PMI | Africa IRS (AIRS) Project
Indoor Residual Spraying (IRS 2) Task Order Four

RWANDA
SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT 2012-2016
AMENDMENT #2

AUGUST 2013
1. The Rwanda Supplemental Environmental Assessment (SEA) (2011) for Rwanda, as amended in 2012 (amendment #1) is valid for implementing PMI-supported Indoor Residual Spraying (IRS) in all high-risk areas in Rwanda, using all WHO-recommended pesticides in the pyrethroids, carbamates, and organophosphate classes that are registered by the government of Rwanda, for the period 2012-2016.

2. It is proposed to amend the registration requirements for the use of carbamates in Rwanda. In the August 2011 IRS SEA, it was specified that only pesticides registered for use by the Rwandan Ministry of Agriculture and Animal Resources (MINAGRI), Ministry of Health, or any other recognized entity may be used for IRS in Rwanda (except in special circumstances). At the time of this Amendment #2, of the WHO pesticides, only three pesticides, all in the pyrethroids class, are registered for use. Due to developing resistance to pyrethroids by the Anopheles vector, it is desired to use carbamates for the 2013 spray season. The Rwandan government is enacting legislation that will allow the registration of the WHO-approved pesticides, including carbamates, by the Malaria and Other Parasitic Diseases Division (MOPDD) but this legislation is not expected to be passed prior to the 2013 spraying season. The current proposed amendment would therefore change the registration requirements of the SEA such that a letter from the Rwandese Ministry of Health authorizing the importation and use of carbamate pesticides would be sufficient to satisfy requirements for host-country authorization of pesticide use. In providing this SEA Amendment #2 to the MOPDD, and by providing the training that has been given in past years, and is scheduled to continue under the PMI IRS program, PMI has complied with the notification and mitigation requirements of United States Regulation 22 CFR 216 3(b).

3. It is proposed to further amend the SEA to include a Rwanda-specific analysis of the pesticide procedures found in Title 22 of the Code of Federal Regulations, Part 216 (22 CFR 216), as mandated by the 2012 IVM PEA, and to provide a general update of the document consistent with current standards.
Signature approval of this SEA Amendment #1 will indicate acceptance of these proposals. Therefore, the following conditions will apply.

1. A letter of authorization from the Rwanda Malaria and Other Parasitic Diseases Division will be sufficient authorization for PMI/AIRS Rwanda to import and use the WHO-recommended carbamate-class pesticide bendiocarb for the 2013-14 spray season.

2. The 2011 SEA will be amended to include the Pesticides Procedures found in Chapter 4 of this document.
AMENDMENT TO THE SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT FOR PRESIDENT'S MALARIA INITIATIVE-INDOOR RESIDUAL SPRAYING (IRS) FOR MALARIA CONTROL IN RWANDA

APPROVAL OF ENVIRONMENTAL ACTION RECOMMENDED:

The United States Agency for International Development, Global Health Bureau has determined that the proposed indoor residual spraying effort, as described in the Supplemental Environmental Assessment: Indoor Residual Spraying for malaria control in Rwanda dated May 2011, as amended, responds to the needs of the community and country as it relates to managing malaria in Rwanda, and also conforms to the requirements established in 22 CFR 216.

This document does not mandate the execution of the proposed IRS, rather, it documents the environmental planning and impact analysis executed by the IRS team in preparation for the proposed action. The design and standards of operation of the IRS program are established to avoid and reduce any potential impact. USAID has concluded that the proposed action, when executed as described in the Supplemental Environmental Assessment and amendment(s) and the Programmatic Environmental Assessment for PMI IRS, is consistent with the Government of Rwanda's and USAID's goal of reducing malaria incidence in Rwanda while minimizing negative impact to the environment and to human health.

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CONTENTS

Contents 7
Acronyms 10

1. Background .................................................................................................................................................................................. 12
  1.1 President’s Malaria Initiative ............................................................................................................................................... 12
  1.2 Program Objectives ............................................................................................................................................................. 12
  1.3 Malaria Burden in Rwanda .................................................................................................................................................... 13
  1.4 History of Malaria Control in Rwanda ............................................................................................................................ 14
  1.5 Other Donors Supporting Malaria Control ......................................................................................................................... 16

2. Proposed Action and Alternatives .................................................................................................................................................... 17
  2.1 Description of Proposed Action ............................................................................................................................................. 17
  2.2 No Project Alternative ............................................................................................................................................................ 19
  2.3 Alternative IRS Geographical Sites Considered .................................................................................................................. 19
  2.4 Use of Alternative Insecticide(s) ......................................................................................................................................... 19
  2.5 Alternative Technologies ......................................................................................................................................................... 20

3. Affected Environment - Rwanda ......................................................................................................................................................... 21
  3.1 Administrative and Political Units in Rwanda .................................................................................................................... 21
  3.2 Physical Environment .............................................................................................................................................................. 21
  3.3 Critical Wetland and Marshlands ........................................................................................................................................... 23
  3.4 Forests ..................................................................................................................................................................................... 34
  3.5 Wildlife .................................................................................................................................................................................. 40
  3.6 Agriculture ............................................................................................................................................................................. 41

4. Pesticide Procedures ........................................................................................................................................................................... 46
  4.1 A. The United States Environmental Protection Agency’s Registration Status of the Requested Pesticide .................................................................................................................................................. 46
  4.2 B. The Basis for Selection of the Requested Pesticides ........................................................................................................ 46
  4.3 C. The Extent to Which the Proposed Pesticide Use Is Part of an Integrated Pest Management (IPM) Program ........................................................................................................................................... 48
  4.4 D. The Proposed Method or Methods of Application, Including Availability of Appropriate Application and Safety Equipment ........................................................................................................................................... 49
  4.5 E. Acute and Long-Term Toxicological Hazards Associated with the Proposed Use and Measures Available to Minimize Such Hazards ........................................................................................................................................... 50
  4.6 F. The Effectiveness of the Requested Pesticide for the Proposed Use .................................................................................. 52
  4.7 G. Compatibility of the Proposed Pesticide with Target and Non-Target Ecosystems .......................................................... 53
  4.8 H. The Conditions under Which the Pesticide is to be Used ............................................................................................... 54
  4.9 I. The Availability and Effectiveness of Other Pesticides or Non-Chemical Control Methods .................................................................................................................................................. 54
4.10 J. The Requesting Country's Ability to Regulate or Control the Distribution, Storage, Use, and Disposal of the Requested Pesticide ............................................................................................. 55
4.11 K. The Provisions Made for Training of Users and Applicators .............................................. 55
4.12 L. The Provisions Made for Monitoring the Use and Effectiveness of the Pesticide ......... 56

5. Environmental Regulations ........................................................................................................ 58
5.1 Legal Framework ..................................................................................................................... 58

6. Environmental and Health Impacts ......................................................................................... 60
6.1 Potential Positive Effects of the IRS Program ........................................................................ 60
6.2 Potential Adverse Impacts .................................................................................................... 60
6.3 Indirect Adverse Effects ....................................................................................................... 61
6.4 Human Exposure Risks/Impacts ......................................................................................... 62
6.5 Cumulative Impact ............................................................................................................... 64

7. Safer Use Action Plan ............................................................................................................. 66

8. EMMP Implementation ........................................................................................................... 71
Annex A: Environmental Mitigation and Monitoring Plan ............................................................. 72
Annex B: General Principles in the Management of Acute Poisoning ......................................... 81
Annex C: Summary of Acute Exposure Symptoms and Treatment of WHO Pesticides ... 84
Annex D: EMMP Report Form .................................................................................................. 89
Annex E: EMMP Certification Form .......................................................................................... 97
Annex F: References .................................................................................................................. 99

LIST OF TABLES

Table 1: Spray round Data 2007-13 (pyrethroid) ........................................................................ 15
Table 2: Rwanda’s Protected Area System .................................................................................. 34
Table 3: Birdlife in Rwanda ........................................................................................................ 41
Table 4: WHOPES Recommended Pesticides with Effective Duration ..................................... 47
Table 5: Pesticide Toxicity ......................................................................................................... 50

LIST OF FIGURES

Figure 1: Slide Positivity Rate by Health Center ........................................................................ 14
Figure 2: Planned PMI Activities September 2013 .................................................................. 16
Figure 3: the 5 provinces of Rwanda ......................................................................................... 22
Figure 4: Rainfall distribution, Rwanda, Source: MINAGRI, 2006 ............................................ 23
Figure 5: Temperature distribution, Rwanda, Source: MINAGRI, 2006 .................................... 23
Figure 6: marshlands and threats from anthropogenic activities ............................................. 25
Figure 7: Rivers and lakes in Rwanda ....................................................................................... 30
Figure 8: Rwanda Watersheds .................................................................................................. 33
Figure 9: Akagera National Park. Source: ORTPN, 2006 .......................................................... 36
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTs</td>
<td>Artemisinin-based combination therapies</td>
</tr>
<tr>
<td>ADS</td>
<td>Automated Directives System</td>
</tr>
<tr>
<td>AI</td>
<td>active ingredient</td>
</tr>
<tr>
<td>AIRS</td>
<td>Africa Indoor Residual Spraying</td>
</tr>
<tr>
<td>AMSL</td>
<td>above mean sea level</td>
</tr>
<tr>
<td>BEO</td>
<td>Bureau Environmental Officer</td>
</tr>
<tr>
<td>CAMERWA</td>
<td>Rwanda Drug, Consumables and Equipment Central Procurement Agency</td>
</tr>
<tr>
<td>CB IRS</td>
<td>Community-based IRS</td>
</tr>
<tr>
<td>CDC</td>
<td>Center for Disease Control</td>
</tr>
<tr>
<td>COP</td>
<td>Chief of Party</td>
</tr>
<tr>
<td>CS</td>
<td>capsule suspension</td>
</tr>
<tr>
<td>DDT</td>
<td>dichloro-diphenyl-trichloroethane</td>
</tr>
<tr>
<td>DHS</td>
<td>Demographic and Health Survey</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EMMP</td>
<td>Environmental Mitigation and Monitoring Plan</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
</tr>
<tr>
<td>FY</td>
<td>Fiscal Year</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GFATM</td>
<td>Global Fund to fight AIDS, Tuberculosis and Malaria</td>
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<tr>
<td>GHI</td>
<td>Global Health Initiative</td>
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<tr>
<td>IEC</td>
<td>Information, Education and Communication</td>
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<tr>
<td>IEE</td>
<td>Initial Environmental Examination</td>
</tr>
<tr>
<td>IMF</td>
<td>International Monetary Fund</td>
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<tr>
<td>IRS</td>
<td>Indoor Residual Spraying</td>
</tr>
<tr>
<td>ITNs</td>
<td>Insecticide Treated Nets</td>
</tr>
<tr>
<td>IUCN</td>
<td>International Union for Conservation of Nature</td>
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<tr>
<td>IVM</td>
<td>Integrated Vector Management</td>
</tr>
<tr>
<td>LATH</td>
<td>Liverpool Associates in Tropical Health</td>
</tr>
<tr>
<td>LLINs</td>
<td>Long Lasting Insecticide Treated Nets</td>
</tr>
<tr>
<td>MFP</td>
<td>Malaria Focal Person</td>
</tr>
<tr>
<td>MINAGRI</td>
<td>Ministry of Agriculture</td>
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<tr>
<td>MIS</td>
<td>Malaria Indicator Survey</td>
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<tr>
<td>MoH -</td>
<td>Ministry of Health</td>
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<tr>
<td>MOP</td>
<td>Malaria Operational Plan</td>
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<tr>
<td>MOPDD</td>
<td>Malaria and Other Parasitic Diseases Division</td>
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<tr>
<td>MSDS</td>
<td>material safety data sheet</td>
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<tr>
<td>NGO</td>
<td>nongovernmental organization</td>
</tr>
<tr>
<td>OPs</td>
<td>organophosphates</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>--------------</td>
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<tr>
<td>PAN</td>
<td>Pesticide Database – Pesticide Action Network</td>
</tr>
<tr>
<td>PEA</td>
<td>Programmatic Environmental Assessment</td>
</tr>
<tr>
<td>PEPFAR</td>
<td>Presidents Emergency Program for AIDS Relief</td>
</tr>
<tr>
<td>PERSUAP</td>
<td>Pesticide Evaluation Report and Safer Use Action Plan</td>
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<tr>
<td>PMI</td>
<td>President’s Malaria Initiative</td>
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<tr>
<td>POPs</td>
<td>Persistent Organic Pollutants</td>
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<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
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<tr>
<td>RBM</td>
<td>Roll Back Malaria</td>
</tr>
<tr>
<td>RDB</td>
<td>Rwanda Development Board</td>
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<tr>
<td>RDT</td>
<td>Rapid Diagnostic Test</td>
</tr>
<tr>
<td>REA</td>
<td>Regional Environmental Advisor</td>
</tr>
<tr>
<td>REMA</td>
<td>Rwanda Environmental Management Authority</td>
</tr>
<tr>
<td>SEA</td>
<td>Supplemental Environmental Assessment</td>
</tr>
<tr>
<td>SOP</td>
<td>Spray Operator</td>
</tr>
<tr>
<td>SUFI</td>
<td>Scaling up for Impact</td>
</tr>
<tr>
<td>ToT</td>
<td>Training of trainers</td>
</tr>
<tr>
<td>UNEP</td>
<td>United Nations Environment Program</td>
</tr>
<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
</tr>
<tr>
<td>USEPA</td>
<td>United States Environmental Protection Agency</td>
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<tr>
<td>USG</td>
<td>United States Government</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
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<tr>
<td>WHOPES</td>
<td>World Health Organization Pesticide Evaluation Scheme</td>
</tr>
<tr>
<td>WP</td>
<td>Wettable Powder</td>
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</tbody>
</table>
1. BACKGROUND

1.1 PRESIDENT’S MALARIA INITIATIVE

Launched in 2005, the President’s Malaria Initiative (PMI)\(^1\) is a five-year, $1.2 billion expansion of U.S. Government efforts to reduce the intolerable burden of malaria and help relieve poverty on the African continent. The goal of PMI is to reduce malaria-related deaths by 50 percent in 19 countries in Africa that have a high burden of malaria by expanding coverage of four highly effective malaria prevention and treatment measures to the most vulnerable populations: pregnant women and children under five years of age (USAID 2005). These interventions include insecticide-treated mosquito nets (ITNs), indoor residual spraying (IRS) with insecticides, intermittent preventive treatment for pregnant women (IPTp), and prompt use of artemisinin-based combination therapies (ACTs) for those who have been diagnosed with malaria.

The 2008 Lantos-Hyde Act (H.R. 5501 (110th))\(^2\) authorized an expanded PMI program for 2009-2013. PMI is a key component of the U.S. Government's Global Health Initiative, which was announced by President Obama in May 2009. As a result, the PMI strategy (USAID 2010a) was revised to achieve Africa-wide impact by halving the burden of malaria in 70 percent of at-risk populations in sub-Saharan Africa – or approximately 450 million people. Now in its seventh year of funding, PMI has expanded to 19 countries plus one region. PMI, in partnership with National Malaria Control Programs (NMCP) and in support of country-level strategic plans, is providing technical, managerial, and commodity support for IRS campaigns in all 19 PMI countries.

1.2 PROGRAM OBJECTIVES

Under the GHI, the goal of PMI is to reduce the burden of malaria (morbidity and mortality) by 70% compared to 2006/2007 levels in the initial PMI countries. By 2015, PMI will have assisted the Rwandan government in achieving the following goals in PMI-supported areas:

- >90% of households with a pregnant woman and/or children <5 years of age will own at least one ITN;
- 85% of children <5 years of age will have slept under an ITN the previous night;
- 85% of pregnant women will have slept under an ITN the previous night;
- 85% of houses in geographic areas targeted for IRS will have been sprayed;
- 85% of pregnant women and children <5 years of age will have slept under an ITN the previous night or in a house that has been sprayed with IRS in the last 12 months (note, because of the highly seasonal transmission of malaria in Rwanda, one spray round per year is thought to be enough to protect the community); and

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\(^1\) See http://www.pmi.gov/
\(^2\) See http://www.govtrack.us/congress/bills/110/hr5501
• 85% of government health facilities have ACTs available for treatment of uncomplicated malaria.

1.3 MALARIA BURDEN IN RWANDA

Rwanda has a population of approximately 10.9 million, making it one of the most densely populated countries in Africa. Administratively the country is made up of 30 districts which are divided into sectors, “cellules” and then into 15,000 “umudugudus” (villages of 50-100 households).

The following malaria statistics are from the World Health Organization (WHO), as reported on http://www.malaria.com/questions/malaria-statistics-rwanda.

• Approximately 90% of Rwandans are at risk of malaria.

• Malaria is the leading cause of morbidity and mortality in Rwanda responsible for up to 50% of all outpatient visits.

• In 2005, Rwanda reported 991,612 malaria cases.

• In 2006, malaria was responsible for 37% of outpatient consultations and 41% of hospital deaths, of which 42% were children under five.

Additionally,

• An estimated 1.6 million children under five and 409,000 pregnant women/year are at risk of malaria (2002 Census, 2008 projection).

