementation.

At the site level, a daily monitoring chart was used to track the daily monitoring of spray performance. Stock and property control booklets were used to account for the receiving, requisition, and return of IRS items. In addition, insecticide management and transport monitoring tools were also used.

### ***Getting RTI Prepared to Support the IRS Process***

The zonal office in collaboration with the two regional offices in Bukoba and Musoma provided support to implementing partners (district authority, communities, and the private sector) to conduct IRS in the Lake Zone.

## **Public-Private-Partnership (PPP) in IRS implementation in the Lake Zone**

During the reporting period (2012–2013), a unique PPP among RTI, Geita Gold Mine (GGM), and Geita District Council was revamped again. The partnership facilitated IRS of urban and a peri-urban wards of Kalangalala and Mtakuja in Geita District, in Geita Region. IRS was conducted between May 27, 2013, and June 11, 2013. In this partnership, RTI provided technical and financial management support; GGM provided financial support while GTC was responsible for field implementation of the IRS intervention.

As part of the collaboration, TVCSP determined the quantity of insecticide and equipment required and procured and supplied 10,000 sachets of deltamethrin (K-Othrine) and 160 spray pumps (Hudson® Expert). The pumps were returned to the project after spray operations concluded. TVCSP also supervised the advocacy, sensitization, and community mobilization for IRS. The multifaceted community media approach utilized a combination of radio spots, flyers, and public address systems, in addition to interpersonal communication through hamlet chairpersons. This multifaceted approach ensured that the districts' residents were prepared for the operation.

The overall target for Geita were estimated at 20,789 structures. Some 10,755 of these structures were located in Mtakuja Ward and 10,034 in Kalangalala Ward.

## **X. Implementation of IRS Activities**

### **Quality Control of Spray**

Refer to *Quality Control of Spray* under *Section B—Zanzibar*.

### **Environmental Monitoring and Mitigation Activities**

Environmental monitoring and environmental compliance inspections were carried out in all operational sites in Mara, Mwanza, and Kagera by the RTI Environmental Officer and RTI Regional Environmental Compliance Inspector. The inspections were carried out in the first round, where pyrethroid (Mara and Mwanza) and bendiocarb (Kagera, Mara, and Mwanza) insecticides were used, and in a second round, where bendiocarb re-spraying was conducted in selected areas of Mara, Mwanza, and Kagera regions. The compliance inspections were carried out between January and May 2013 to ensure program compliance with mitigation measures stipulated in SEA of 2010 and PEA of 2011.

A total of three inspections were conducted at different stages of the operations. In the first round, pre- and mid-spray environmental compliance inspections were conducted in January 2013. A mid-spray compliance inspection was conducted in March 2013, (see *Annex K*) on environmental compliance inspections reports of 2013).

The second round pre- and mid- spray environmental compliance inspection was conducted between May 22, 2013, and May 30, 2013. Observations from all

inspectors present at these inspections noted that improvements were made in all storage documentation from IRS sites.

During the pre- and mid-IRS inspections, randomly selected IRS sites in Mara, Mwanza, and Kagera were selected and visited to assess the teams' preparedness and compliance with best practices and environmental requirements. Following the rigorous inspection, the sites were found to be in compliance with all the environmental and human safety requirements (see *Annex K* on environmental compliance inspection reports).

## Logistics

### *Storage of Insecticide and Other Supplies*

Insecticide and other IRS supplies were stored at the zonal, regional, and district warehouses. Movement and management of supplies were handled by RTI through each of the offices located in Kagera, Mara, and Mwanza regions. *Table 19* shows the movement of insecticide; *Tables 20* and *21* show the movement of IRS consumables and PPE during operations.

**Table 19. Insecticide movements by type and by warehouse**

<b>Bendiocarb</b>		<b>Sachet and weight movement</b>		
Warehouse	Initial	Kgs	Used	Remaining
Mwanza	53,021	6,628	31,939	21,082
Bukoba	98,988	12,374	94,313	4,675
Mara	37,483	4,685	24,485	12,998
<b>Total</b>	<b>189,492</b>	<b>23,687</b>	<b>150,737</b>	<b>38,755</b>
<b>Deltamethrin</b>		<b>Sachet and volume movement</b>		
Warehouse	Initial	Liters	Used	Remaining
Mwanza	113,933	7,117	113,523	410
Bukoba	-	-	-	-
Mara	65,351	4,082	64,451	900
<b>Total</b>	<b>179,284</b>	<b>11,199</b>	<b>177,974</b>	<b>1,310</b>

**Table 20. PPE consumables movements by type and by warehouse**

<b>Mask</b>			
<b>Warehouse</b>	<b>Initial</b>	<b>Used</b>	<b>Remaining</b>
Mwanza	33,365	24,137	9,228
Bukoba	25,440	13,479	11,961
Musoma	10,070	15,005	(4,935)
<b>Total</b>	<b>68,875</b>	<b>52,621</b>	<b>16,254</b>

**Table 21. Selected PPE and spray equipment movement by type and warehouse**

	Spray Pumps Hudson Expert					Overall					Boots				
Warehouse	Initial Balance	Issued	Final Balance	Working	Out of Order	Initial Balance	Issued	Remaining	Intact	Worn out	Initial Balance	Received	Remaining	Intact	Worn out
Mwanza	1,577	0	1,577	1,510	67	4,755	0	1,755	896	713	1,729	1,902	1,902	1,573	329
Bukoba	1,066	0	1,066	1,056	10	1,704	0	1,704	3,776	170	1,212	1,333	1,333	808	525
Musoma	842	0	842	800	42	1,770	0	1,770	2,013	212	849	934	934	675	259
<b>TOTAL</b>	<b>3,485</b>	<b>0</b>	<b>3,485</b>	<b>3,366</b>	<b>119</b>	<b>8,229</b>	<b>0</b>	<b>8,229</b>	<b>9,216</b>	<b>1,096</b>	<b>3,790</b>	<b>4,169</b>	<b>4,169</b>	<b>3,056</b>	<b>1,113</b>

## Provision of Transport for Operators and Supervisors

During IRS operations, numerous vehicles were hired to transport operators and supervisors from the national, regional, and district levels. *Table 22* indicates the number of cars hired during the last IRS round.

**Table 22. Vehicles hired during IRS operations**

	Kagera	Mara	Mwanza	Lake Zone	
Vehicles	Operators cars	116	131	180	427
	Supervisor cars	12	6	10	28
	<b>Total vehicles</b>	<b>128</b>	<b>137</b>	<b>190</b>	<b>455</b>

## End of Spray Activities

### ***Post-spray Environmental Compliance Inspections and Site Decontamination and Decommissioning***

Post-spray environmental compliance inspections were conducted in all IRS sites in Kagera, Mara, and Mwanza regions. RTI Environmental Compliance Officers carried out IRS site decontamination and decommissioning, making sites and storage areas safe for the surrounding communities. After the post-spray inspections, the IRS operational sites were handed over to the local authorities for safe custody until the next IRS operation.

### ***Solid Waste Disposal***

After the end of IRS operations, all insecticide-contaminated waste were transported to the regional and zonal warehouse for storage to await disposal at the incinerating facility recently commissioned by RTI at the Nyanguge Health Centre, located 33 km from Mwanza City. The facility is currently operational, having started incinerating a stockpile of 15 tons of waste that was safely accumulated from the previous rounds, since 2007. Thus far, 4 tons of waste has been disposed, with the disposal of remaining 11 tons estimated to take another 1 year.

### ***End of Spray Inventory in Storage Facilities***

See *End of Spray Inventory in Storage Facilities* under *Section B—Zanzibar*.

## Section D: IRS Results

### XI. IRS Results—Mainland

#### Population and House Structures Found

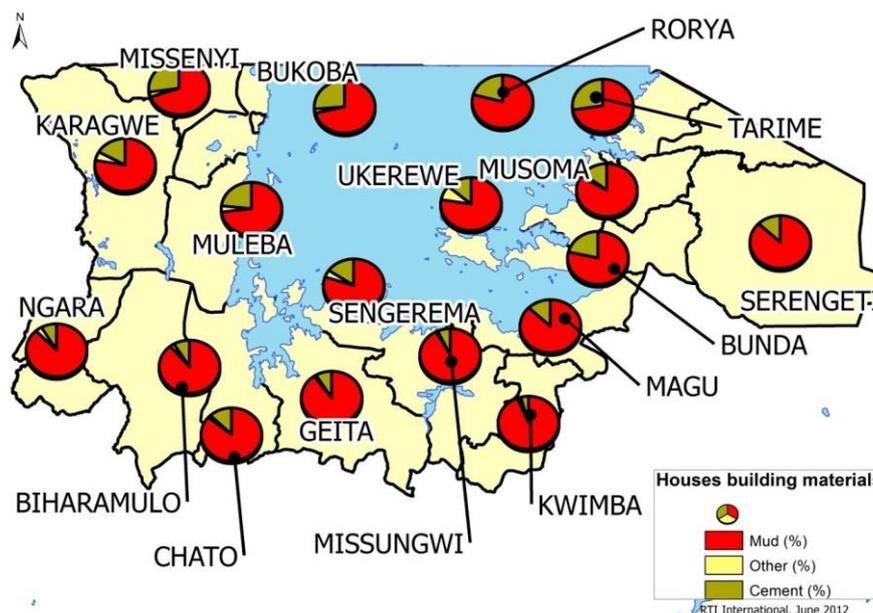
##### *House Characteristics and Population Profile*

In Mainland Tanzania, out of 817,836 eligible house structures (see *Annex A*) in the Lake Zone, 776,425 were visited (95%). Wall characteristics of houses were only captured for Mainland Tanzania, where 82% of houses were mud-walled, 16% were cement, and 2% were classified as “other” (see *Table 23*). The district variations are illustrated in *Figure 22*. On average, the size of houses in Mwanza Region was the largest (108 sqm) and the lowest in Mara Region (97 sqm). House size in Kagera Region was average (106 sqm).