• Based on the health management information system (HMIS) data, Rwanda has seen an 84% decline in reported malaria cases from 1.5 million in 2005 to an unprecedented low of 227,015 in 2011, representing a significant reduction in transmission, even in the context of the change in malaria case definition.

• However Rwanda experienced more than 100% increase in reported malaria cases from 2011 to 2012, which emphasizes the need for continued malaria control efforts.

Malaria transmission patterns in Rwanda have fluctuated over time. The country has been divided into four natural “malarial eco-zones” based on altitude, climate, level of transmission, and disease vectors. Malaria is meso-endemic in the plains whilst the high plateaus and hills are epidemic prone. The MOPDD has classified 19 of the 30 districts as endemic and the remaining 11 as epidemic prone; however, due to changes in migration patterns and increased coverage of malaria control interventions, this classification may no longer accurately reflect transmission patterns. The MOPDD is currently remapping malaria transmission to better reflect the current epidemiology of malaria in Rwanda.

Figure 1 below shows the proportional morbidity (% of outpatient visits attributed to malaria) of confirmed and presumed malaria cases by district reported to HMIS in 2012 and indicates that the highest burden of malaria remains mainly in the districts historically classified as endemic.

13

3 WHO World Malaria Report 2012
The primary sources of information used to track trends in malaria prevalence and coverage indicators are aggregated case reports from health facilities and national household surveys. The national health management information system (HMIS) collects monthly data on the number of reported cases (presumed and confirmed) of malaria and deaths attributed to malaria by age group from the 524 health centers and district hospitals. Performance-based financing and monthly data quality audits, showing concordance between clinic registers and HMIS reports, encourage completeness of reporting.

Based on HMIS data, Rwanda has seen an 84% decline in confirmed malaria cases from 1.5 million in 2005 to an unprecedented low of 227,015 in 2011, representing a significant reduction in transmission, even in the context of the change in malaria case definition.

From 2010 to 2011, there was a 68% decline in malaria reported cases, a 45% decline in the number of malaria deaths, and a 5% decrease in the slide positivity rates. However, Rwanda experienced an upsurge in confirmed malaria cases with a greater than 216% increase in 2012 compared to 2011, from 208,355 in 2011 to 472,058 reported cases in 2012. This increasing trend seems to be even steeper in 2013 (data still being validated). The MOPDD is currently preparing for a scheduled universal net distribution campaign in July 2013, which will hopefully halt the increasing trend.

1.4 History of Malaria Control in Rwanda

Indoor Residual Spraying in Rwanda is part of a wider and integrated approach in combating malaria. The Ministry of Health continues to pursue the use of LLINs as part of the Integrated Vector Management
(IVM) intervention as described below. Environmental management and larviciding are also part of the national malaria control strategy but it has not been developed into programs for implementation.

### 1.4.1 Indoor Residual Spraying

Indoor residual spraying has been featured in malaria control strategies in Rwanda since 2007. Beginning in 2008, declining malaria incidence in some areas prompted adjustments, from district-wide IRS coverage, to more targeted focal spraying to cover high risk areas. These focal targets are now being reconsidered because of recent generalized increases in malaria caseloads, but expansion to cover entire districts has depended on available resources. See Table 1 below for coverage rates from 2007 to spring 2013.

The PMI-funded IRS program in Rwanda was launched in 2007, with three districts, (Gasabo, Nyarugenge, and Kicukiro), which protected 720,764 people. The second round in 2008 covered the same three districts plus two districts of Kirehe and Nyanza. In 2009, PMI conducted the third (97.4% of targeted structures and protecting 866,002 people) and fourth (98.1% of seven targeted districts, and protecting 1,323,442 people) spray rounds. PMI and the Ministry of Health (MOH) agreed to a scaled-down fifth round in March 2010, targeting only 72,494 structures based on the epidemiological data, remaining insecticide available and operational funds available in the FY2010 budget. The sixth round was conducted in September–October 2010 in seven districts, covering 303,659 structures, achieving 99.4% coverage and protecting 1,365,949 people. The 2011 spray round targeted the districts of Kirehe, Nyanza, Bugesera, Nyagatare, and Gisagara, protecting approximately 1,571,625 people from malaria. Both of these rounds were supported by PMI.

For 2012-13, the Rwanda Malaria and Other Parasitic Diseases Division (MOPDD), with the support of PMI implemented two rounds of indoor spraying in three districts in Rwanda. Those districts are Nyagatare, Gisagara and Bugesera.

#### TABLE 1: SPRAY ROUND DATA 2007-13 (PYRETHROID)

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Number of Districts</th>
<th>Number of Structures Sprayed</th>
<th>Population Protected</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>August</td>
<td>3</td>
<td>160,000</td>
<td>690,693</td>
</tr>
<tr>
<td>2008</td>
<td>August</td>
<td>5</td>
<td>189,756</td>
<td>885,957</td>
</tr>
<tr>
<td>2009</td>
<td>February</td>
<td>5</td>
<td>191,051</td>
<td>866,002</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>7</td>
<td>295,174</td>
<td>1,329,340</td>
</tr>
<tr>
<td>2010</td>
<td>March</td>
<td>2</td>
<td>63,395</td>
<td>280,832</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>7</td>
<td>303,659</td>
<td>1,365,949</td>
</tr>
<tr>
<td>2011</td>
<td>August/Sept</td>
<td>5</td>
<td>358,804</td>
<td>1,571,625</td>
</tr>
<tr>
<td>2012</td>
<td>Aug/Sept</td>
<td>3</td>
<td>236,610</td>
<td>1,025,181</td>
</tr>
<tr>
<td>2013</td>
<td>Feb/March</td>
<td>3</td>
<td>121,154</td>
<td>522,315</td>
</tr>
<tr>
<td></td>
<td>Sept/Oct</td>
<td>3</td>
<td>220,550*</td>
<td>917,455*</td>
</tr>
</tbody>
</table>

*Targets for September – October 2013.

In summary, since 2007, pyrethroid insecticides have been used in the PMI-supported IRS for malaria control in Rwanda.
1.4.2 INSECTICIDE TREATED NETS

The Malaria Strategic Plan promotes universal long-lasting ITNs (LLINs) coverage for all age groups, with one for every two people or three nets per household by 2013. The main delivery channels are free mass distribution during integrated health and vaccination campaigns, and routine distribution of free nets through antenatal care (ANC) and Expanded Program for Immunization clinics in all health centers.

1.4.3 ENVIRONMENTAL MANAGEMENT

The National Malaria Control strategy outlines sanitation action plans aimed at improving the environmental conditions so as to avoid mosquito breeding sites will be elaborated and implemented at district level. Larviciding is included in the national malaria control strategy but not yet developed into specific programs.

1.5 OTHER DONORS SUPPORTING MALARIA CONTROL

In addition to PMI, other development assistance for malaria comes from the Global Fund to Fight AIDS, Tuberculosis and Malaria. Global Fund grants support the expansion of community case
management with the inclusion of RDTs, anti-malarials for treatment at health facilities, procurement of LLINs and resources for health communication needed to achieve universal coverage.

2. PROPOSED ACTION AND ALTERNATIVES

This section describes the alternatives for malaria control that were considered in the preparation of the report, including those that were accepted or rejected. Alternatives considered include the following:

1. **Preferred action:** Establish annual campaigns that spray pesticides registered for use by the government of Rwanda (or with special waiver from Ministry of Health as per this Amendment #1) in high-risk districts and sectors identified by an evaluation of criteria such as transmission rate, vector susceptibility, and residual effect, appropriate home and wall structure, and ecological/human health impacts.

2. **No action alternative:** This action would discontinue PMI support for IRS activities in Rwanda.

3. **Spraying in alternative geographic regions:** This alternative would use different criteria to select alternative districts and sectors to spray. This alternative does not contribute to PMI’s goal targeting vulnerable groups based on entomological data.

4. **Using alternative pesticides:** This alternative would consider pesticides other than those recommended by WHO.

5. **Alternative technologies:** This alternative would consider methods other than IRS to achieve the stated goals of reduction in malaria mortality and morbidity.

2.1 DESCRIPTION OF PROPOSED ACTION

The preferred action is to implement an IRS program as a malaria control intervention in districts and sectors selected through a consultative process between MOPDD and USAID/PMI, considering current entomological, epidemiological, logistical, environmental, and economic conditions. The pesticide to be used will be determined by a process summarized below and more fully explained in Pesticide Procedure part B.

The insecticide class selected for each campaign of a PMI-supported IRS program is dependent on a number of criteria:

2.1.1 PRIMARY CRITERIA FOR CHOOSING PESTICIDES:

- Approval by the World Health Organization Pesticide Evaluation Scheme (WHOPES);
- Registration for use in Rwanda or special waiver from the Ministry of Health if not registered;
- Residual effect for a period longer than, or equal to, the average duration of the malaria transmission season in the selected areas;
- Appropriate for use on the wall surfaces of the selected location;
- Local vector susceptibility to the insecticide;
• Ecological impact:
• Human health impact:

2.1.2 SECONDARY SELECTION CRITERIA:

Based on these primary factors, a request for bids is tendered in accordance with US and Rwandan open competitive procurement rules. In evaluating the resulting bids, secondary criteria are considered, including:

• Appropriate packaging for safety and standard delivery tools
• Unit cost of insecticide
• Timely delivery of the insecticide to the preferred point of delivery
• Local representation of supplier in host country
• Technical assistance with training and troubleshooting by supplier

The insecticide of choice will be purchased using best procurement practices (competitive bidding and use of the above selection criteria outlined in bid documents). Should the economic and technical comparison between formulations be neutral (similar cost and vector susceptibility), then relative toxicity of formulations will be considered when making procurement decisions.

2.1.3 PESTICIDE CHAIN OF CUSTODY

Once the pesticide is procured, it proceeds through the following sequence:

Pesticide Supplier

| Quality assurance
| Rwandan Customs
| Rwandan Medical Procurement and Distribution Division (MPDD) Stores
| PMI District Storage (Storekeeper and Supervisor)
| Spray Team Leaders/Operators
| District Storage (Storekeeper, empty containers)
| Incinerator (Environmental Compliance Officer, Logistical Assistant)

Inventory of insecticides will be taken at all shipping points. The insecticides will be freighted to Kigali airport, where the contractor’s environmental logistics team will inspect the shipment and verify that the quantities supplied tallies with the request made as indicated in the way bill. The insecticides will then be transported in closed containerized trucks to a secure central warehouse. From the central warehouse, the insecticides will be transported by truck to rented warehouses in the proposed districts where the spray operations will commence, to be issued on a daily basis to team leaders and then to spray operators for IRS use.
2.1.4 PREPARATIONS FOR SPRAY

Prior to spraying, the contractor or implementing partner will:

- Conduct preliminary logistical assessment to quantify eligible house structures, target population, spray equipment, insecticide, and spray teams and identify suitable sites and facilities for pesticide storage and disposal of effluent waste.
- Promote acceptance of IRS in the targeted communities through information, education and communication (IEC) activities. Households do have the opportunity to “opt-out” of participation in IRS after hearing the IEC messages on benefits and risks.
- Identify sensitive areas (water bodies, habitat, aquacultural activities, etc.) to avoid during IRS.
- Develop the selected sites for year-round and temporary storage of IRS equipment and insecticide, and construct effluent waste disposal facilities as necessary.
- Procure, transport, and store all necessary spray and personnel protective equipment (PPE), insecticides, and consumables.
- Train spray teams in a variety of positions, including site managers, team leaders, spray operators, overalls washers, site attendants, security guards, and water fetchers.
- Implement the Environmental Mitigation and Monitoring Plan (EMMP) in Annex A of this SEA Amendment #1 throughout all processes.

2.2 NO PROJECT ALTERNATIVE

Indoor Residual Spraying is one of the critical interventions in the control of the spread of malaria. A no project alternative will result in rising rates of infections, transmissions, mortality, and morbidity due to the increased prevalence of infected vectors. Therefore, the no action alternative does not meet the overall goal of the Rwanda National Malaria Control Program and President’s Malaria Initiative, which is to reduce malaria mortality by 50% in up to 15 countries (total population: 175 million) in sub-Saharan Africa in five years.

2.3 ALTERNATIVE IRS GEOGRAPHICAL SITES CONSIDERED

In this SEA, areas considered as highly malarias and those areas that fit within the MOPDD strategic plan were considered while lower risk areas were not considered for IRS as an intervention. The map in figure 2 in section 1.4.1 illustrates the currently chosen areas, but this might change over the project implementation period depending on the malaria status of these areas. Using different criteria for selecting geographical sites would reduce the effectiveness and impact of IRS, decreasing progress towards the goals of the Rwanda National Malaria Control Program and the PMI program. This alternative could also include spraying special habitats such as wetlands, marshes, within 30 feet of water bodies, as well as areas of sensitive habitats such as bee keeping areas, organic farming, and National Forests, Parks and other protected habitats. This would tend to increase the negative environmental consequences of IRS, which violates the mandates of 22 CFR 216, and PMI policy.

2.4 USE OF ALTERNATIVE INSECTICIDE(S)

For IRS to be implemented, a pesticide approved by World Health Organizations (WHO) under the World Health Organization Pesticide Evaluation Scheme (WHOPEX) must be selected for use. WHOPEX is the institution that analyses and recommends the pesticides that should be used in IRS based on their effectiveness, cost, and toxicity to human health and the environment.
To date WHOPES has approved the use of pesticides within the following four classes of pesticides: pyrethroids, carbamates, organochlorines and organophosphates. The proposed action includes the use of organophosphates, carbamates and pyrethroid formulations. The proposed action excludes the use of DDT as it is banned in Rwanda. Currently, there are no other pesticides eligible for use in PMI-sponsored IRS, so deliberations were confined to the WHO-approved pesticides.

2.5 ALTERNATIVE TECHNOLOGIES

A full range of known, available technologies is continually considered for use by the stakeholders in the malaria prevention and control efforts. It has been determined that IRS plays a significant part in malaria prevention in concert with those other technologies. The specific focus of this PMI effort and the role that PMI plays in Rwanda includes IRS. If other, viable approaches were to arise that would replace or improve upon the role that IRS plays, the National Malaria Control Program, PMI and its partners would evaluate them and proceed accordingly.

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4 PRESIDENT’S MALARIA INITIATIVE Malaria Operational Plan (MOP) Rwanda FY 2013
This section describes the environments and ecosystems that could be adversely affected in the implementation of the IRS program if adequate and necessary mitigation measures and monitoring is not put into place.

The government of Rwanda projects that in the next 5 years, IRS intervention is likely to expand into certain districts spread across the country. The MOPDD will make decisions on where to intervene for malaria control based on entomological, epidemiological, economic, and other criteria.

For this reason, this section describes the critical resources or activities in those areas that could potentially be negatively affected in the event that prescribed mitigation measures are not followed in the application of pesticides during IRS. These critical ecosystems or activities include surface water bodies (lakes, river, groundwater, marshlands and wetlands), air, soils, and economic and sustenance activities including agriculture, apiculture, fisheries and organic farming that might be adversely affected by application of pesticides.

### 3.1 Administrative and Political Units in Rwanda

Rwanda is divided into five provinces. The provinces are divided into thirty districts (uturere), which are subdivided into 418 administrative sectors, which are further subdivided into 9,165 cells. These subdivisions have been in place since 2006.

### 3.2 Physical Environment

Rwanda is a small, mountainous, landlocked country with an area of 26,338 km². It is bordered to the north by Republic of Uganda, on the south by the Republic of Burundi, to the east by the United Republic of Tanzania, and to the west by the Democratic Republic of the Congo (DRC). Its varied territory has an average altitude of 1,250m above mean sea level. Rwanda has been described as the country of a thousand hills (mille collines), some with flat peaks and convex slopes, separated by deep valleys measuring between 50 m to 100 m. The six dominant types of topography are the Great Rift Valley and Lake Kivu in the west; Virunga Mountains and the high lava plains of the northwest; the Nyungwe afromontagne rainforest of the Congo-Nile divide and the central plateau east of the mountains; savannas and swamps of the east and southeast; central plain; and arid area of the southeast. Within these areas, there are five distinct ecosystems: cropland and natural vegetation (47 percent of total land); scrubland, savannah, and grasslands (32 percent); forest (12 percent); wetlands and water bodies (8 percent); and sparse/barren vegetation (1 percent). (World Resources Institute 2003b).
3.2.1 CLIMATE

Despite the proximity of Rwanda to the equator, the climate is mild, being moderated by altitude. The high peaks experience almost permanently inclement weather, cool or cold and very rainy. The high plateau is temperate, but still comparatively wet, while the eastern third of the country has a tropical rather than an equatorial climate. Mean annual rainfall may reach 2800 mm on the western faces of the highest peaks, but is probably no more than 2400 mm/yr over most of the western dorsal. It averages 1200 mm/yr in central districts but declines eastwards with loss of altitude to as little as 650 mm/yr in stations on the Tanzanian border. Over most of the country there are 4 seasons, two warm and wet, and two warm and dry.