*Table 24* presents the population breakdown of households visited in Mainland Tanzania. In total, 4,277,436 people were recorded during the spray operations, of which 24% were high-risk groups (pregnant women and U5 children). The family size was 5.5 per household.

A summary of household characteristics and population by district, region, and zone is presented in *Annex C*.

**Figure 22. House walls characteristics by district in the Lake Zone**



**Table 23. Visited household characteristics**

		Kagera	Mara	Mwanza	Lake Zone
House structures found		221,571	221,920	332,934	776,425
Wall materials	Mud wall houses (%)	79%	84%	83%	82%
	Bricks wall houses (%)	18%	16%	15%	16%
	Other wall materials (%)	3%	0%	1%	2%
Average # of rooms per house structure		4.3	2.9	3.5	3.5
Average house structure size (sqm)		106	97	108	104

**Table 24. Population recorded during spray in visited households**

		Kagera	Mara	Mwanza	Lake Zone
Population	Total	1,071,291	1,165,584	2,040,561	4,277,436
Average Family size		5	5	6	5
Risk group	U5 (%)	190,600 (18%)	258,551 (22%)	439,671 (22%)	888,822 (21%)
	Pregnant women (%)	25,924 (2%)	46,143 (4%)	73,951 (4%)	146,018 (3%)
Five years and above	Male (%)	426,517 (40%)	423,228 (36%)	757,437 (37%)	1,607,182 (38%)
	Female (%)	428,250 (40%)	437,662 (38%)	769,502 (38%)	1,635,414 (38%)

## Spray Results

### Main Spray Indicators

In Mainland Tanzania, out of the eligible households, 95% were visited<sup>4</sup> by spray operators. The remaining eligible houses were unreachable because spray operators

<sup>4</sup> “Visited” is defined as houses that spray operators were able to reach, which are made up of sprayed and unsprayed houses.

could not get to them. **Table 25** gives a breakdown of the main spray indicators for the Lake Zone.

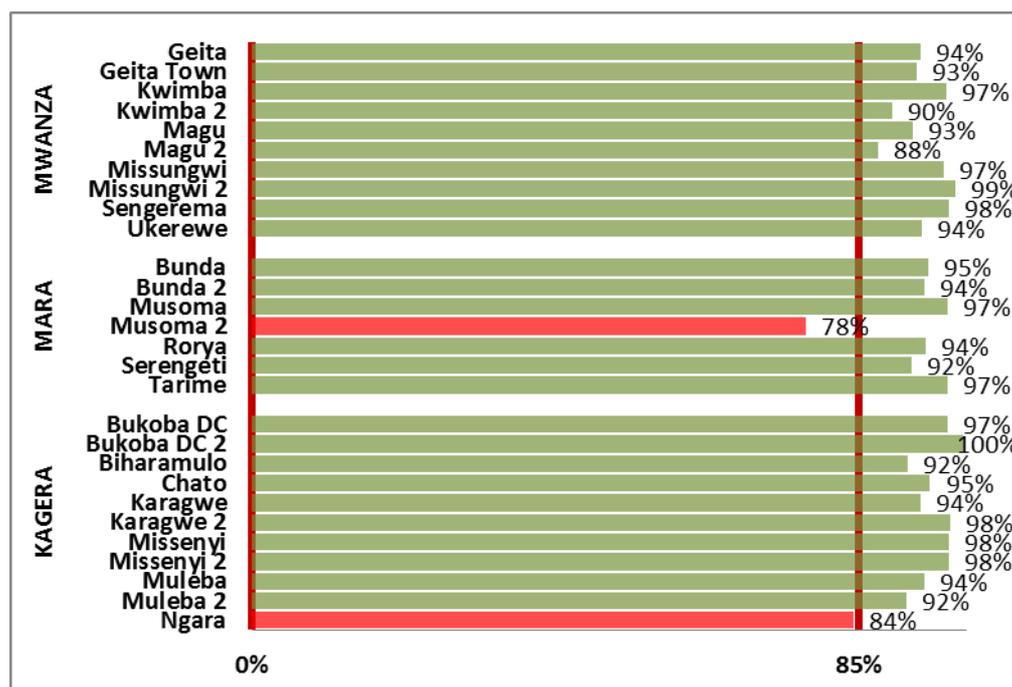
The spray coverage results reflect houses that were visited and sprayed out of those targeted (i.e., eligible). In 2012–2013, nearly 95% spray coverage was attained in Mainland Tanzania. Spray coverage by district in Mainland Tanzania is illustrated in **Figure 23**. The lowest IRS coverage was recorded in the second cycle of carbamate spraying in the targeted areas of Musoma District (78%) while the highest was in Bukoba DC (100%), also conducted in the second cycle of carbamate spraying.

Summary of spray indicators by district region and zone are reported in **Annex D**.

**Table 25. Main spray indicators by area**

House structures	Kagera	Mara	Mwanza	Lake Zone
Eligible	233,125	234,520	350,191	817,836
Visited	221,571	221,920	332,934	776,425
Visited %	95%	95%	95%	95%
Sprayed	220,415	221,607	331,907	773,929
Visited and not sprayed	1,156	313	1,027	2,496
Not reached	11,554	12,600	17,257	41,411
Spray coverage	94.5%	94.5%	94.8%	94.6%

**Figure 23. Spray coverage by districts of Lake Zone**



### **Refusal and Houses Not Reached**

A total of only 2,496 house structures in the Lake Zone were visited but not sprayed, which represents < 1% of eligible house structures. This was due to a combination of reasons ( e.g., funeral ceremonies, a very sick person in a house, crops stored inside the structure eligible for spray). Almost 25% of nonsprayed houses were closed at the time of the visit. The interpretation of this event is difficult, such as silent refusal or being uninformed about the operation (see **Table 26** and **Annex G** for district data).

A higher proportion of houses, about 5%, were not reached by spray teams (41,411). The main reason for failure to reach all eligible houses is due to their accessibility during the scheduled time. Unfavorable road conditions during the rainfall period significantly contributed to the missed houses.

**Table 26. Reasons for non-spray**

	Kagera Region		Mara Region		Mwanza Region		Lake Zone	
Crops inside	480	36%	27	9%	447	57%	954	39%
Funeral	107	8%	10	3%	52	7%	169	7%
Sick person	148	11%	35	12%	-	0%	183	8%
House closed	366	27%	68	24%	177	22%	611	25%
Refused	193	14%	139	48%	76	10%	408	17%
Other reasons	48	4%	10	3%	38	5%	96	4%

### **Use of Insecticides**

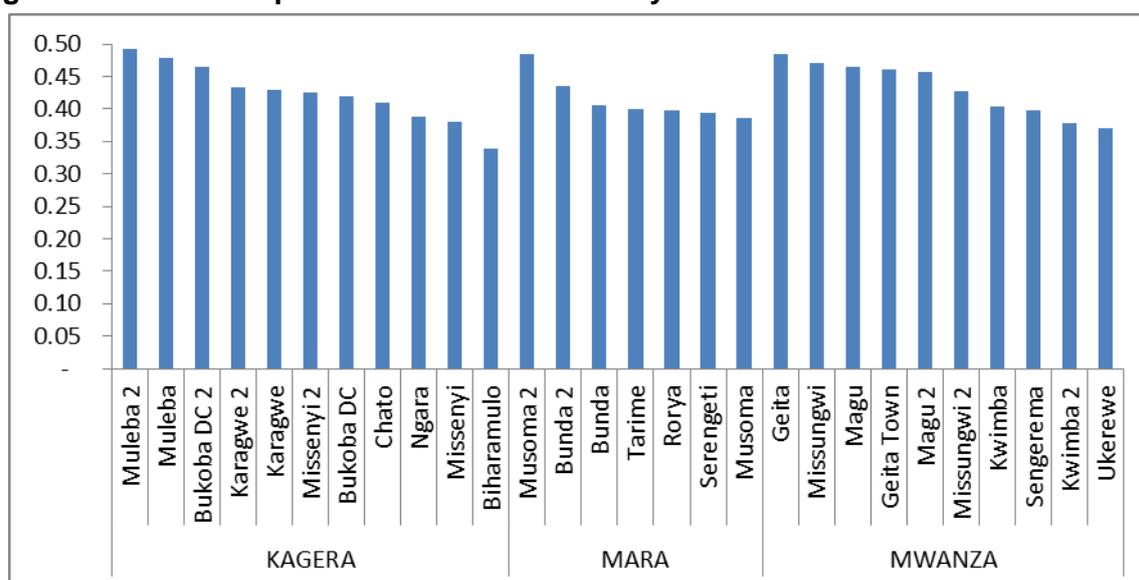
A total of 328,711 sachets of deltamethrin and bendiocarb were used to spray 776,425 house structures in the 18 eligible districts of Mainland Tanzania at a ratio of 0.41 sachets per house structure. **Figure 24** gives a summary of sachet to house ratio in each of the rounds conducted in the 18 districts. An average of nine rooms was sprayed per sachet. A total of 3,559 kg (11,118 litres) of K-Othrine WP and 18,842 kg of FICAM were used in the Lake Zone.