The short rainy season lasts from October to December, the short dry season from January to February, the long rains from March to May, and the long dry season from June to September. The eastern half of the country experiences 2200-2400 hours of sunshine each year, with a maximum in July and a minimum in January. During the long dry season relative humidity may fall to 20%. Wind speeds are usually light, 3-6 km/hr during the wet season, but higher during the dry. The SW monsoon brings thunderstorms, and most of the rain.
3.3 Critical Wetland and Marshlands

Rwanda is located on the eastern rim of the Albertine Rift, where two major drainage basins are located: the Nile to the east and the Congo to the west. The Congo River basin, which covers 33 percent of Rwanda, receives 10 percent of all national waters. The Nile River Basin, which covers 67 percent of Rwanda, receives 90 percent of the national waters. Nyungwe National Park is Rwanda’s major watershed for both the Nile and the Congo basins. The waters of the Nile basin flow out through the Akagera river system, which contributes between eight and ten percent to the Nile drainage system.
Rwanda’s hydrology is characterized by a dense network of lakes, rivers, and wetlands. Approximately eight percent of the entire country (210,000 ha) is under water: lakes occupy about 128,000 ha, rivers about 7,260 ha, and water in wetlands and valleys account for about 77,000 ha.

In Rwanda the term “wetlands” has been restricted to the large permanent swamps; the seasonal grass swamps have been generally classified as marshlands, which is equivalent to the French term marais.

Rwanda’s wetlands are extremely important. They act as a buffer in floods or overflow plains, reducing maximum flow rates during the rainy season and maintaining relatively high flow rates during the dry season. Wetlands (large permanent swamps) and marshlands (seasonal grass swamps, marais) occupy about 10 percent of the country and comprise three large and numerous small marais interspersed among the country’s many hills. Wetlands cover a total area of 164,000 ha of Rwanda’s territory. The wetlands include a variety of ecosystems, ranging from large, permanently flooded swampy peat-lands to smaller, seasonally flooded wetlands with a more mineral soil. The wetlands are composed of marshes, lakes, rivers and brooks representing around 14.9% of the national territory of which 6.3% consist of marshes and 8.6% of lakes, water courses and pools of permanent or seasonal fresh water.

The wetlands and marshlands, which occupy about 10 percent of the country, are comprised of three large swamps and small wetlands scattered among the country’s many hills. The main swamps are Akanyaru (12,546 ha) on the border with Burundi, Akagera along the Tanzania border to the east (12,227 ha), and the Nyabarongo (24,698 ha) and Rugezi wetlands (6294 ha) to the north (Odada, 2004).

The marshland systems are the most physically and chemically heterogeneous of all the aquatic ecosystems in Rwanda. They act as sinks for silt particles and soluble inorganic nutrients and are sources of dissolved and particulate organic matter. They are seasonal wetlands, with the water table near or above the lowest ground surface during the wet season. They do not have large flood plains (generally less than 200m wide) or great length.

The wetlands serve as troughs for sediment particles and play an important role in the national water balances by acting as a buffer, thus reducing the maximal flow rates during the rainy season and maintaining a relatively high flow rate during the dry season.
FIGURE 6: MARSHLANDS AND THREATS FROM ANTHROPOGENIC ACTIVITIES
In the highlands of the Northwest, there are Bulera and Ruhondo lakes as well as the marshes of Rugezi. In the Central and the East of the country, wide marshes are those of Nyabarongo, Akanyaru and Akagera rivers. Many cuvette lakes connect with rivers and most of them are located in the Akagera National Park. From the Southeast to the Northwest, there are lakes like Cyohoha in the South, Mugesera, Rweru, Sake, Cyambwe, Ihema, Milindi, Rwanyakizinga, Kivumba, etc. In 2003 Rwanda ratified the Ramsar Convention on wetlands, and has registered the site of Rugezi.

From a hydrological point of view, marshlands are complex, with runoff and river valleys downstream replacing seepage in the upland areas. Because they are environmentally fragile, it is critical that their ecological integrity be safeguarded — a difficult task when Rwanda’s growing population wants to convert them to agriculture.

3.3.1 THE NYABARONGO/AKANYARU RIVER SYSTEM

The Nyabarongo has several sources in southern Rwanda in forested country at 2600-2750 m AMSL, chief among which are the Mbirurume and Rukarara/Mwogo Rivers. Below the confluence of these major headwater tributaries the Nyabarongo flows east, through much boggy highland country, before descending to 1500 m and entering a deep and narrow valley oriented N-S. It continues in this valley for 80 km before swinging SE at Muramba. From here it meanders over its narrow valley floor, receiving first the overspill from Lake Mohazi via the Nyabugogo River on the left bank, and then, some 35 km farther on, the Akanyaru River on the right bank.

The Akanyaru is the most important tributary of the Nyabarongo. It has sources in the south of the country, but the Mugere, an important headwater tributary, rises in Burundi at 2450 m asl. In its lower course the river flows sluggishly through a broad belt of permanent swamps, up to 7 km wide and 82 km long immediately above its confluence with the Nyabarongo. The swamps cover some 25 000 ha, of which the lower 7000 ha are in Rwanda. The Akanyaru descends from 1465 m asl at the head of the swamps in Burundi, to 1400 m asl at the confluence with the Nyabarongo where the swamps end. Above this, in the swamp belt in Rwanda, it receives overspill from the two Cyohoha Lakes on the right bank.

The boundary between Rwanda and Burundi runs through Lake CyohohaSouth for 22 km, and about 25% of the lake surface is in Rwanda. Below this the river receives the seasonal overspill from Lake Cyohoha North, described in section 2.6.8. Many of the higher tributary valleys are choked by papyrus, with seasonal swamp forest behind. This latter is dominated by Syzygium guineense, but with S. owariense in the wettest sites, and often with Ficus verruculosa and Myrica kandtiana as associates. Seasonally inundated savannas, with Acacia polyacantha var. campylacantha, A. sieberana and Bridelia nizicrantha occur on the margins of Lake Cyohoha and around the permanent swamps.

Below the Akanyaru/Nyabarongo confluence the swollen river flows due east in a broad valley which soon becomes swampy again. At first it carries galleries of forest flooded only seasonally, but Ficus verruculosa, Myrica kandtiana, Phoenix reclinata and Cyperus papyrus become progressively more common at the riverside in passing downstream. Then, after turning SE again, the river traverses the Mugesera/Rugwero Swamp, dominated by floating islands of Cyperus papyrus, with great beds of Miscanthidium violaceu.nz rooted on the margins. After leaving the swamps the river flows 35 km eastwards to a confluence with the Ruvubu River, forming the Kagera River, which is the principal affluent of Lake Victoria.

The Nyabarongo/Kagera River system descends with a mean gradient of 1:2326 in traversing Rwanda between the head of the high valley at 1500 m and the Tanzanian border. The floor of the high valley of the Nyawarungu is inundated in the wet seasons but is intensively cultivated in the long dry season. There are mine workings along it at several points. Swamps in some tributary valleys along its upper course have been drained, more or less completely, with attendant problems of increased erosion, and decreased soil fertility because silt is no longer deposited. Along the swampy middle course, some areas
are being used for rice cultivation, and many drier sites have been converted for the cultivation of sugar cane.

There is a rich avifauna in undisturbed parts of the river system, especially in the Mugesera/Rweru Swamps, while in developed areas some water birds still survive, including Balearica pavonina. Very many of the animals listed for Eastern Equatorial Africa in the regional introduction are present in undisturbed areas, but only the smaller species survive in densely populated areas. No part of the valley is protected.

3.3.2 LAKE KIVU

Lake Kivu lies in the Western Rift Valley, enclosed on three sides by land which rises steeply from the lake to altitudes of over 2000 m and to 4507 m just to the north. The lake is 100 km long, and has a maximum width of 50 km almost exactly along the parallel 2°S. There are 68 islands in the lake, most small, and most in Rwanda, but Idjwi Island, 40 km long and with an area of 69 000 ha is in DRC.

Hydrology & Water Quality: The lake receives run-off from the surrounding mountains, with no less than 30 rivers entering along the highly indented Rwandan shore. In addition it is believed that warm water is injected into the lake from submerged hot springs, and that the effluents from the small group of Mokoto Lakes (in DRC) reach Lake Kivu underground. Rainfall in the catchments exceeds 2400 mm and is not markedly seasonal. The lake is deep, c. 480 m, meromictic, and the most firmly stratified lake in Africa. Water density increases towards the bottom, but not as a steady gradient; there is a series of discrete layers. The surface water has a salinity of 1%, and the top 70 meters are mixed, but it seems that below this the hypolimnion is completely stagnant, highly saline, and very rich in nitrogen and phosphorus. The pH of the surface waters is about 9.1. It appears that natural phenomena, other than earth movements and the pouring of hot lava into the lake do not cause upwellings of the bottom water, which is highly nutritive but contains much dissolved sulphide and methane. The temperature at the surface is close to 25°C, decreasing with depth to about 22°C at 70 m, but then increasing again to 25°C at 375 m depth. The 70 m contour is very close to the shore, and since only the upper 70 m of the water column is oxygenated, it has been estimated that only 12% of the lake floor receives any oxygen. This is the most saline lake in the Western Rift Valley.

Flora & Fauna: There is little information regarding the phytoplankton, but it is neither diverse nor abundant. The macrophyte flora, which extends down to a depth of 8m, is extremely poor, and there is only a narrow fringe of lake bottom above this depth. The deep lake floor is covered by organic ooze, although towards the shores the bottom is quite sandy, but encrusted with calcareous scale. Here Cladophora sp. is the dominant plant. Higher up there are beds of Ceratophyllum demersum, Najas marina and Potamogeton pectinatus, the latter species being most abundant. Around the shallowest margins there are beds of Phragmites mauritianus and species of Cyperus and Scirpus. The fish fauna is poor, comprising just 16 species. Of these, 3 also occur in Lake Tanganyika, namely Barbus serrifer, Barillus moori and Clarias mossambicus. The first and last have wide distributions and were possibly introduced, but Barillus moori is found only in these two lakes.

There are 6 species of Haplochromis, all endemic, and a distinct subspecies of Oreochromis niloticus ssp. regani, which suggests that speciation has occurred in the lake over the last 20 000 years. There are no large predatory species in the lake. Birds and otters are the principal piscivores, and the lake supports many birds of passage.

3.3.3 THE KAMIRANZOVU SWAMP

This swamp is situated in an area receiving some 2200 mm rain/yr in the Afro-montane vegetational zone on the high dorsale of southern Rwanda. The center of the swamp is dominated by clumps of Cyperus and Lobelia spp. The margins are fringed by a swamp forest dominated by Antholeista grandifolia, Podocarpus latifolius and Syzygium guineense. Animals present include Aonyx capensis, Cephalophus niger, Tragelaphus scriptus and some snakes, birds and rodents. The swamp is an
important natural reservoir near the source of the Rukarara River, a headwater tributary of the Nyabarongo River. It is protected in the now Nyungwe National Park.

### 3.3.4 The Rugezi Swamp

This high altitude swamp is situated immediately east of Lakes Bulera and Ruhondo below the high peaks of the Virunga volcanoes. It is 30 km long, oriented NW-SE in the valley of the Hondo River, and reaches a maximum width of 6 km at the southeastern end. It drains via the Hondo River at its northwestern end over two waterfalls into Lake Bulera. It contains Cyperus papyrus, Miscanthidium violaceum, and several lesser species of Cyperus and Scirpus. Part of it has been drained and cultivated in recent years, and it is not protected. The fauna includes an abundance of amphibians, a variety of water birds including herons, egrets, ducks, warblers and weavers, and Aonyx capensis, Lutra inaculicollis and some rodents among the mammals. It is an important reservoir, buffering inflows to Lake Bulera to which it drains.

### 3.3.5 Lakes Bulera & Ruhondo

These lakes are situated on the southern slopes of Mt. Muhabura in NW Rwanda. Lake Bulera is 12 km long and reaches 8 km in width. It contains two small islands and is fed by 6 streams. The largest influents are the Kabga and Kageri Rivers, and the Hondo River which drains the Rugezi Swamp. The lake has a maximum depth of 173 m and an open water surface of approximately 3500 ha. It drains from its southwestern extremity to Lake Ruhondo.. This latter lake is shaped like an inverted 'V'. Its eastern arm is 9 km long and reaches 3 km in width, and the lake has an area of 2800 ha. In addition to the overflow from Lake Bulera, it receives water from 4 other streams, of which the Gasura is the most important. There is a 500 ha swamp at the northern end of the lake, i.e. at the apex of the 'V'. It drains to the southwest via the Mukungwa River, a tributary of the Nyabarongo, and a hydroelectric power station has been constructed where the Mukungwa leaves the lake. Both lakes are very young, a fact reflected by their poor floras and faunas. They both contain Clarias sp., while tilapia have been introduced and now constitute the basis of a local fishery.

### 3.3.6 The Cyohoha Lakes

The Rwanda/Burundi border runs through Lake Cyohoha South which covers some 7000 ha at high water and of this about 2000 ha is situated in Rwanda. The lake is 30 km long, about 1.3 km wide, oriented SE-NW, and has a highly indented perimeter with several long narrow arms. It is situated on the floor of a forested basin at about 1460 m asl, between two low hill ridges rising in parallel to 1531 m on the southwestern side and to 1510 m on the northeastern side. It is fringed by papyrus and Miscanthidium swamps, with scattered patches of swamp forest. It is fed at the southeastern end (in Burundi) by the Muburiba River, and drains to the Akanyaru River some 3.5 km distant from the northwestern end in Rwanda. The lake is fished but is not protected.

Lake Cyohoha North is situated entirely in Rwanda. The lake is fed at its southern end by a river from Burundi, and drains from its northeastern end through 10 km of permanent swamps to the Akanyaru River. The lake occupies the floor of a triangular basin about 1450 m asl, situated between two low undulating ridges oriented SW-NE and NW-SE. Its effluent river passes between these hills at the narrow western end of the basin. The shallow lake is 12 km long and about 1 km wide, with an open water surface of 1200 ha at high water. It is fringed at the waterside by papyrus, and peripheral vegetation. Agriculture is locally intensive on the floodplains of the affluent and effluent rivers, and in places around the lake margin where it has been possible to drain the swamps.

### 3.3.7 Lake Muhazi

This lake is located in Eastern Province and is 40 km long with a mean width close to 1 km, with a maximum width of 2 km. It occupies the floor of a system of valleys; tributary to a main valley aligned E-
W, and extends into the tributary valleys as a series of 13 narrow arms. Much of the lake shore is swampy and there are swamps at the heads of all 13 arms. The lake is fed by the Muvumba River at the eastern end, and by 13 other small streams, and drains from the western end via the Nyabugogo River to the Nyabarongo River.
FIGURE 7: RIVERS AND LAKES IN RWANDA
3.3.8 MUGESERA/RWERU LAKE/SWAMP COMPLEX

The system occupies the lowest part of a very flat valley, 35 km wide, aligned NNW-SSE. The Nyabarongo River meanders through this, overtopping its banks, filling depressions which contain lakes, and inundating a zone of permanent swamps and a peripheral floodplain. The permanent swamps occupy a central zone up to 14 km wide, but are best developed on the right (west) bank of the river. There are 4 lakes on the left (east) bank. From north to south these are Lake Mugesera and Lakes Birira and Sake. The left bank lakes are, also from north to south, Lakes Gashaga, Murago, Rumira, Mirayi, Kilimbi, Gaharwa, Rweru and Kazigiri.

The last is situated entirely within Burundi, while Lake Rweru is mostly in Burundi. The largest lakes are Mugesera and Rweru. Lake Mugesera (4000 ha) at the upper (northeastern) end of the system is fed by the Bubindi, Gitinga, Mwambu, Nyaruvoma and Rwazurasi Rivers and ten other minor streams, which are all in spate twice a year. These rivers originate on hilly ridges to the north, east and south of the lake, north of Kibungo, while the southern swamps near Lake Rweru receive several similar streams from hills in the east, south of Ngoma and Kirehe.

Lake Mugesera comprises a main basin oriented NNE-SSW, with 4 arms running roughly eastwards separated by ridges of low hills. Lake Rweru (10 000 ha) is fed by streams from the central plateau of Burundi, and by overspill from Lake Kanzigiri which finds its way northwards through the swamps, either to Lake Rweru or directly to the Nyabarongo River. The other lakes, none of which is known to exceed 5 metres in depth, are much smaller, each a few hundred hectares in extent in the dry seasons. Flood waters which are not dissipated in the main swamp basin collect back into the Nyabarongo which leaves the southeastern end of the basin and flows through a narrow swamp belt to a confluence with the Ruvubu River immediately above the Rusumo Falls.

Flora & Fauna: The central swamp is essentially a papyrus swamp with many islands of floating vegetation, and these are especially well developed on Lake Rweru. The papyrus grows 4-5 m tall, with an understory of Dryopteris gongylodes up to 1.5 m, and Ipomoea fragrans climbing to 4 m. Polygonum spp. are also common associates, while Echinochloa cruspavonis, Hydrocotyle ranunculoides, Leersia hexandra, Utricularia inflensa and Vossia cuspidata occur in the water along the outer margins of the papyrus. Islands of papyrus occur in the lakes, and are especially abundant in Lake Rweru. Extensive stands of Miscanthidium violaceum are rooted in the shallower parts of the swamp. There are also groves of Phoenix reclinata and thickets of Aescynomele elaphroxylon, Dissotis incana, Ficus verruculosa and Myrica kanditana on the margins, on levees, and on island shores. Permanent deep water is covered by carpets of floating-leaved or free floating plants, principally Lenzna paucicosta, Ludwigia stolonifera, Nymphaea caerulea, N. nouchali, Pistia stratiotes and Trapa natans, and it supports dense beds of submerged aquatics, including Ceratophyllum demersum, Myriophylun spicatum, Potantogeton pectinatus, Utricularia spp., and Vallisneria spiralis.