**Table 27** gives a summary breakdown of type and quantity of insecticide used, as well as the proportion of the different classes in relation to the targeted structures that were sprayed in Kagera, Mara, and Mwanza regions. For district breakdown see **Annex J**.

**Table 27. Use of insecticide**

	Kagera		Mara		Mwanza		Lake Zone	
	Bendiocarb	Bendiocarb	Deltamethrin	Bendiocarb	Deltamethrin	Bendiocarb	Deltamethrin	
Sachets used	94,313	24,485	64,451	31,939	113,523	150,737	177,974	
Kgs	11,789	3,061	1,289	3,992	2,270	18,842	3,559	
Number of houses sprayed by type of insecticide	220,415	58,395	163,212	74,076	257,831	352,886	421,043	
% of houses sprayed by type of insecticide	100%	26%	74%	22%	78%	46%	54%	

**Figure 24. Sachet per house structure ratio by district in the Lake Zone**



### Population Protected

A total of 4,052,354 people were protected with IRS in the Lake Zone out of the 4,505,752 targeted eligible populations. The estimated number of pregnant women and U5 children protected by IRS<sup>5</sup> was 138,281 and 841,451, respectively (see *Table 28* and *Annex E*).

**Table 28. Population protected by spray zone**

Population protected	Kagera	Mara	Mwanza	Lake Zone
<b>U5</b>	179,876	244,477	417,098	841,451
<b>Pregnant women</b>	24,445	43,761	70,075	138,281
Five years and above male	403,856	400,407	718,771	1,523,034
Five years and above female	405,373	414,059	730,156	1,549,588
<b>Five years and above all</b>	809,229	814,465	1,448,927	3,072,621
<b>Total</b>	1,013,550	1,102,703	1,936,100	4,052,353
Eligible	1,127,554	1,232,638	2,145,560	4,505,752
Percent	90%	89%	90%	90%

<sup>5</sup> As per PMI's definition, the protected risk groups are those living in houses that have been sprayed.

## **Community Sensitization Results**

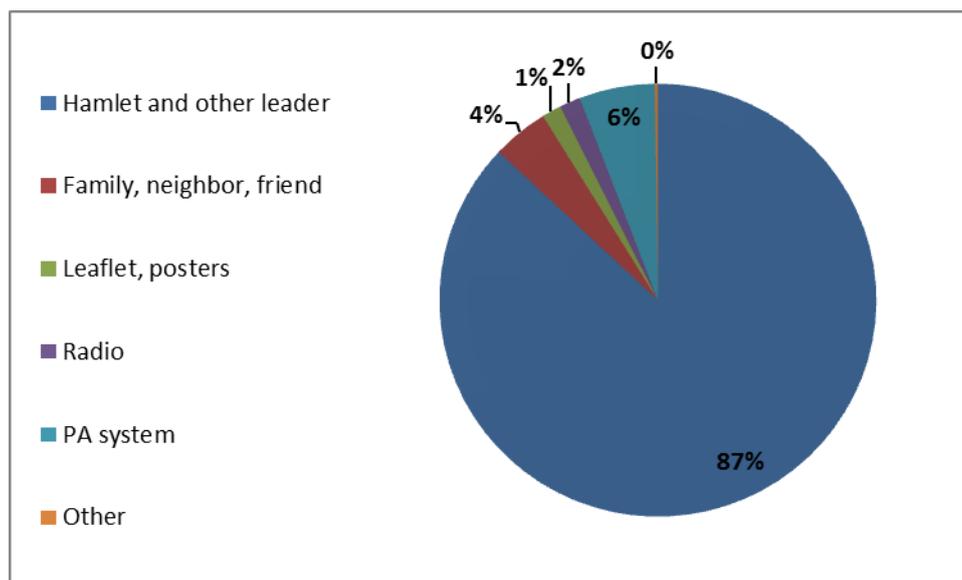
### ***Source of Information***

A large proportion (93%) of households (776,425) received information prior to an IRS operator's visit to the respective houses. Interpersonal communication from community leaders and other members was by far the largest source of information and constituted the majority of our IEC/BCC efforts (91%). In total, 3,018,935 people (1,496,500 males and 1,522,435 females) were reached through various IEC approaches in the Lake Zone. Other sources of information are reported in ***Table 29***, ***Figure 25***, and ***Annex I***.