Savannas surrounding the lakes, subject to seasonal inundation, are dominated by Acacia campylacantha and A. sieberana, with Boerhaavia plumbaginoida, Bridelia micrantha, Cordia abyssinica, Crassocephalum bojeri, Panicunt deustunz, Securinega virosa, Setaria kagerensis and Sorghum verticilliflorum. Peripheral floodplain supports the grasses Hyparrhenia filipendula and H. rufa, or Bothriochloa insculpta and Therneda triandra.

The phytoplankton and zooplankton are abundant, if not very diverse, and there is a high mollusc biomass. Some 30 species of fish have been identified belonging to 9 families, and of these, 22 are also found in Lake Victoria. Alestes, Clarias and Oreochromis are well represented, and some cichlids have been introduced, reputedly Oreochromis esculentus and 0. macrochir. No less than 173 birds have been identified, of which 30 are piscivorous and 50 feed on insects and molluscs. There are a number of European migrants, e.g. Hippolais icterina, Hirundo rustica, Motacilla flava, Phylloscopus trochilus, Riparia riparia and Sylvia borin.
Other species of interest include Anhinga rufa, Ardea goliath, Ardeola ralloides, Balearica regulorum, Ceryle rudis, Haliaeetus vocifer, Pandion haliaetus, Phalacrocorax africanus, P. carbo, Plectropterus gambensis and Quelea erythrops. There are water turtles (Pelusios), crocodiles, monitors, snakes, otters and rodents. Hippopotamus amphibius is now scarce.

Human Impact & Utilisation: The lakes and swamps are fished, mainly from canoes, with yields of up to 125 kg/ha/yr, comprising some 60% cichlids and 20% clariids.

3.3.9 THE AKAGERA SWAMPS & LAKES

The wetland lies in a N-S anticline on the Rwanda/Tanzania border between two ridges of low hills, below Rusumo Falls. The Akagera River, which delimits the Rwanda/Tanzania border, meanders along the centre of the flat bottomed valley for about 110 km, spilling over to inundate a swamp belt 2-18 km wide. This is lined on each margin by a series of substantial lakes, 20 on the right bank being situated in Tanzania.

These are, from north to south, Lakes Gwelu, Nyakatala, Nyaruwale, three un-named, Lubuga, Ishaka, Duko, Kashani, Twamwala, Mujunju, un-named, Kashanga, Weru Kwa Kalambi, three un-named, Katabi-Kazinga and Bisongo. The swamp belt is more extensively developed on the left bank, in Rwanda, where there are 21 lakes, and from north to south these are Lakes Ferongo, Rwanyakizinga, Mihindi, unnamed, Kishandju, two un-named, Muhari, Hago, Ngerenke, Kivumba, Sekama, five un-named, Ihema, Rwakibale, Nasho, Rwehikama and Rwampanga. The lakes lie partly in and partly out of the permanent swamp belt. Outside the permanent swamps some are fringed by seasonally inundated savannas. The river descends about 40 m from the foot of the Rusumo Falls to an altitude of 1270 m AMSL at the northern end of the swamp complex.

The largest lakes are Ihema (9100 ha), which measures 20 km in length and is 7 km wide in places, Mujunju (2250 ha), which is 11 km long and up to 3 km wide, and Bisongo (c. 2000 ha). Lake Mujunju is the deepest, with a maximum depth of 11 m and a mean depth of 5.9 m; the others have maximum depths between 7.8 and 4.3 m and mean depths between 5.2 and 2.6 m (Rwanyakizinga). Very few of the lakes have permanent connections with the Akagera River, and in the past 30 years, the river has changed course and lost contact with lakes with which it formerly had continuity.

Flora & Fauna: The flora and fauna is very similar to that described in the previous section for the Mugesera/ Rweru Swamps, but with the difference that a variety of large mammals survive in the Kagera National Park covering the northern half of the swamp complex. These include Hippopotamus amphibius, Hippotragus equinus, Kobus ellipsiprymnus, Loxodonta africana, Panthera pardus, Phacochoerus aethiopicus, Redunca arundinum, Sylvicapra grimmzia, Syncerus caffer and Tragelaphus spekei. Amphibians, crocodiles and water turtles are abundant.
3.4 **FORESTS**

Rwanda’s remaining natural forests which are mainly located in the highlands in the Congo-Nile ridge and around the volcanoes, the Nyungwe Forest, the Gishwati Forest and the Mukura Forest, and the Volcanoes National Park, have a high degree of biological diversity and rare animal species, such as mountain gorillas, Ruwenzori Colobus monkeys, golden monkey and chimpanzees.

Rwanda’s 26,338 km² is covered predominantly by mixed cropland/natural vegetation (47 percent), followed by savannah (32 percent), forests (12 percent), and water and wetlands (8 percent). Deforestation and conversion of natural habitats to agricultural systems in the last three decades has caused a loss of variability across all of its ecosystems. A little less than nine percent of Rwanda’s total land area is protected. Almost all of Rwanda’s remaining forested lands of any significance are found within the borders of its national parks and two forest reserves. A few small gallery forests and remnant forests also exist.

Figure 10 illustrates the extent and location of the forest resource in Rwanda. Not surprisingly, biodiversity is also greatest within the protected areas. Table 2 provides an inventory of the protected area system in Rwanda.

**TABLE 2: RWANDA’S PROTECTED AREA SYSTEM**

<table>
<thead>
<tr>
<th>Name</th>
<th>IUCN category</th>
<th>Management Responsibility</th>
<th>Date Established</th>
<th>Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akagera National Park</td>
<td>II</td>
<td>Dubai World³</td>
<td>1934</td>
<td>1,085</td>
</tr>
<tr>
<td>Nyungwe National Park</td>
<td>II</td>
<td>RDB</td>
<td>2005</td>
<td>1,013</td>
</tr>
<tr>
<td>Volcano National Park</td>
<td>II</td>
<td>RDB</td>
<td>1929</td>
<td>140</td>
</tr>
<tr>
<td>Gishwati Forest Reserve</td>
<td>IV</td>
<td>For Dept</td>
<td>1933</td>
<td>61</td>
</tr>
<tr>
<td>Mukura Forest Reserve</td>
<td>IV</td>
<td>For Dept</td>
<td>1933</td>
<td>20</td>
</tr>
</tbody>
</table>

1 - IUCN defines protected areas based on management objectives. The two categories into which Rwanda’s protected areas fall are:

Category II: National Park: protected area managed mainly for ecosystem protection and recreation. Definition: Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

Category IV: Habitat/Species Management Area: protected area managed mainly for conservation through management intervention. Definition: Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.

2 - The Government of Rwanda (GOR), through ORPTN, (now part of RDB), signed a 49-year lease agreement with Dubai World Rwanda in 2008 to conduct the management of ANP as well as the operation of the tourism facilities within the Park boundary.
3.4.1 Akagera National Park

Akagera National Park is located in the north-east of Rwanda, on the Tanzanian and Ugandan borders. It now covers an area of 100,000 ha, following a recent reduction of its original size of 250,000 ha. The excised areas are mainly from the eastern and northern parts of the park's original limits. The park was contiguous to the north-west with the Mutara Hunting Reserve (34,000 ha), de-gazetted in 1997. The topography of the park is characterized by rolling sandstone hills in the west, cut in places by deep, narrow valleys. In the east, flood-plains and swamps are predominant. The extensive lakes and swamps of Akagera river valley cover an area of 100,000 ha.

The Akagera National Park (ANP) hosts more than 900 species of plants, 90 mammals, of which 47 species of big mammals, 530 species of birds, 9 species of amphibians and 23 species of reptiles. Four animal species are protected by the CITES (Convention on International Trade of Endangered Species) namely Loxodonta Africana, Sincerus caffer, Panthera leo and Tragelaphus oryx.

The highest point in the park is Mount Mutumba (1,825 m). The vegetation of the park is extremely varied and, indeed, has been described as the most heterogeneous savanna ecosystem in the region. Open savannas are dominated by three typical grasses, Themeda triandra, Hyparrhenia filipendula and Cymbopogon afronardus. Though Acacia spp. and Combretum spp. predominate, more than 250 tree species occur in the park. The relatively steep hills of central and southern parts support a denser tree- and bush-cover. Towards the lake borders to the east, the savanna becomes more heavily wooded, with gallery forest occurring along lake edges. Gallery forest species include Albizia spp., Acacia polyacantha and some Ficus spp. Flood-plain and marsh vegetation occur in the river valley, with marshes dominated by Cyperus papyrus, Cladium and Miscanthidium.

These areas are exclusively reserved for the protection of flora and fauna, eco-tourism, biodiversity conservation, and for geological formations of scientific and aesthetic value. The geographical distribution of those parks on the national territory is a guarantee of the conservation of biological diversity representative of the fauna and flora of the country.
3.4.2 Nyungwe National Park

Nyungwe National Park (NNP) was newly created in 2005, primarily to protect a natural resource that is widely recognized as being of global as well as national significance. When it was originally designated a forest reserve in 1933, its total area was 1,141 km²; encroachment by local farmers between 1958 and 1979 reduced the reserve area to 971 km². Today, partially buffered by forest plantations and tea estates around some of its borders, and with the addition of the remnant forest of Cyamudongo, it covers slightly more than 1,000 km². The forests at Nyungwe are interrupted by two large permanent swamps, Kamiranzovu and Uwasenkoko. Kamiranzovu (“swallows elephants”), which covers approximately 13 km², is one of the largest peat bogs in Africa. With the destruction of Gishwati and Mukura forest reserves (see below), NNP is one of only two remaining afromontagne components of Rwanda’s protected area system.

NNP is important for conservation of several restricted-range species that are found only in the Albertine Rift eco-region in Africa. It is home to 26 Albertine Rift endemic birds, more than any other protected area in the region; only the unprotected Itombwe Mountains contain more endemic species. NNP also contains 13 species of primate, including the owl-faced monkey (Cercopithecus hamlynii) and l’Hoest’s monkey (C. lhoesti) — both restricted-range species. The black and white colobus (Colobus angolensis) groups in Nyungwe are unusually large, ranging up to 450 individuals — larger than any other groups recorded for this species. Eastern chimpanzees (Pan troglodytes schweinfurthii), an endangered species, live in Nyungwe, and IUCN classifies the owl-faced monkeys as vulnerable.

Within its altitudinal range of 1,600 to 2,900 meters, NNP is home to 1,068 recorded plant species, of which about 250 are endemic to the Albertine Rift. There are more than 200 different tree species. Among fauna, 85 mammal, 278 bird, 32 amphibian, and 38 reptile species have been recorded there; of these, 62 species are endemic to the rift. A comparison with the Albertine Rift shows that for all taxa, NNP ranks consistently high. It has more endemic species than any other rift forest that has been surveyed (about 60 percent). Thus, Nyungwe is considered a critical area for conservation of restricted-range species not only by the GOR but also by the international conservation community.

NNP’s socioeconomic importance is as significant as its biological importance. Nyungwe is the watershed for over 70 percent of Rwanda; its streams feed both the Congo and the Nile basins. It thus protects a major watershed for surrounding communities as well as communities much further downstream. Population densities around Nyungwe are among the highest in Africa (250-500/km²), but the forest’s tempering effect results in longer periods of rain each year, supporting a relatively high degree of agricultural production.

The buffer zone around the forest has been planted with a variety of species (Pinus patula, Cupressus lusitanica, and Acacia melanoxylon) and is a source of building poles and firewood for local populations. (At the moment, this is done illegally because there is no management plan for these plantations to enable harvests by local communities.) Local herbalists harvest medicinal plants in the forest and an RDB-TC (aka ORTPN) program allows herbalists to harvest wildings from the forest to plant on their own land. Beekeeping associations place hives at the edge of the forest because the honey produced there is of superior quality. Tourism in Nyungwe generates a growing amount of direct revenue (see Section 3.5) for the national park system, but probably has a greater importance to the industry as part of a larger tourism circuit. Private sector investments begun in mid-2008 in a site-friendly tourist lodge at the western entrance to the park will help reinforce NNP as a key component in that circuit.

3.4.3 Mukura Forest Reserve

Staying on the western side of the country but moving to the north, the next significant block of afromontagne forest is the Mukura Forest Reserve. Founded in 1933 with a total area of 2,000 ha, Mukura Forest Reserve was at one time linked to Gishwati along the Nile-Congo crest. Subject to
intense human pressure over the years in the form of agriculture encroachment, illegal cutting, grazing (1,000 milk producers are in the forest), and more recently returnee resettlement, Mukura has been reduced to a series of small, disjointed primary forest relics in remote valleys and on steep slopes that are difficult to access. The total area left is very small and that many of Mukura’s previously important plant and animal species, particularly birds, have disappeared. Like other afromontagne forests of the Nile-Congo crest, Mukura played an important watershed role for Rwanda and was the source of a number of permanent springs and streams. With the disappearance of the forest, many of these springs have apparently become seasonal. Mukura forests also acted as a sponge, absorbing excess water and preventing runoff and erosion, thus stabilizing agriculture in surrounding areas. Local residents report that this benefit has all but disappeared; according to GOR and NGO authorities, the residents have formed an association in an attempt to help reconstitute the forest.

3.4.4 **GISHWATI FOREST RESERVE**

Founded in 1933, Gishwati Forest Reserve originally had an area of about 28,000 ha in Ruhengeri/Gisenyi provinces, running for about 25 miles along the Nile-Congo crest at between 2,000 m and 3,000 m altitude. Plant and animal species distribution in Gishwati was similar to that of Nyungwe.

Gishwati Forest is a protected reserve in the north-western part of Rwanda, not far from Lake Kivu. The reserve’s forests were largely intact in 1978, and substantial forest cover still remained in 1986. During the Rwandan Genocide, wave after wave of refugees arrived in Gishwati Forest and began clearing it, often for subsistence farming. By 2001, only a small circular patch of native forest remained, 1500 acres of the forest’s original 250,000. In addition to tremendous loss of biodiversity, the region experiences soil erosion and degradation and landslides. Reforestation efforts in the past few years have increased the remnant native forest to about 2,500 acres. Large tea estates occupy the central and northern parts of the reserve.

3.4.5 **VOLCANO NATIONAL PARK**

The final significant portion of the afromontagne forest in Rwanda is that found in Volcano National Park (or Parc National de Volcan) along the northern border with the Democratic Republic of the Congo (DRC). This area is also a part of the critical Albertine Rift Ecosystem that is shared by Rwanda, the DRC, and Uganda.

Volcano National Park (PNV) has probably the longest conservation history in Africa. Its major objective was saving the last representatives of a species becoming extinct, the mountain gorilla (Gorilla gorilla beringei). In 1902, Captain Oscar von Beringei was the first European to observe the mountain gorilla. He and a fellow explorer spotted a group of black apes while climbing Mount Sabinyo of the Virunga Mountains. They shot two of the animals and sent them to the great German anatomist, Matschu, who said they were a separate subspecies. This started a flurry of international scientific interest that brought the death of 54 more Virunga gorillas between 1902 and 1929.

Carl Ackey, after shooting five mountain gorillas in 1929 for the American Museum of Natural History, was so impressed with the subspecies and its habitat that he urged the Belgian Government, headed by King Albert, to make the Virunga Mountains a national park. That same year, Albert National Park was established as one of the first national parks in Africa, with the Volcano National Park as the Rwandan component.

Currently, mountain gorillas are found in four national parks in two forested blocks. Together they cover about 590 km² of afromontagne and medium-altitude forest typified by high species diversity and endemism. One of the forest blocks is the Bwindi Impenetrable National Park in Uganda, which has 310 gorillas. The other is composed of three national parks: Mgahinga Gorilla National Park in Uganda, Virunga National Park in the DRC, and PNV in Rwanda.
FIGURE 10: FOREST AREAS IN RWANDA
Together, these parks account for at least 358 gorillas, with half residing in Rwanda. Seven groups, ranging in size from 7 to 33 individuals, are tracked for conservation and ecotourism efforts.

The Volcanoes National Park (VNP) is famous worldwide due to the presence of the mountain gorilla (gorilla beringei). In addition to the mountain gorilla, the mountain ecosystem (high altitude, plenty of rainfall, humid temperature) induces a variety of biodiversity. The VNP host 245 species of plants of which 17 are predominant, including 13 orchid internationally protected, 115 species of mammals, 187 species of birds, 27 species of reptiles and amphibians and 33 species of arthropods. Some of these species are endemic while others are internationally protected.

3.4.6 Relic Forests and Gallery Forests

The Gishwati forest that covered 21,000 ha before 1981, consisted of only 600 ha in 2002. The search for arable lands, extensive farming, illegal felling of forests for firewood, production of wood for charcoal and poles for building in urban areas, as well as a land mismanagement have drastically contributed to the reduction of the surface area of forests.

In general, for a period of about 40 years, the surface area of the natural forests of Rwanda underwent a decrease of about 65% between 1960 and 2002. The search for arable lands, extensive farming, illegal felling of forests for firewood, production of wood for charcoal and poles for building in urban areas, as well as a land mismanagement have drastically contributed to the reduction of the surface area of forests.

3.5 Wildlife

The dense high altitude forests of Volcanoes National Park is home to about half (320) of the Worlds remaining population (650) of Mountain Gorillas. Mountain gorillas eat large amounts of vegetation from more than 70 different plant species and spend about 30% of each day foraging for food. They consume roots, leaves, and stems of herbs, vines from trees, shrub-sized plants, wild celery, gallium, vines, berries, barks and bamboo shoots.

Among the 12 species of primates in the Nyungwe National Park, are the black and white Colobus monkeys that wander around in huge troupes, some of which are made up of over 300 agile individuals. There are also known to be 275 species of birds in the Nyungwe.

In the Akagera National Park is the largest variety of wildlife species that include Buffalo, zebras, antelope, warthogs, chimpanzees, lions, elephants, rhinoceros, hippopotamus, as well as the rare species – such as the giant pangolin, or anteater. The main threat they face is the destruction of their habitats and poaching.

Rwanda as a whole is known for its rich variety of flora is accompanied by an equal variety of fauna, including several species of birds and primates. The country has more than 275 species of birds, 24 of which are endemic to Albert Rift. Thirteen types of primates have been identified, representing fifth of Africa’s primate species among which is the most threatened. Most of these species are concentrated in large wetlands of (Kagera, Kamiranzovu Rugezi, and Rweru-Mugesera) and protected areas of Volcanoes, Nyungwe and Akagera.

3.5.1 Birdlife

At least 525 species are known from the Akagera Nation Park, reflecting the extremely wide diversity of habitat. These include 44 species of raptor, Balaeniceps rex and many Palearctic migrants, amongst which Falco naumanni, Gallinago media and Glareola nordmanni have been recorded. The park represents the northern limit of distribution of a number of Zambezian biome (A10) species, including Lanius souzae, Myrmecocichla arnotti and Cisticola angusticauda. In addition, one species of the Guinea-Congo Forests biome (A05) and seven of the Afrotropical
Highlands's biomes (A07) also occur (see Table 3). However, all these data need to be reviewed in the light of the recent reduction in size of the park, which means that some species are no longer likely to occur within it, e.g. species of gallery forests (e.g. Camaroptera chloronota, Cossypha cyanocampterus) and montane forests (e.g. Illadopsis pyrrhoptera, Cisticola chubbi).

### TABLE 3: BIRDLIFE IN RWANDA

<table>
<thead>
<tr>
<th>Species</th>
<th>Season</th>
<th>Year</th>
<th>Min</th>
<th>Max</th>
<th>Quality</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ring-necked Francolin (Francolinus streptophrus)</td>
<td>resident</td>
<td>1998</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>A3</td>
</tr>
<tr>
<td>Madagascar Pond-heron (Ardeola ralloides)</td>
<td>winter</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>A1</td>
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<tr>
<td>Shoebill (Balaeniceps rex)</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>A1</td>
</tr>
<tr>
<td>Pallid Harrier (Circus macrourus)</td>
<td>winter</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>A1</td>
</tr>
<tr>
<td>Red-faced Barbet (Lybius rubrifacies)</td>
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<td>1998</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>A1, A3</td>
</tr>
<tr>
<td>Papyrus Gonolek (Laniarius mufumbi)</td>
<td>resident</td>
<td>1998</td>
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<td>0</td>
<td>-</td>
<td>A1, A3</td>
</tr>
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<td>Carruthers’s Cisticola (Cisticola carruthersi)</td>
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<td>1998</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>A3</td>
</tr>
<tr>
<td>White-winged Scrub-warbler (Bradypterus carpalis)</td>
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<td>1998</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>A3</td>
</tr>
<tr>
<td>Sharpe’s Pied-babbler (Turdoides sharpei)</td>
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<td>1998</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>A3</td>
</tr>
<tr>
<td>Red-chested Sunbird (Nectarinia erythrocerca)</td>
<td>resident</td>
<td>1998</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>A3</td>
</tr>
<tr>
<td>Northern Brown-throated Weaver (Ploceus castanops)</td>
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<td>1998</td>
<td>0</td>
<td>0</td>
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<td>A3</td>
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<td>White-collared Oliveback (Nesocharis ansorgei)</td>
<td>resident</td>
<td>1998</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>A3</td>
</tr>
</tbody>
</table>


### 3.6 AGRICULTURE

#### 3.6.1 CROP PRODUCTION

Even though agricultural activities is widely practiced in Rwanda especially farming in the marshlands (intensive) there is already intensive sue of chemicals and fertilizers especially in the cultivation of rice and other food crops. The application of chemicals in crop production has been intensive an indiscriminate in Rwanda to an extent that the government has prepared an Integrated Pest Management (IPM) policy to stop further pollution of the marshlands and major wetlands that have ended up being recipients of the chemicals through run off.
IRS activities in the country are not expected to impact adversely on agriculture due to the insignificant potential for spill and releases and also owing to the pesticide type. Organic Farming is also not practiced in Rwanda with the only existing data on this indicating that the small “sweet” banana and some vegetables are cultivated at a very low scale in Easter Province through organic method.
FIGURE 11: SOIL TYPES, RWANDA

Source: CGIS-UNR, 2003
3.6.2 APICULTURE

Bee keeping remains the only other critical agricultural activity that could be negatively affected by IRS activities specifically in regard to pesticide application. According to the National Bee Keeping Strategic Plan (2007-2008) beekeeping in Rwanda has been practiced for many years through successive generations and along inherited patterns. The activity has basically been traditional and of non-commercial nature, where honey is used as a food product, medicine and for brewing traditional liquor.

Many development organizations have been involved in supporting beekeeping activities in Rwanda with producer organizations but in spite of these attempts, the sector remains underdeveloped. Production is mainly through traditional methods and the few modern techniques introduced have not been successful due to un-sustainable implementation of projects.

It is estimated that there may exist over 15,000 active beekeepers managing in excess of 30,000 hives, mainly traditional, across Rwanda today. Available statistics from the Food and Agricultural Organization (FAO) database citing production show an average of 30MT and 21MT for honey and beeswax respectively. However, these figures do not project actual indices of a truly representative sector to provide the basis for justification. There exists an unmeasured traffic of honey and bee products across the regional borders, and whose revenue identities remain elusive due to lack of the necessary systems and enforcement of traceable channels.

Most of the honey produced in Rwanda is sold locally within the villages to neighbours and middlemen. Some of the honey is also purchased by non-governmental organizations (NGOs) financing the projects. The most 'defined markets' include traditional honey brew manufacturers, poorly packaged honey supplied by traders in different food shops in urban areas (and used as table honey in households), industrial honey used by liquor, pharmaceutical and food processing industries.

As the demand for beekeeping and its products increases, recent forums have called for support to the sector. In April of 2006, stakeholders mandated a task force represented by RARDA, CAPMER, ARDI and SNV to develop strategies for the sector. As a result, a framework was proposed to support the establishment of a competent authority for beekeeping development in Rwanda to coordinate interventions.

All beekeepers agreed that the natural forest was the most productive habitat for honey production and that productivity of hives had decreased over living memory as the area of forest had decreased. Hives situated within the forest were most productive but hives situated on the forest margin could also produce well.

Mobilizers will work to identify and ensure the protection of bee-keeping activities, and ICT workers will continue to inform IRS beneficiaries of the danger to bees. As an identified “sensitive area”, IRS will not take place within 30 meters of bee-hives. Therefore if the above strategy is to be adhered to, it means that the impact of IRS to bees will be insignificant because all the forests where the strategy is focused in terms of placing the hives are protected and there are no settlements that are targeted for spraying which could end up exposing the bees to the chemicals in such areas.
4. PESTICIDE PROCEDURES

Title 22 of the United States Code of Federal Regulations, Part 216 (22 CFR 216) mandates the consideration of twelve factors when a project includes “assistance for the procurement or use, or both, of pesticides”. This section addresses each of those twelve factors for the Malaria Control Program in Rwanda.

4.1 A. THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY’S REGISTRATION STATUS OF THE REQUESTED PESTICIDE

Pesticides recommended by WHOPES and registered for IRS or a similar use in the United States and the host country government will be preferred in this IRS project. However, some of the pesticides on the WHOPES list are not registered with the USEPA, for economic reasons rather than technical ones. Because this is an economic issue rather than a technical one, US regulations permit the use of these insecticides, conditioned on the performance of the proper environmental assessments, as well as notification to and authorization from the host country government. There is widespread acceptance and use of these chemicals around the world, with a good database attesting to the safety of the chemicals when used as directed. PMI/USAID works closely with host country governments, with full and clear disclosure, as well as providing any necessary assistance in the mitigation of risk from the use of these WHOPES pesticides. This SEA, supported by the PMI IVM PEA, and accepted by the Rwandan MOPDD, provide the notification and mitigation requirements of US regulations. PMI/USAID is therefore empowered, upon the receipt of formal authorization from a competent Rwandan entity, to allow the use of all WHOPES-recommended pesticides under the Africa IRS program.

The Rwandan government is in the process of passing legislation that will establish a registration system for public health pesticides. However, this legislation is not expected to pass prior to the 2013-14 spray season. For this spray season, PMI has received a letter of authorization from the MOPDD granting permission to use carbamates-based-pesticides. If and when legislation is passed requiring registration of public health pesticides, PMI/USAID and the implementing partners will abide by all host country regulations

4.2 B. THE BASIS FOR SELECTION OF THE REQUESTED PESTICIDES

In addition to the above criteria, insecticide selection for any PMI supported program is subject to international procurement requirements of the US Federal laws. Requests to purchase public health insecticides used in IRS must be initiated at class level, rather than for a particular insecticide (compound). The insecticide class to be used in IRS is selected each season based on a number of considerations.

4.2.1 PRIMARY CRITERIA FOR CHOOSING PESTICIDES

Approval by the World Health Organization Pesticide Evaluation Scheme: Only insecticides approved by WHO can be used in IRS. Certain pesticides in the organophosphate, carbamate, pyrethroid and organochlorine classes are WHOPES-approved for use in IRS. Table 4 shows the list of WHO-recommended pesticides.
TABLE 4: WHOPES RECOMMENDED PESTICIDES WITH EFFECTIVE DURATION

Table 1: WHO Recommended Pesticides

<table>
<thead>
<tr>
<th>Insecticide compounds and formulations(1)</th>
<th>Classgroup (2)</th>
<th>Dosage (ga.i./m²)</th>
<th>Mode of action</th>
<th>Duration of effective action (months)</th>
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</thead>
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<td>OC</td>
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<td>contact</td>
<td>&gt;6</td>
</tr>
<tr>
<td>MalathionWP</td>
<td>OP</td>
<td>2</td>
<td>contact</td>
<td>2-3</td>
</tr>
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<td>FenitrothionWP</td>
<td>OP</td>
<td>2</td>
<td>contact</td>
<td>3-6</td>
</tr>
<tr>
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<td>OP</td>
<td>1-2</td>
<td>contact</td>
<td>2-3</td>
</tr>
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<td>BendiocarbWP</td>
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<tr>
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<td>contact</td>
<td>3-6</td>
</tr>
<tr>
<td>Alpha-cypermethrin WP&amp;SC</td>
<td>PY</td>
<td>0.02-0.03</td>
<td>contact</td>
<td>4-6</td>
</tr>
<tr>
<td>BifenthrinWP</td>
<td>PY</td>
<td>0.025-0.05</td>
<td>contact</td>
<td>3-6</td>
</tr>
<tr>
<td>CyfluthrinWP</td>
<td>PY</td>
<td>0.02-0.05</td>
<td>contact</td>
<td>3-6</td>
</tr>
<tr>
<td>DeltamethrinWP, WG</td>
<td>PY</td>
<td>0.02-0.025</td>
<td>contact</td>
<td>3-6</td>
</tr>
<tr>
<td>EtofenproxWP</td>
<td>PY</td>
<td>0.1-0.3</td>
<td>contact</td>
<td>3-6</td>
</tr>
<tr>
<td>Lambda-cyhalothrinWP, CS</td>
<td>PY</td>
<td>0.02-0.03</td>
<td>contact</td>
<td>3-6</td>
</tr>
</tbody>
</table>

(1)CS=capsulesuspension; EC=emulsifiableconcentrate; SC=suspensionconcentrate; WG=waterdispersiblegranule; WP=wettablepowder.
(2)OC=Organochlorines; OP=Organophosphates; C=Carbamates; PY=Pyrethroids.

Registration for use in the country: As previously stated, only three pyrethroids AIs are registered. In the case where the insecticide proposed to be used for IRS is not registered in Rwanda, PMI will work with the Ministers of Agriculture and/or Health to obtain special authorization for the use of the pesticide.

Residual effect for a period longer than, or at least equal to, the average duration of the malaria transmission season in the area: As seen in the figure above, all pyrethroids, carbamates, and organophosphates are expected to stay active and effective for 3 to 6 months after application; however, the effective duration varies under different climatic conditions and other factors. Three pyrethroids, known as longer-lasting pyrethroids, can last up to eleven months based on various field trials. For this reason, pyrethroids make the best choice for extended seasons. However, in order to manage vector resistance, it has proven to be necessary to periodically switch the class of pesticides used in IRS. The duration of effectiveness on the primary wall surface types will continue to be researched and considered when selecting insecticide class and AI.

Pesticide must be appropriate for use on the wall surfaces of the selected location: Structures in the targeted regions are mainly of 3 different types: plastered and painted; plastered and not painted; and mud. Pyrethroids, carbamates and organophosphates are known to function well on mud and cement walled houses and are therefore appropriate for use.

Local vector susceptibility to the insecticide: Resistance to insecticide develops when a hereditary feature is selected in an insect population that reduces the population’s sensitiveness to a given insecticide. In Rwanda, vector susceptibility studies are conducted by the Malaria and Other
Parasitic Diseases Division (MOPDD) of the Ministry of Health (MOH) in collaboration with the IPM program. In recent past seasons, MOPDD has identified the high burden malaria districts in which to implement IRS (Bugesera, Gisagara and Nyagatare in 2012), and confirmed the effectiveness of lambda-cyhalothrin and deltamethrin in these districts. Due to developing resistance to these pesticides, for 2013, the carbamate bendiocarb is being considered for IRS in Rwanda.

**Ecological impact:** Rwanda boasts a diverse wildlife throughout the country, but especially in the 3 National Parks, it is extremely important that IRS does not in any way diminish this biodiversity. The ecological impact of the WHO pesticides are well-documented, including in the 2012 PMI IVM Program Environmental Assessment (IVM PEA). More information on ecological impact of the proposed pesticides is found in section 2.5 below, as well as other sections of this document.

**Human health impact:** The IVM PEA also assessed cancer and non-cancer risks associated with all WHOPES-approved insecticides by process (e.g., mixing insecticide, spraying, residing in sprayed house, etc.) and pathway (e.g. inhalation, dermal, ingestion, etc.), and cancer risks by process and pathway where available (mainly for DDT and select pyrethroids). In general, pyrethroids and carbamates pose less non-cancer risks via any pathway than organophosphates when risks are assessed.

### 4.2.2 Secondary selection criteria:
- Appropriate packaging for safety and standard delivery tools
- Unit cost of insecticide
- Timely delivery of the insecticide to the preferred point of delivery
- Local representation of supplier in host country
- Technical assistance with training and troubleshooting by supplier

### 4.3 The extent to which the proposed pesticide use is part of an Integrated Pest Management (IPM) Program

IPM is defined as:

...an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials [pesticides] are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment."

IPM is often used in an agricultural context, but similar in nature is the concept of Integrated Vector Management (IVM). Use of IPM for the control of the malaria vector population is limited to some common sense safeguards, such as limiting standing water which can serve as a breeding ground for mosquitoes. However, because of the life-cycle requirements and the adaptability shown by these vectors, integrated practices have not demonstrated effectiveness.

The major characteristics of IVM include:

Methods based on knowledge of factors influencing local vector biology, disease transmission, and morbidity;

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5 [http://www.ipm.ucdavis.edu/IPMPROJECT/about.html](http://www.ipm.ucdavis.edu/IPMPROJECT/about.html)
Use of a range of interventions, often in combination and synergistically;
Collaboration within the health sector and with other public and private sectors that impact vectors;
A public health regulatory and legislative framework.

As opposed to IRS, agricultural activities distribute pesticides directly to the environment, and can contribute to malaria vector resistance. Major classes of insecticides used in the agricultural sector that could promote malaria vector resistance include pyrethroids and organophosphates. The most popular pesticide in Rwanda is dithane. Other pyrethroid and organophosphate pesticides used in Rwanda include sumicombi and ridomil liquid. Dithane is mainly used in Ruhengeri province, Gisenyi, and Kibuye. Dithane is used by the Irish potato producers in the northern part of the country.

Cognizant of the potential environmental and medical consequences of the non-rational use of the pesticides and the creation of pesticide resistance, the Ministry of Agriculture is emphasizing and implementing the use of Integrated Pesticide Management (IPM) coupled with research and development activities aimed at finding sustainable alternatives to chemical control. Also, GOR has developed a series of legal instruments to regulate pesticide use, as detailed elsewhere in this document.