**Table 29. IRS information and source by administrative level**

	Kagera	Mara	Mwanza	Lake Zone
Information on IRS not received	8%	9%	5%	7%
Information on IRS received	92%	91%	95%	93%
Source of information				
Interpersonal communication (community leaders and others)	96%	93%	92%	89%
Printed media (leaflets, posters)	1%	2%	1%	2%
Electronic media (radio, TV)	2%	2%	1%	1%
Public address system	1%	3%	6%	7%
Other sources	0%	0%	0%	0%
No answer	0%	0%	0%	0%

**Figure 25. Source of Information of IRS**



***Perceived Advantages and Disadvantages from Previous IRS Rounds***

Information for this indicator was specifically collected for the Lake Zone. The response rate was over 98%. Around 85% of respondents felt the main advantages of IRS were to reduce malaria, as well as the number of mosquitoes. About 80% of the respondents did not perceive any negative effects of IRS. The proportion is much higher in Mara and Mwanza (about 90% and 89%, respectively). In some districts of Kagera, respondents complained about proliferation of fleas (see **Table 30**). However, this finding did not affect acceptance of IRS as demonstrated by the high spray coverage in the same districts (see **Annex H** for details).

**Table 30. Advantages and disadvantages cited by communities after IRS by administrative level**

Perception/Region	Kagera	Mara	Mwanza	Lake Zone
<b>Perceived Advantages of IRS</b>				
No advantages	6%	18%	12%	12%
Malaria/mosquitoes reduced	91%	79%	86%	85%
Other advantages	2%	2%	1%	2%
No answer	1%	1%	1%	1%
<b>Perceived Disadvantages of IRS</b>				
None	60%	90%	89%	80%
Pest/fleas proliferation	37%	4%	5%	15%
Side effects	2%	4%	4%	3%
Other disadvantages	0%	0%	1%	1%
No answer	1%	2%	1%	1%

## Usage of ITNs

In the Lake Zone, 136,184 (93%) of pregnant woman and 818,455 (94%) of U5 children were declared to have slept under ITNs the previous night in the house structure visited during this reporting period (see **Table 31**; for district breakdown, see **Annex F**).

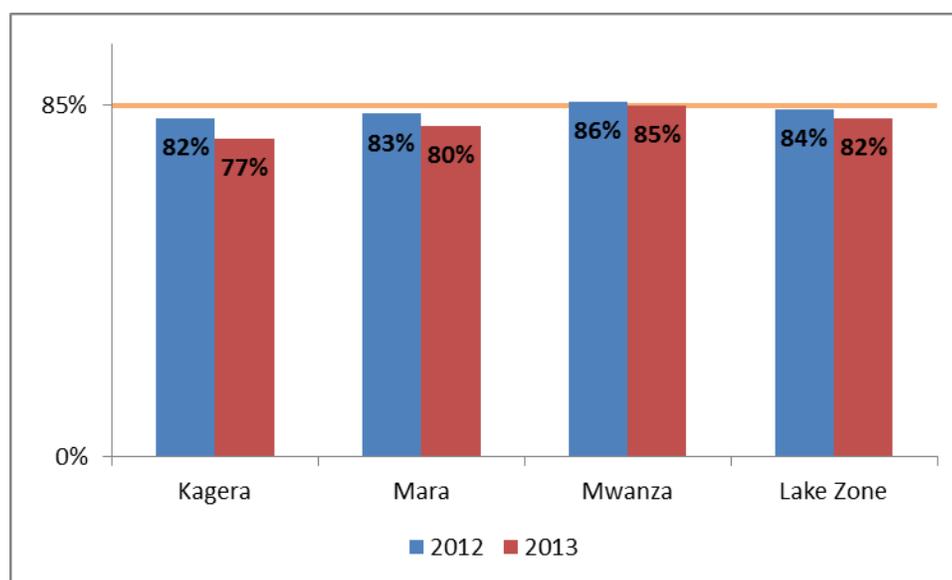
The results showed that overall net usage in the Lake Zone is 93% and 92% for pregnant woman and U5 children, respectively (see **Table 31**).

Universal LLIN coverage (82%) in 2013 IRS campaign shows a slightly lower figure than the 2012 IRS (84%) campaign (see **Table 31** and **Figure 26**).