PMI strategy has been that IRS will be implemented as a component of IVM for malaria control, along with ITNs, preventative and curative drugs, and environmental management. PMI supports an evidence-based approach and will continue to review health management information systems and entomologic data to determine where best to deploy IRS.

4.4 D. THE PROPOSED METHOD OR METHODS OF APPLICATION, INCLUDING AVAILABILITY OF APPROPRIATE APPLICATION AND SAFETY EQUIPMENT

IRS involves spraying a liquid insecticide with long lasting residual activity on indoor wall surfaces where mosquitoes usually rest. The pesticide then dries up and leaves a crystalline deposit on the sprayed surface. A lethal dose of the insecticide is absorbed when the mosquito rests on the surface, which kills the mosquito.

Pesticide will only be applied using pressurized spray equipment approved for the pesticide in use, by trained spray operators wearing gloves, overalls, hard hats with face shields, neck shields, and boots. All necessary PPE for this activity is supplied by PMI, and its use is supervised and enforced throughout the course of the campaign. Spray operators are trained in and use spray patterns that have proven effective for providing long-lasting toxicity toward the malaria vector mosquito.

The spray operators who implement IRS use backpack compression sprayers to apply a measured amount of insecticide on the interior walls of houses and structures. A water-soluble insecticide is added to the sprayer containing a pre-measured amount of water, the sprayer is pressurized, and the material is then applied. After the day’s spraying is complete, spray operators clean the sprayer following PMI BMPs to guard against release and/or exposure, and the manufacturer’s recommendations to ensure their proper operation and calibration.
The IVM PEA assessed the toxicity of WHO-recommended IRS insecticides to non-target organisms, including mammals, birds, fish, bees, and other aquatic organisms. A brief summary is given here for each insecticide, with the pesticide class in parentheses. P is for insecticides in the pyrethroid class, C for carbamates, OP for organophosphates, and OC for organochlorines. The reader is referred to Annex E of the 2012 IVM PEA for greater detail about toxicity. Table 5 below provides information about the relative toxicity of the WHO-approved pesticides on various receptors.

### Table 5: Pesticide Toxicity

<table>
<thead>
<tr>
<th>IRS Insecticide</th>
<th>Mammal</th>
<th>Bird</th>
<th>Fish</th>
<th>Other Aquatic</th>
<th>Bee</th>
<th>Persistence</th>
<th>Bioaccumulate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha-cypermethrin (P)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bendiocarb (C)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bifenthrin (P)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyfluthrin (P)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDT (OC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deltamethrin (P)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Etofenprox (P)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fenitrothion (OP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lambda-cyhalothrin (P)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malathion (OP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pirimiphos-methyl (OP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propoxur (C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: IVM PEA 2012

**Key**

- **High Toxicity**
- **Medium to High Toxicity**
- **Medium Toxicity**
- **Low to Medium Toxicity**
- **Low Toxicity**
- **Data Not Found**
4.5.1 HAZARDS

The two broad categories of hazard are release and exposure to humans and domestic animals, and releases causing environmental damage. Release and exposure may occur at any point, from the production or importation of the pesticide through transportation, storage, distribution, pesticide make-up, spray application, clean-up, and final disposal, as well as post-spray due to improper spray deposition on household articles, or improper behavior of beneficiaries regarding sprayed surfaces.

In humans, both organophosphates and carbamates can produce cholinesterase depression if the proper protective measures are not utilized and exposure results. Cholinesterase inhibition results in overstimulation of the nervous system, with symptoms that include nausea, dizziness, confusion, and respiratory paralysis and death at very high exposures (U.S. EPA, 2000b). The two classes of insecticides differ in their impact on human health in that with carbamates, the cholinesterase inhibition is temporary, and may dissipate in as little as 2-3 hours, providing the exposure is eliminated. With organophosphates, the inhibition is longer-lasting and cumulative, and thus more dangerous.

In the environment, most of the insecticides are all highly toxic to fish and other aquatic organisms. Similarly, apart from pirimiphos methyl all the approved insecticides are highly toxic to bees. In mammals, all the insecticides approved by WHO for IRS carry low-to medium toxicity, with the exception of lambda cyhalothrin and propoxur, that are categorized as highly toxic to mammals. In avifauna, only propoxur is categorized as highly toxic with the rest categorized as low-medium in toxicity.

Specific hazards include exposure during handling (transporting or spraying), environmental release through vehicular accidents during transportation, and the possibility of fire causing combustion of pesticides, in storage or in transportation. These hazards are discussed in more detail, along with the mitigation measures to be employed, in the Environmental Mitigation and Monitoring Plan (Annex A).

4.5.2 MITIGATION

Training for supervisors, spray team leaders, spray operators, washpersons, storeroom managers, and health officials include recognition of the symptoms of poisoning, incident response elevation protocol, and, for the medical professionals, the treatment protocols for each pesticide. Exposure treatment for the proposed carbamate-, organophosphate- and pyrethroid-based pesticides is detailed in annex B.

Specific measures to mitigate transportation-related exposure will include:

- Training drivers before they transport insecticides from the customs warehouse or central storage facility to the local storage facility.
- Ensuring that drivers are thoroughly knowledgeable about the toxicity of insecticides, and that training includes opportunities for drivers to respond to scenarios related to the transport of specified insecticides.
- Preventing pesticide contamination in vehicles rented for the project in order to avoid negative consequences when the vehicles are used for other purposes, such as food transport. To prevent pesticide runoff from vehicle washing, drivers are responsible for wiping the vehicle bed with a damp cloth before washing the exterior of the vehicle.

Other than transporters, storage area personnel, and spray teams, the people at risk of exposure are primarily the beneficiary population in the targeted communities. Acceptance of the pesticide and indeed
of the IRS intervention among the targeted households is a primary external factor, and is critical for the overall safety of the program and environmental compliance. The Information, Education, and Communication (IEC) program is the primary tool for gaining this acceptance. It is important that the targeted community and households are adequately educated on safety, including procedures for removing personal belongings prior to spraying, observing the required exclusion period, and avoiding contact with sprayed surfaces on an indefinite basis.

IEC programs have been and continue to be implemented in targeted communities under the ongoing IRS operation. The campaign includes radio spots for mass media announcements and also direct communication through mobilizers, and eventually the spray operators. Communities are mobilized by local governments and administrations. Clear instructions are provided on what to do before and after the house is sprayed, including the removal of all foodstuffs and cooking utensils, barring of entry into the sprayed rooms for at least two hours, and preventing the re-entry of children and animals until the floors have been swept clean or washed. Targeted training of selected health care providers is provided at the region, district, and community levels on the management of pesticide poisoning.

For more information on the risks of IRS and the measures for mitigation, refer to the EMMP (Annex A).

4.6 F. THE EFFECTIVENESS OF THE REQUESTED PESTICIDE FOR THE PROPOSED USE

Pesticides are selected for IRS based on technical efficacy and economic efficiency in the intended use, along with other extrinsic variables. Selection criteria have been expounded upon in Section 4.2. Knowledge of vector susceptibility is critical to planning and evaluating the effectiveness of the IRS program. It enables timely forward planning to (i) manage the development of the resistance and (ii) evaluate new or alternative insecticides for possible future introduction should a change of pesticide be required. Resistance testing is done to (i) establish a baseline susceptibility of the local vectors for future reference, (ii) monitor changes that occur as time progresses, (iii) identify the mechanisms of resistance and cross-resistance to inform the resistance management strategy that will be adopted, and (iv) evaluate the susceptibility of the local vectors to potential alternative insecticides, should there be a need to change pesticide.

Prior to each campaign, it is necessary to measure vector resistance in the target areas, to ensure that acceptable kill levels will be achieved. A resistance monitoring program has been established by the MOPDD, and the results from this ongoing program are the primary determinants of the choice of pesticide and other supplementary actions.

Pesticide efficacy is affected by vector behavior, insecticide quality, and the residual action of the pesticide. The probability of vector-pesticide contact depends on whether the targeted vector feeds indoors (endophagic) and rests indoors (endophilic), as this increases the likelihood of the vector resting on the sprayed wall. The efficacy of the pesticide to kill may be compromised if the vector exits after feeding without resting on the wall, or if the vector feeds outdoors (exophagic) and rests outdoors (exophilic). An. arabiensis and An. funestus, the major malaria vectors in Rwanda, are mainly endophagic and endophilic. This makes them suitable targets for IRS.
Vector resistance may differ in origin, intensity, type, and significance for vector/disease control in a given population. The evaluation of the significance of resistance to vector control should therefore consider the biochemical and genetic characteristics of the resistance, as well as the eco-epidemiology of the disease and operational characteristics. Resistance also tends to be highly focal (i.e., limited to a definite area). It is therefore important to ascertain the spatial distribution of the observed resistance to better inform the resistance management strategy to be employed and the geographical extent to which it will apply (e.g., what geographical area a possible change in pesticides for IRS should cover). The operational criterion for vector resistance is having 20% or more survival rate in the number of mosquitoes tested using standardized methods of the WHO.

The residual efficacy of the pesticide being used for IRS is crucial to evaluating the implication of vector resistance. Generally, a positive correlation between observed vector resistance and a decline in pesticide efficacy is an important criterion in determining the need for a change of the pesticide in a local area. It is important that wall bioassays be carried out at specified intervals after the IRS operation in order to determine the period and level of residual activity in a given locality and the sprayed surface. A third major factor affecting the effectiveness of the pesticides is their quality (specification). If the active ingredient, for example, is not up to the recommended specification and concentration, it may lead to under-dosage of deposited pesticide, which then contributes to intervention failure. Storage of pesticide for too long a time, or in extremely hot warehouses can lead to breakdown of the active ingredient. Poor pesticide quality may present additional risks to the pesticide handlers and spray operators who may be exposed. For this reason, samples of the pesticide should be taken prior to use, and analyzed for the concentration of the active ingredient. If feasible, susceptibility testing should also be performed, but seasonal dips in vector population usually limit this activity.

4.7 **G. Compatibility of the Proposed Pesticide with Target and Non-Target Ecosystems**

The pesticides are compatible with the target environment (walls, ceilings, eaves) in that they dry on these surfaces, and are not released to receptors or the general environment to any great extent. The dried pesticide remains on the sprayed surfaces, and performs as designed, killing vector mosquitoes that rest on them, and the exposure to non-target organisms and ecosystems is very limited.

The WHOPE recommended pesticides are incompatible with the non-target ecosystems (humans, animals, and the environment), in that, if they are released to the non-target environment in large quantities, they would have negative effects on land and water based flora and fauna. However, the IRS implementation process is designed to ensure that to the maximum extent possible, pesticides are deliberately and carefully applied to the walls and ceilings, of dwellings, and do not come in contact with

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humans, animals, or the environment. IRS implementation is also planned to minimize and responsibly manage the liquid wastes through the reuse of leftover pesticides, the triple rinsing of equipment, and the daily washing of PPE. Wherever possible, recycling is incorporated into the waste management plan, particularly in the case of plastic bottles used for pesticide containers. Where is it not feasible to recycle materials, they are either washed thoroughly and disposed in a landfill, or contaminated solid wastes are incinerated in an approved incinerator that will destroy the pesticide and prevent environmental contamination. The Environmental Mitigation and Monitoring Plan Annex A details the measures that have been and will be enacted to prevent contamination of ecosystems.

4.8 H. THE CONDITIONS UNDER WHICH THE PESTICIDE IS TO BE USED

Chapter 3 of this document provides a detailed account of the Rwandan environmental conditions under which the pesticide is to be used.

During IRS, particular attention will be paid to any sensitive areas identified in Chapter 3, including water bodies, schools, hospitals, any area where organic farming is practiced, where bee-keeping or natural bee habitats are established, etc. In addition, bird-nesting habitat will be protected, and all insecticides will be kept away from all water habitats and resources. IRS will be prohibited within protected areas or sensitive ecosystems, and not allowed within 30 meters of these features. Prior to spraying, contractor will identify households in sensitive areas, and train sprayers to identify houses that should not be sprayed. The contractor will consult with the Rwanda Environment Management Agency regarding the application of pesticides near ecologically sensitive areas, such as wetlands, lake shore, river edge and protected areas and follow their policies and guidelines unless the conditions prescribed herein are more strict, in which case the SEA will have precedence.

Strict supervisory control will also be established to prevent contamination of agricultural products.

4.9 I. THE AVAILABILITY AND EFFECTIVENESS OF OTHER PESTICIDES OR NON-CHEMICAL CONTROL METHODS

This IRS program is limited to using those pesticides that are on the WHO list of recommended pesticides. WHO currently recommends twelve insecticides from four chemical groups for IRS, each with a specific dosage regime, duration of effectiveness, and safety rating. Each of these agents has been evaluated for effectiveness within the program, and continuing monitoring for resistance and susceptibility will be employed to allow up-to-date decisions prior to each spray campaign. The goal of this SEA is to broaden the options for pesticide use to three approved pesticide classes to combat periodic resistance development.

The recommended insecticides (see Table 4), are effective for differing periods, generally categorized as 2-3 months, 3-6 or 4-6 months, and >6 months. Within this range, the effective period depends on local circumstances, including dosage actually applied, wall type, climate (temperature and humidity), and resistance to that chemical in the mosquito population.

For IRS to be effective, the NMCP must either use a chemical that lasts longer than the average malaria transmission season or conduct multiple rounds of spraying to achieve continuous control with a shorter-lived chemical. Thus, current formulations of carbamates that are effective for 3-6 or 4-6

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months may be sufficiently effective with one application per year in the northeast arid zone, but would require two applications per year if used in zones with perennial transmission.

Non-chemical means of malaria vector control are generally not effective. For example, while elimination of standing water breeding habitats is a logical and sensible concept, the malaria mosquitoes only need the smallest of aquatic habitats to successfully reproduce, and it is nearly impossible to eliminate all of these minute breeding habitats. Wherever possible, non-chemical means will be employed in place of IRS.

4.10 J. THE REQUESTING COUNTRY’S ABILITY TO REGULATE OR CONTROL THE DISTRIBUTION, STORAGE, USE, AND DISPOSAL OF THE REQUESTED PESTICIDE

Rwanda is developing regulations for the control and distribution of public health pesticides. The Ministry of Agriculture of Rwanda is currently responsible for the registration, control, and management of agricultural pesticides in the country. Under the Law Governing Agrochemicals (LAW N° 30/2012 of 01/08/2012), there are detailed guidelines and frameworks governing the procurement, packaging and storage, as well as transport and disposal of pesticides. It is likely that similar provisions will be built into the new regulations.

Solid waste management has emerged as one of the greatest challenges facing local authorities throughout Rwanda. The volume of waste being generated continues to increase at a faster rate than the ability of authorities to improve the financial and technical resources needed to parallel this growth. Waste management services have increasingly become inadequate, as evidenced by the rise in illegal dumping and proliferation of the now seemingly permanent piles of rubbish in some commercial, industrial, and residential areas of urban settings. Fortunately, the Gahini Hospital incineration plant, whose combustion temperature is 1100 degrees Celsius, is suitable for the destruction of IRS waste and is available to the PMI IRS program. This incinerator was purchased and installed with USAID assistance, and has become a central facility for hazardous waste disposal in the country.

4.11 K. THE PROVISIONS MADE FOR TRAINING OF USERS AND APPLICATORS

The effectiveness of the IRS program depends on the availability of adequately trained spraying personnel, well-maintained equipment, and competent supervision, as well as end-user acceptability and compliance. USAID has developed guidelines for IRS operations (“PMI IRS Best Management Practices”), and WHO provides a training manual “Manual for Indoor Residual Spraying”\(^\text{10}\). Other resources include the WHO-UNEP Manual on Sound Management of Pesticides and Diagnosis and Treatment of Pesticide Poisoning,\(^\text{11}\) USAID PMI’s IVM PEA (USAID, 2012 Update), as well as this SEA Amendment #2, all of which provide precautions and recommendations on many aspects of IRS operations. The IRS BMP manual and the PMI IVM PEA requirements must be adhered to, but the other documents may be used as a reference. It is not incumbent upon the implementing partner to comply with non-PMI documentation except where required by law. However, PMI/USAID requirements are usually stricter than others’, so there should not be a conflict.


PMI will support the training of spray operators and supervisors, and provide overall guidance and logistical support to the IRS operations in Rwanda. The contractor will continue to provide technical support for environmental compliance, with a medium-term goal of building national capacity to progressively transfer responsibilities. Preparations will include the following:

- A training of trainers program, in which potential supervisors\(^{12}\) and team leaders are trained on all aspects of IRS operation in collaboration with the MOH and the District Health Service. Areas of training shall include planning of IRS, household preparations, record keeping, community mobilization, rational/judicious use of insecticides including sprayer and PPE cleaning, personnel management, environmental aspects of IRS – including geographical reconnaissance, and data recording and analysis.

- The identification of temporary workers recruited from local areas and trained as spray operators and wash persons. New operators will receive five to seven days of training prior to the spray operations. Priority areas of training will include:
  - How to properly mix the wettable powder and filling of the sprayer
  - Correct spraying (maintaining 35-55 psi pressure, spray nozzle at 45 cm from the sprayable surface, swath overlap, etc.)
  - The correct use of protective materials and related safety precautions
  - Support to households on safety issues
  - Personal safety relating to the different pesticides used for IRS (carbamate and organophosphate-based pesticides, as well as the pyrethroids which are currently in use)
  - Environmental safety in relation to pesticides, including management of the empty pesticide sachets
  - The use of daily spray cards and data entry.