**Table 31. LLIN usage by region and zone by age group**

Group		Kagera	Mara	Mwanza	Lake Zone
U5	Slept under LLIN/ITN previous night	170,086	235,208	413,161	818,455
	Net usage %	90%	92%	96%	92%
Pregnant women	Slept under LLIN/ITN previous night	22,808	42,532	70,844	136,184
	Net usage %	89%	92%	97%	93%
Five years and above	Slept under LLIN/ITN previous night	632,356	658,699	1,251,833	2,542,888
	Net usage %	74%	77%	85%	79%
All ages	Slept under LLIN/ITN previous night	825,250	936,439	1,735,839	3,497,527
	Net usage %	77%	80%	85%	82%

Figure 26. Universal net coverage 2012 and 2013 by regions and zone



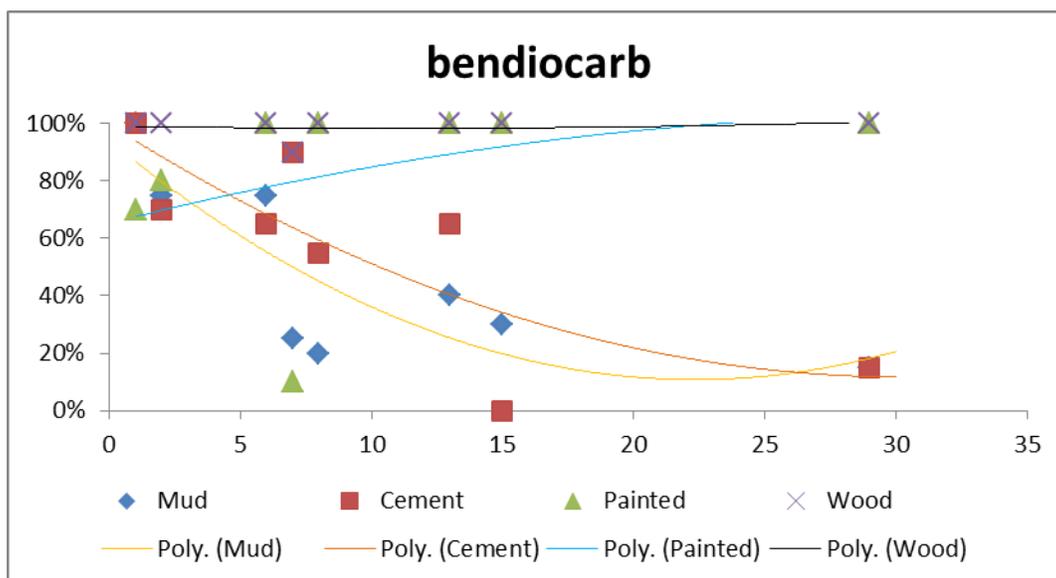
## XII. Monitoring Insecticide Quantification After Spray, Insecticide Decay, and Insecticide Resistance

### 2013 Preliminary Results of Insecticide Decay Monitoring Using Cone Bioassay

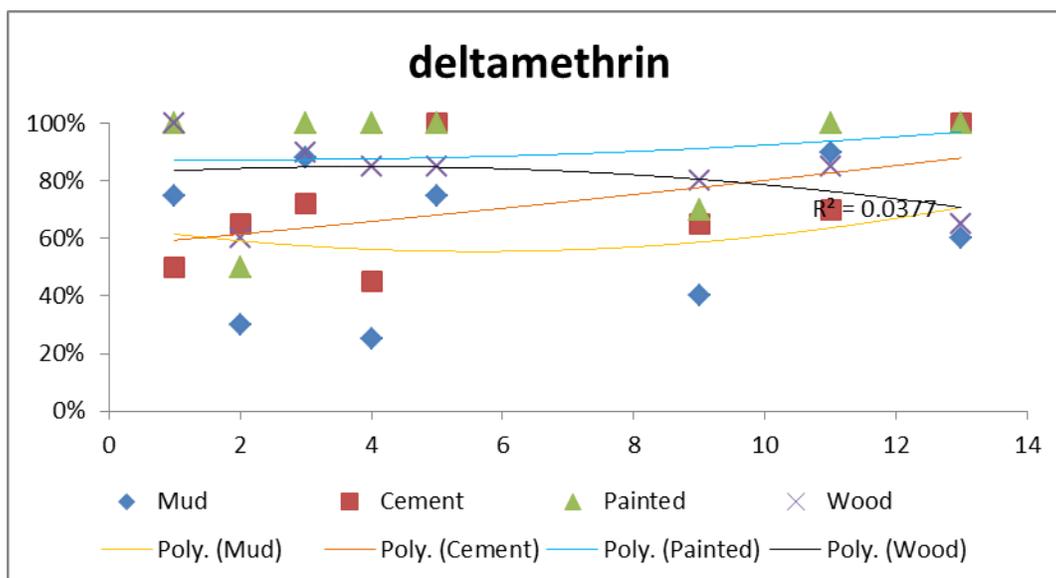
Seven districts were selected to monitor insecticide effectiveness on the walls sprayed with deltamethrin (Ukerewe, Sengerema, Tarime, and Serengeti) and with bendiocarb (Chato, Karagwe, Muleba, Serengeti, Tarime, Sengerema, and Ukerewe). Six months after the last spray round, bendiocarb elicited 100% mortality on wood and painted wall surfaces. On the other hand, poor performance was recorded on mud and wall surfaces, with a drop in mortality to below 80% in 3–4 weeks after spraying (see *Figure 27*).