4.12 L. THE PROVISIONS MADE FOR MONITORING THE USE AND EFFECTIVENESS OF THE PESTICIDE

Two kinds of measurements are needed to provide a complete understanding of the effectiveness of pesticide that is being used for IRS. The immediate (output) level relates to the efficacy of the pesticide, that is, the degree to which the pesticide is able to kill the targeted mosquito vectors, and involves direct entomological evaluations on pesticide contact bioassays and related pesticide resistance methodologies as recommended by WHO.\(^{13}\) The second broad level of measuring the effectiveness of the pesticides relates to the general goal of reducing the local disease burden. This will require specialized entomological and epidemiological skills and the assessment of the impact of vector control operations, and possibly the assignment of the contributory impact of the IRS operations. This latter measurement is usually done through a combination of methodologies such as measuring the changes in

\(^{12}\) These are usually health-related government staff within the targeted district (health assistants/educators/inspectors, nursing assistants, and community development assistants).

parasite inoculation rates, passive case detection at health centers, and periodic community fever and parasite surveys (active case detection).

Another key characteristic of pesticide effectiveness is the longevity of the treatment. This characteristic has important economic and health implications: the program must adjust its spray schedule to make sure that there is active pesticide on the walls of homes during critical breeding periods. Unfortunately, the guidance that is provided with regard to effective period for each pesticide is very broad (e.g., 3-6 months), and the effective period is probably subject to complex environmental factors such as heat, humidity, and substrate (wall) composition. This area is ripe for research, and any contributions that could be made towards increasing the knowledge of the relationship between these variables and the resultant effectiveness of the pesticide would be very valuable.
5. ENVIRONMENTAL REGULATIONS

This section of the SEA outlines and reviews the existing relevant Rwandese legislation, policies and institutions and identifies requirements that pertain to the development and execution of the project.

5.1 LEGAL FRAMEWORK

Since 2003, Rwanda has since enacted new institutional, policy and legislative framework in all its sectors and sub sectors after operating with colonial framework until after 1994. The Constitution of the Republic of Rwanda of 04 June 2003, as amended to date constitutes the basis for the legal framework for the protection and safeguarding of environment in Rwanda.

5.1.1 LAW ON ENVIRONMENT PROTECTION AND MANAGEMENT

The most relevant legislation for this study is the Organic Law on Environmental Protection, Conservation and Management, Nr 4/2005 of 8 April 2005. The legislation sets out the general legal framework for environmental protection and management in Rwanda. The law centers on avoiding and reducing negative consequences on environment.

Article 67 specifies that every project/investment must have an environmental impact assessment report before implementation, and that the Rwanda Environmental Management Authority (REMA) is responsible for the analysis and approval of these environmental impact assessments.

In 2008 the Government of Rwanda issued MINISTERIAL ORDER N°004/2008 OF 15/08/2008 new establishing a list of works and activities and projects that must undertake an Environmental Impact Assessment (EIA). Because of its reliance on pesticides, Indoor Residual Spraying is on this list and hence requires an EIA.

In 2010, a nationwide SEA was prepared and submitted to Rwanda Development Board (RDB) as part of the contractor’s continued compliance with the host government regulations. That SEA satisfied the requirement for an EIA. This SEA Amendment will also be submitted to REMA and the RDB to further ensure continued compliance with Rwanda national regulations.

Ministerial Order No 005/2008 established the modalities of inspecting companies or activities that may pollute the environment.

5.1.2 LAW DETERMINING USE AND MANAGEMENT OF LAND IN RWANDA- N° 08/2005 OF 14/07/2005

This law on land use and management determines how land should be used in Rwanda. It also institutes the principles on the legal rights associated with any land in the country. Chapter II of the law categorizes land according to its uses. Article 12 of the law gives the state ownership over land that constitutes the public domain, including lakes and rivers, riparian zones, land containing springs and wells of a certain size, land reserved for environmental conservation, including natural forests, national parks,
reserved swamps, public gardens and tourist sites, among others. Article 29 gives the state sole authority and control over swamps.

The law calls for inventory of all swamps and their boundaries, the structure of the swamps, their use, how they can be organized. According to Article 29 of the Land Organic Law, swamp land belongs to the state, and no person can use the reason that he or she has spent a long time with it to justify the definitive takeover of the land. In order for the swamp land to be efficiently managed and exploited, a Minister with environmental responsibilities must issue an order that shall determine a list of swamps and their boundaries. The law further requires that such a list shall clearly indicate the structure of the swamps, their use, how they can be organized, managed and exploited so that they can be beneficial to Rwandan nationals on a sustainable basis. The ministerial order must also certify the modalities of how swamp land shall be, organized.

5.1.3 PESTICIDE REGISTRATION IN RWANDA

Relevant legislation:

PRIME MINISTER ORDER N°27/03 OF 23/10/2008 DETERMINING A LIST OF PROHIBITED DRUGS OR CHEMICAL SUBSTANCES UNLESS AUTHORIZED OR TEMPORARY PERMITTED

In Rwanda, all pesticide use is governed by MINAGRI, which is empowered to oversee the registration, importation, supply and use of pesticides in agriculture and public health. In 2008 the Government of Rwanda under the office of the Prime Minister developed a decree determining the list of prohibited drugs and chemical substances, unless authorized or temporarily permitted. Carbamates, pyrethroids and organophosphates are not on this list.

Carbamates and organophosphates are not yet registered by MINAGRI for use in Rwanda in public health and for that reason, cannot be used in IRS in Rwanda under USAID support until the host government formally authorizes it. Part of the reason for this amendment is to change the registration requirement so that a letter from the MOH is sufficient authorization for use.
6. ENVIRONMENTAL AND HEALTH IMPACTS

This section addresses the risks and hazards of the IRS program in Rwanda.

6.1 POTENTIAL POSITIVE EFFECTS OF THE IRS PROGRAM

6.1.1 DIRECT POSITIVE EFFECTS

The direct positive impacts of the IRS program are the reduction in child and adult malaria morbidity and mortality that will result in a reduction in human suffering. In addition, economic losses due to absenteeism or inability to work will be reduced. Other positive impacts include reduced incidence of miscarriages, low birth-weight, adverse effects on malaria-induced fetal neurodevelopment, and reduced incidence of malaria-related childhood and maternal anemia, complications, and organ failure. There is also the benefit of elimination of other household insects, as well as vermin in some cases.

6.1.2 INDIRECT POSITIVE EFFECTS

The IRS program will also indirectly contribute in the enhancement of the local economy in the following indirect ways: spray operators, washers, mobilizers, supervisors will all receive a daily payment for their work. There will also be human and institutional capacity building in the form of training of a large number of people associated with IRS operations. A reduction in household pests may result in a reduction in other diseases carried by the pests.

6.2 POTENTIAL ADVERSE IMPACTS

Adverse impacts of IRS project are those unintended effects of the project that can compromise the well-being of the environment and/or human health.

6.2.1 DIRECT POTENTIAL ADVERSE EFFECTS

6.2.1.1 CONTAMINATION OF SURFACE WATERCOURSES AND UNDERGROUND WATER

During IRS implementation, it is possible to accidently release insecticides into water bodies during the transportation and storage of pesticides, application of insecticides to walls, and clean-up of IRS equipment and PPE. It is also possible to have a deliberate release that will affect surface or groundwater through washing in areas other than the soak pit, or improper disposal of leftover pesticide. A spill into surface water bodies is a key concern in IRS because it could lead to contamination of water routinely used for domestic purposes. Fish and other aquatic organisms that are vital to a healthy ecosystem could also be wiped out.

Contamination of underground water resources is possible through improper disposal of leftover pesticide on the ground, especially if there is a high water table. However, the impacts of this risk are likely to be insignificant, primarily because the sites for soak pits are carefully chosen according to criteria in the PMI BMPs, and secondarily because pyrethroids, OPs and carbamates degrade very quickly when exposed to sunlight and in the soil. If wash areas and soak pits are properly constructed and used, liquid pesticide waste will be captured in the charcoal layer of the soak pit and held until it breaks down by natural processes.
6.2.1.2 **IMPACTS TO BIRDS, FISHES, AND OTHER ORGANISMS FROM PESTICIDES**

The degree of toxicity of the four WHO approved pesticide classes to birdlife, aquatic life and insects especially bees including the degree of persistence and bio-accumulation is well-documented and very important to remember. See Table 5 in Section 4.5 of this SEA Amendment #2 for details.

6.2.1.3 **IMPACTS ON BEES**

Bee keeping is done at a household level and the sale of honey provides some income to the residents. Spraying in areas near beehives can lead to the death of the bees, which are vulnerable to all WHO-recommended pesticides. In addition, spraying near hives can lead to contamination of edible honey. These risks must be mitigated at all times. The project will make conscientious efforts to identify locations where beehives are kept, and observe a 30 meter no-spray buffer zone around them.

6.3 **INDIRECT ADVERSE EFFECTS**

After completion of the IRS program, USAID will leave remaining IRS equipment in the hands of the DHOs and with the communities (community based programs); and will no longer supervise its use. IRS equipment left to district health officials includes backpack compression sprayers, used, clean boots, wash basins, progressive rinse barrels, etc. that are still in operable condition. The action of leaving behind IRS equipment may temporarily, and in a minor way increase the total pesticide load on the environment.

6.3.1 **SUMMARY OF TOXICITY OF PESTICIDES TO AVIFAUNA, AQUATIC LIFE, MAMMALS AND INSECTS BY CLASS**

6.3.1.1 **PYRETHROIDS:**

- All pyrethroids are highly toxic to bees and highly toxic to fish and other aquatic organisms except Deltamethrin, which has low toxicity to other aquatic organisms. All other pyrethroids have very low toxicity to birds.
- Birds, if exposed, are most affected by bifenthrin (low to medium toxicity). All other pyrethroids have very low toxicity to birds.
- In the pyrethroid class, only lambda cyhalothrin is highly toxic to mammals. Alpha-cypermethrin and etofenprox have very low toxicity to mammals while bifenthrin, cyfluthrin and deltamethrin have low to medium toxicity.
- In terms of persistency in the environment, only cyfluthrin is considered persistent. The rest of the pyrethroids have low to medium persistency.
- Bifenthrin does not accumulate in the environment. Potential for bio-accumulation in aquatic organisms for deltamethrin and cyfluthrin is relatively low while lambda-cyhalothrin is medium and alpha-cypermethrin is high.

6.3.1.2 **CARBAMATES (BENDIOCARB AND PROPOXUR):**

- Carbamates are highly toxic to bees, and have the potential to cause cholinesterase depression in humans. Care must be taken to avoid skin contact with carbamates, especially by spray operators. All spray personnel should be trained to recognize the symptoms of cholinesterase depression, and know the protocol for obtaining medical assistance.
- In addition to other aquatic organisms propoxur is also highly toxic to mammals and birds. Acute symptoms of propoxur poisoning in birds include eye tearing, salivation, muscle

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14 USAID’s IVM PEA
incoordination, diarrhea, and trembling. Depending on the type of bird, poisoning signs can appear within 5 minutes of exposure, with deaths occurring between 5 and 45 minutes, or overnight. On the other hand this insecticide has very low toxic properties on fish.

- Bendiocarb has low to medium toxicity on mammals and birds.
- In general both carbamates have low to medium indications for persistency in the environment and bioaccumulation in organisms

6.3.1.3 **ORGANOPHOSPHATES (OPs)**

- OPs have different characteristics and impacts on different organisms depending on the type of insecticide. However, all three WHO-approved OPs have the potential to cause cholinesterase depression in humans and other organisms, and *skin contact with these pesticides must be strictly avoided, especially by spray personnel*. All spray personnel should be trained to recognize the symptoms of cholinesterase depression, and know the protocol for obtaining medical assistance.
- Fenitrothion has low toxicity on mammals and fish and is not persistent in the environment. However it is highly toxic to bees, birds and other aquatic organisms, like crustaceans and aquatic insects and has a medium toxicity to aquatic worms. It has moderate to medium potential to bioaccumulate in organisms.
- Malathion is only highly toxic to bees. It has very low impacts on fish and other aquatic organisms, and has a very low potential to bioaccumulate in organisms or persist in the environment. Its toxicity on mammals and birds is low to medium.
- Pirimiphos-methyl is highly toxic to fish and other aquatic organisms and has a high potential to persist in the environment. It has low to medium toxic effects on mammals and bees. It does not bioaccumulate in organisms.

6.4 **HUMAN EXPOSURE RISKS/IMPACTS**

Exposure risks of all WHO approved pesticides in relation to cancer and non-cancer endpoints, and with respect to exposure dosage, Hazard Quotient and the Life Time Average Daily Dose are presented in IVM PEA 2012. The exposure risk for cancer and non-cancer endpoints is presented at different stages of the pesticide application including mixing, spraying, post spraying, dermal risk, etc.

6.4.1 **INHALATION EXPOSURE AND RISK DURING MIXING**

- Of the proposed pesticides, only etofenprox (pyrethroid) and propoxur (carbamate) have carcinogenic properties once threshold levels are exceeded.

6.4.2 **DERMAL EXPOSURE AND RISK DURING MIXING**

- On the WHOPES list of insecticides to be used in IRS only three (DDT, etofenprox (pyrethroid) and propoxur (carbamate)) have been determined to be carcinogenic at dermal exposure levels of 8E-07 mg/kg-day for etofenprox and 4E-06 mg/kg-day for propoxur.

6.4.3 **INHALATION EXPOSURE AND RISK DURING SPRAYING**

- Of the proposed pesticides, only etofenprox (pyrethroid) and propoxur (carbamate) have carcinogenic properties once threshold levels are exceeded.

6.4.4 **DERMAL EXPOSURE AND RISK DURING SPRAYING**

- Of the proposed pesticides, fenitrothion and pirimiphos-methyl have non-cancer risks due to dermal exposure.
6.4.5 Resident Dermal Exposure and Ingestion Risk After Spraying

- The only concerns are to adults when using cyfluthrin and etofenprox (pyrethroids) and propoxur (carbamate). The risk is however very low.

6.4.6 Resident Exposure and Risk Due to Chronic Ingestion After Spraying

- There are four insecticides with potential impact due to chronic ingestion by drinking insecticide contaminated water. These are Cyfluthrin, Permethrin and Etofenprox (pyrethroids) and propoxur (carbamate). Best management practices are recommended.

6.4.7 Resident Dermal Exposure and Risk Due to Bathing Using Contaminated Groundwater

- Cyfluthrin and etofenprox (pyrethroids) have potential impact for dermal exposure using contaminated groundwater. When best management practices are applied in IRS, this risk is significantly reduced.

6.4.8 Resident Exposure and Risk Due to Reuse of Pesticide Containers

- Only deltamethrin is registered to have potential for acute ingestion from using pesticide containers. However, residents will have no access to pesticide containers used in IRS. The pesticide containers are only available in IRS storage facilities which are securely double locked and must be disposed by recycling into non-consumer products or incineration at high temperature.

6.4.9 Worker Exposure and Risk Due to Inhalation During Spillage

- According to information presented in the IVM PEA, etofenprox and propoxur have potential to impact workers through inhalation during spillage. The workers are trained on how to handle spillage and must be equipped with appropriate PPE.

6.4.10 Worker and Resident Exposure Pathway

During the IRS spraying process, spray personnel are at risk of un-intentional or deliberate exposure through accidents or poor and improper handling of the spray chemical. Worker exposure to the chemical could arise during the pre-spraying, spraying and post-spraying phase of the IRS operations. Beneficiaries can also be exposed during each of these phases, and additionally over the life of the pesticide on the wall.

6.4.10.1 Pre Spraying Exposure Pathway

Preparing pesticide solutions during the IRS requires pouring the pesticide in the spray pump to ensure ample mix with the water. The process of mixing the pesticide can lead to exposures via inhalation, dermal contact, and incidental ingestion, mostly from releases of pesticide vapors, and solutions. Vapor releases can occur when liquid concentrated emulsions are diluted. Workers or residents can inhale the vapors or the particulates or be exposed through dermal contact. Spills could also pose significant risk, especially for children who ingest the resulting residues that are left on surfaces such as food, floors, soil, as well as absorbing additional doses from eating plants and animals contaminated during the preparation for spraying.
6.4.10.2  **EXPOSURE DURING SPRAYING**

Inhalation of aerosol vapors during spraying is the main process for worker exposure during IRS, however, dermal exposure through spills or absorption onto cotton overalls is also a significant risk. Especially in the case of OPs, the dermal hazard is significant, and can cause cholinesterase depression. Residents are mainly exposed through dermal contact with sprayed surfaces and incidental ingestion of insecticide after their houses have been sprayed, especially when food or drink are left in the house during spraying. Leaky equipment can also lead to insecticide exposure through dermal contact with the floors and incidental ingestion by children who may come in contact with the spills before they are cleaned up.