Results for bioassays on walls sprayed with deltamethrin show that wood and painted wall surfaces could elicit 100% mortalities up to 13 weeks after spraying. Cement wall surfaces elicited slightly above 70% mortality and mud 60% mortality up to 13 weeks after spraying (see *Figure 28*).

**Figure 27. Insecticide decay on various surfaces up to week 29 after bendiocarb application in 2013 IRS campaign**



**Figure 28. Insecticide decay up to week 13 after deltamethrin application in 2013 IRS campaign**



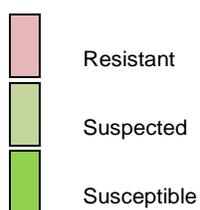
### Insecticide Resistance Monitoring in Lake Zone and Zanzibar

NIMR-Amani Centre regularly monitors country-wide insecticide resistance in collaboration with NMCP. RTI subcontracted the NIMR-Amani Centre to monitor insecticide resistance in national representative sites, making up a total of 10 district sentinel sites. Three districts in which IRS is ongoing are among those sites regularly

monitored—Tarime, Geita, and Ngara. **Table 32** shows that resistance to both pyrethroids tested (permethrin and lambda-cyhalothrin) was recorded in Ngara and Geita districts.

**Table 32. Summary of susceptibility levels of malaria vectors to insecticides using WHO susceptibility test kits**

Sentinel Districts	% Mortalities of malaria vectors observed 24 hours post exposure insecticides				
	DDT -4%	Bendiocarb	Fenitrothrin 1%	Permethrin 0.75%	Lambda cyhalothrin .05%
Moshi	99	100	98	60	56
Arumeru	92	97	100	74	68
Sumbawanga	100	100	100	100	100
Manyoni	100	100	100	100	100
Ngara	-	100	-	60	54
Geita	98	-	100	80	78
Tarime	100	100	100	100	99
Bariadi	97	100	100	97	91
Kigoma	100	100	100	100	100
Bagamoyo	100	100	100	97	100



# Section E: Lessons Learned, Challenges & Recommendations

## **XIII. Lessons Learned**

- SIMs continued to be a good linkage between site managers and community leaders. SIMs played a big role in advocating IRS to the community and are attributed with much of the good coverage attained during this round.
- Deltamethrin (K-Othrine), which was used for the first time in this IRS campaign, was well accepted by community members, claiming that it was very effective, even against bedbugs.
- The cascade mode of training has significant impact in team leaders' supervision of spray operators.
- Staff compensation payments made through Vodacom M-Pesa proved to be efficient and timely compared to payments made through bank accounts with NMB.
- District Malaria Focal Persons that were trained as National IRS Core Facilitators were very supportive in the training of site managers, team leaders, and spray operators.

## **XIV. Challenges**

- We observed a discrepancy between the number of targeted structures and those found on the ground during IRS. Available data from national and district authorities is based on households and is not up to date.
- Lack of sufficient epidemiological and entomological data at the ward level poses difficulties during the stratification of eligible villages for IRS as we move towards targeted and focal spraying.
- Complaints from household members observing an increase of fleas immediately after spraying houses affected households' compliance with spray activities in certain villages in Kagera Region, to the extent of being a major reason for refusals. As a result, spray operators spent significant time convincing home owners to allow spraying to continue as planned.

## **XV. Recommendations**

- Before IRS, registration data for eligible structures to be sprayed should be updated through logistic assessment.

- With the increasing trend of resistance to pyrethroids and carbamate, it would be important to explore other classes of insecticides, such as Vectron (Etofenprox) and (Actellic) Pirimiphos-methyl 300 CS, among the list of insecticides being monitored for vector susceptibility.

## XVI. IRS in Action



*An incineration in progress at Nyanguge site in Mwanza Region.*



*Incineration attendants loading empty sachets in the incineration machine.*



*Spray operators cleaning their work gear in the washing bay at Buhemba IRS operation site in Musoma District.*



*Spray operator collecting relevant information from a resident of Mtakuja Ward in Geita District immediately after the spraying activity.*



*Spray operators' overalls hanging on the washing bay at the Ilyamchele IRS operation site in Chato District.*



*Spray operators in training.*



*IRS spray operator applying insecticide on a wall.*