6.4.10.3  **EXPOSURE DURING DISPOSAL (INCLUDING PROGRESSIVE RINISING)**

Disposal is a key issue with IRS intervention that utilizes pesticides especially during the decontamination process and disposal of the liquid effluent that will arise from washing and progressive rinse. Both burying and dumping can lead to dermal exposure to residents who come in contact with the soil or water in which the pesticide was disposed. Ingestion exposure can occur from drinking contaminated surface water. Once the excess formulation gets into the soil, the pesticide can reach the groundwater, which may be used as a water supply via household wells. Residents may then be exposed to this contaminated water by ingestion or by dermal contact when it is used for cleaning or drinking purposes.

6.4.10.4  **OCCUPANT LONG-TERM EXPOSURE FROM RESIDUE**

Residents of sprayed structures, especially crawling babies and children, will have a finite exposure risk due to physical contact with sprayed surfaces, as well as small amounts released from substrate walls, ceilings, and eaves, due to physical surface breakdown.

6.5  **CUMULATIVE IMPACT**

The combined, incremental effects of human activity, referred to as cumulative impacts, pose a serious threat to the environment. Cumulative impacts develop over time, from one or more sources, and can result in the degradation of important resources.

The critical resources or ecosystems that can be affected by the IRS program over a period of time especially with regards to pesticide application include water supply, food supply, waste assimilation/disposal capacity, river, lake, and stream quality, agriculture, aquaculture, apiculture, human and animal health, biodiversity resources, environmental services, and others. Pesticide run-off and accumulation in the rivers, streams and other water bodies, can lead to the progressive contamination of the water resources and reduction of aquatic biodiversity. However, using the IRS BMPs reduces the likelihood of releases, and the chances of a series of releases within the pesticides half-life are extremely unlikely, except in the case of willful malfaisance.

Continuous human exposure to pesticides over time can lead to health risks or complications, especially among spray operators and others in close contact with pesticides. This is particularly true in the case of OPs. However, the risk assessment performed in the IVM PEA indicates minimal exposure with the use of proper technique and appropriate PPE, i.e. dust masks, helmet, face shield, gloves, overalls and boots that minimize exposure by dermal absorption or inhalation, and a great reduction in the potential for harm.
The sprayed pesticides solidify on the walls, ceilings, and eaves of the structures, and become largely immobile and significantly less harmful. Exposure to the occupants will be further reduced by the procedures and safety measures described in the EMMP.

Pyrethroids, OPs and carbamates degrade very quickly when exposed to light and to the external environment, thus the cumulative and residual adverse impacts of their use will be insignificant. The soak pits used for waste disposal are designed to break down influent pesticides wastes within about three months, while the pesticides are held by the charcoal used in pit construction.

The long-term use of any pesticide could lead to insecticide resistance. To minimize this cumulative impact, insecticide resistance is actively monitored. The proposed action is designed with the concept of vector monitoring, insecticide rotation and mosaicking which will reduce the future incidence of vector resistance.
This section outlines the safer use action plan proposed for the potential adverse impacts outlined above. The primary mitigation measures include delivery of a mix of IEC approaches targeting the residents and spray operators and all IRS personnel, training of spray operators and strengthening supervision and monitoring, and provision of appropriate PPE. The mitigation measures, along with monitoring and reporting information, are compiled in the EMMP found in Annex A and in Annex D.

### 7.1.1 PESTICIDE QUALITY ASSURANCE

The procurement and use of pesticides that do not meet the necessary quality assurance standards can compromise the overall spray quality and desired vector action while at the same time could expose the residents and spray operators to hazards related to altered toxicological characteristics. Rwanda does not currently have a certified laboratory to do quality assurance tests. It is assumed that all pesticides procured from reputable manufactures are of good quality and testing in country is not required. Pesticides that are manufactured at the Adami Tulu plant are sent to a certified laboratory in Belgium for quality testing.

### 7.1.2 PESTICIDE TRANSPORT

After the procurement of the insecticides for use during the current IRS campaign, insecticides are expected to move to the district warehouses by road. During transportation, there is a risk of vehicle accidents and consequently insecticide spillage. The transport must comply with Rwanda’s environment management regulation, statutory instrument 12 of 2007 section 14, regarding hazardous substances, pesticides and other toxic substances and the guidelines of NEMA on transport of pesticides.

Prior to long-distance transport of the insecticide from the customs warehouse/central storage facility of the supplier, drivers will be informed about general issues surrounding the insecticide and how to handle emergency situations (e.g. road accidents). Training for long-distance transport will include the following information:

- Purpose of the insecticide.
- Toxicity of the insecticide.
- Security issues, including implications of the insecticide getting into the public.
- Hazardous places along the routes to be taken, and mitigation measures.
- Steps to take in case of an accident or emergency (according to FAO standards).
- Combustibility and toxicity of combustion byproducts of insecticide.

Drivers hired specifically for the spray campaign period will receive:

- Training in operator transportation best practices and vehicle requirements from PMI BMP #2, Worker and Resident Health and Safety.
- Training provided to spray operators (with the exception of sprayer operation and spray practice).
- Handling an accident or emergency (according to FAO standards).
- Handling vehicle contamination.

The vehicles to transport insecticides must be in good condition and preferably a lockable box truck. If the pesticides are to be left unattended for any period of time, including lunch breaks or overnight stops, a lockable box truck is essential.
Because vehicles used for insecticides transportation can be used for the transport of other goods, including food, it is important to ensure that vehicles are decontaminated. The drivers will be responsible for cleaning and decontaminating the interior of the vehicle and exterior bed at the end of the spray campaign. Drivers will be provided with gloves, overalls, and rubber boots to wear for cleaning the vehicle. All cloths used in wiping down the interior and bed of the vehicle will be washed with soap.

### 7.1.3 Warehouse/Storage Risks

In order to mitigate risks associated with pesticide storage, the following key points will serve as key mitigation steps:

- All primary pesticide storage facilities will be double-padlocked and guarded on a 24 hour basis.
- All the storage facilities will be located away from nearby watercourses, domestic wells, markets, schools, hospitals, etc.
- Soap and clean water will be available at all times in all the facilities.
- A trained storekeeper will be hired to manage each facility.
- Recommended pesticide stacking position and height in the warehouse as provided in the FAO Storage and Stock Control Manual will be followed.
- All the warehouses will have at least two exit access routes in case of fire outbreak.
- A fire extinguisher will be available in the storage facilities and all workers will be trained on how to use this device.
- Warning notices will be placed outside of the store with skull and crossbones and the local language (Ndebele and Shona).
- All pesticides waiting to be used and any remnants will be stored under lock and key until the next rounds of spraying.

### Accidental Warehouse Fires

Human inhalation of toxic fumes in the event of a storehouse fire is also an unavoidable risk. The risk can be minimized, however, by following BMPs for storage, including prohibiting lighted materials in the warehouse and in the vicinity of pesticides, providing proper ventilation, etc.
7.1.4 **Fetal Exposure (Pregnancy Testing)**

All female candidates for washers will be tested for pregnancy before being recruited into the spray operations and every thirty days until operations end. Females found to be pregnant will be re-assigned to positions that do not have the potential for exposure to insecticides. Women who are breastfeeding cannot have any contact with pesticides, and are thus prohibited from spraying of pesticide or washing contaminated items. In addition to PMI guidelines, Rwandan law does not allow females to work as spray operators.

7.1.5 **Spray Operator Exposure**

Each spray operator will be provided with safety equipment in accordance with PMI BMP specifications. Workers will be closely monitored for acute symptoms, because there will always be some level of exposure. In addition, workday duration should be monitored to limit exposure as required by safety recommendations.

Monitoring spray operators for symptoms of pesticide exposure will be mandatory for team leaders and supervisors, as well as for storekeepers and other senior personnel. Any case of an operator or beneficiary displaying symptoms of exposure will require the immediate completion of a standard Incident Report Form by the district coordinator, who will forward the report to the AIRS Operations Director.

Similarly, residential exposure will be monitored. During the IEC campaign, residents are made aware of the steps to take if exposed, and especially if acute symptoms are encountered, the advice is to report to the nearest health facility. Thus reported cases at health facilities or by IEC mobilizers will serve as the principal monitoring strategy for exposure incidents.

The individuals recruited for IRS campaigns will receive intensive training on the use, operation, calibration and repair of the spray pumps and practical exercises during a five-days training period prior to the beginning of the spraying campaign. They will also receive training to understand proper hygiene, to recognize the signs and symptoms of poisoning, and to understand the referral procedure for any incidents involving poisoning. This training will be conducted in accordance with 2002 WHO’s *Manual for Indoor Residual Spraying* and the BMP. Potential spray operators must also pass written and practical tests at the end of training.

For malathion and fenitrothion OPs, it will be necessary to monitor the level of acetyl cholinesterase in any worker who may have been exposed to contamination. Occupational exposures to OP insecticides are measurable using blood cholinesterases and urinary excretion of chemical biomarkers. PMI will evaluate various approaches for monitoring sprayer exposure to OPs, and will develop protocols based on these evaluations. PMI will use these protocols to guide the implementation of the OP monitoring program.

7.1.6 **Residential Exposure**

District Health Officers, Health Extension Workers, implementing partners and IRS staff will work with relevant institutions at all levels to carry out an IEC campaign to sensitize residents to IRS activities, in accordance with WHO guidelines and also Rwanda National Malaria Strategy Plan 2011-2015 and PMI Malaria Operational Plan. The IEC campaign (as well as IRS Project team leaders and Health Extension Workers who will also instruct residents on best practices prior to spraying) should focus on the following elements of residential safety during an IRS program:
• Clear homes of mats or rugs, furniture, cooking implements and foodstuffs prior to spraying; if furniture cannot be moved out of the home, then move it to the center of the room and covered with impermeable material.
• Stay outside the home during spraying for two hours after spraying.
• Move and keep all animals outside the home during spraying, and for two hours after spraying.
• After two hours, open all windows and doors and air the house out for ½ hour.
• Sweep up any insects killed from the spraying and drop them in latrine pits.
• Sweep floors free of any residual insecticide that may remain from the spraying and dispose of in pits or latrines.
• Do not re-plaster or paint over the sprayed walls after spraying.
• Keep using bed-nets for protection against malaria.
• If skin itches after re-entrance into home, wash with soap and water; for eye irritation, flush eyes with water; for respiratory irritation, leave the home for fresh air; for ingestion, if soap and water are unavailable, or if symptoms persist, contact program staff or go to nearest health facility which has the appropriate medical intervention.
• If spraying during the rainy season, the teams should follow the following Contingency Plan which will minimize exposure of household effects.

During the rainy season:
• Each spray operator must be given adequate covering material (3m by 3m minimum), which should be used to cover household effects not removed from the houses.
• Adopt a system of moving household effects to the center of the room and covering them with impermeable material before spraying.
• Materials can also be moved into structures that are not targeted to be sprayed, e.g., an isolated kitchen or other domestic animal shelter.
• Move the household effects to one room which will not be sprayed on that particular day, but the next day.
• The spray teams should pay close attention to any signs of potential rains so that they prepare the communities accordingly.

When it rains in the mid of spraying:
• Stop the spraying activities. After the rains stop and the weather is considered good, spraying can continue.
• Cover the household effects with an impermeable material. These materials should have already been procured by the program and given to each operator.

7.1.7 PESTICIDE EXPOSURE AND TREATMENT

The project will ensure that all the health facilities around the spray sites have in their store these recommended drugs and that all the staff responsible receives appropriate training on administering emergency treatment to pesticide exposure. Annexes B and C provide additional information on symptoms and treatment protocols.

All the spray operators, team leaders, and supervisors will receive detailed training on the emergency steps to take if accidental exposure of the chemical occurs including ingestion, eye or dermal contact with the chemical. This training will be conducted by the district health officers and will include drills to test knowledge of the operators. However, most interventions will have to be provided by medical professionals at the nearest health clinic.

7.1.8 SOLID AND LIQUID CONTAMINATED WASTES

Liquid wastes will be disposed of on a daily basis in soak pits that are carefully sited according to criteria in the PMI BMP manual. The soak pit is designed so that pesticides are adsorbed by the charcoal layer, and held until environmental processes result in the degradation of the pesticide.
At the end of the spray season, non-contaminated wastes, or those that are cleaned thoroughly with soap and water will be recycled whenever possible, and disposed of in a landfill if there is no appropriate recycling outlet. Contaminated solid wastes are incinerated in approved incinerators that destroy the pesticide and prevent environmental contamination. In Rwanda, the incineration will take place at the Kanombe Military Hospital incineration plant, which meets PMI criteria for destruction of non-chlorinated pesticide waste. The EMMP in Annex A details the steps and measures that will be taken to prevent negative impacts on the non-target ecosystems. EMMP Implementation.
8. EMMP IMPLEMENTATION

The DHOs, with the support from the implementing partner, MOPDD, and other stakeholders will implement the EMMP. The staff in charge of implementation of EMMP will be trained to ensure effectiveness of the mitigation measures during spray operation. The District Environmental Health Officers will monitor environmental compliance during the IRS campaign. The implementing partner will complete the annual EMMP Report Form in Annex D and submit to USAID along with the annual report.

The implementing partner will work closely with District Environmental Health Officers throughout the spray campaign. The implementing partner’s Environmental Compliance Officer will conduct environmental compliance inspections during pre-spray activities, during mid-spray operations and at the completion of the spray campaign. These inspections will endeavor to ensure that all the mitigation measures in the EMMP are being implemented and propose measures for improvement for the next IRS campaign. These compliance inspections achieve the following objectives:

- Create a baseline of current compliance activities for the purpose of evaluating improvement in future IRS programs.
- Observe IRS activities in progress to determine and document whether the intervention is in full compliance with USAID requirements as included in the approved SEA.
- Determine, in consultation with EPA officials, the training and support required to improve and ensure future compliance with the SEA.
- Ensure adherence to relevant international rules and regulations, including USA regulations.
- Ensure accurate record keeping and daily collection of empty sachets.
- Ensure that progressive rinsing methods are used in all spray sites and ensure that leftover insecticide solution is re-used for spraying the next day to prevent environmental contamination.
- Ensure that SOPs, washers, team leaders and supervisors are knowledgeable of the correct way to handle and apply insecticides.
- Ensure that all persons in potential contact with pesticides use PPE at all times.

As required by USAID’s Automated Directives System 204.5.4, USAID will actively monitor ongoing activities for compliance with the recommendations in this Supplemental Environmental Assessment (SEA), and modify or end activities that are not in compliance. PMI has annually-programed funds to conduct an independent environment compliance audit to ensure that all the mitigation measures are implemented during the spray campaign.
# Annex A: Environmental Mitigation and Monitoring Plan

<table>
<thead>
<tr>
<th>Potential Negative Impact</th>
<th>Mitigation Activities</th>
<th>Monitoring Frequency</th>
<th>Monitoring Method</th>
<th>Monitoring Indicators</th>
<th>Implementation Responsibility</th>
</tr>
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<tbody>
<tr>
<td>Driver and/or community exposure, or environmental contamination due to improper transport of pesticide</td>
<td>• Driver training according to FAO recommendations</td>
<td>Once prior to campaign, reinforcement as needed</td>
<td>• Completed inspection checklist</td>
<td>• Procedures being followed</td>
<td>Drivers, Implementing partners, Pesticide distributors, spray team leaders</td>
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<td></td>
<td>• Provision of appropriate equipment (reliable vehicle with side walls capable of negotiating rugged roads, tie-downs, packing materials, tarps, spill clean-up kit)</td>
<td>Continuous</td>
<td>• Vehicle inspection Reports</td>
<td>• Demonstrated knowledge</td>
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<td></td>
<td>• Cautious driving while transporting chemicals</td>
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<td>• Accident reports</td>
<td>• Existence of training materials</td>
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<td></td>
<td>• Checking for and repairing leaks from spray equipment prior to transport</td>
<td></td>
<td></td>
<td>• Absence of vehicle accidents</td>
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<tr>
<td></td>
<td>• In case of accident, completion of accident and corrective action report</td>
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<td>• Vehicle condition</td>
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<tr>
<td>Environmental contamination due to improper siting or construction of storage and wash facilities</td>
<td>• Use site qualification checklist. Locate storage and wash facilities on high ground, above floodplains, away from sensitive receptors (water bodies, birds, bees, fish, children, etc.). Provide berms around pesticide storage if necessary.</td>
<td>Once prior to campaign</td>
<td>• Site qualification checklist, inspection reports</td>
<td>• Absence of spills during insecticide transport</td>
<td>District Environmental Officers, Implementing partner</td>
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<tr>
<td></td>
<td>• Use appropriate construction materials as specified in FAO recommendations</td>
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<tr>
<td>Potential Negative Impact</td>
<td>Mitigation Activities</td>
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<td>Monitoring Indicators</td>
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</tbody>
</table>
| Storekeeper and/or community exposure or environmental contamination due to improper storage or pilferage | • Provision of secure storage facilities  
• Training of storekeepers, team leaders and supervisors according to FAO recommendations  
• Daily tracking of insecticide sachets issued, used, and returned  
• Storage procedures according to PMI BMPs  
• Storekeepers trained to not issue pesticides for agricultural or any other unauthorized use | Once prior to campaign  
Continuous  
Continuous | • Training records, waste transportation record and inventory record  
• Daily supervision reports  
• Inspection report | • Dedicated and trained storekeeper who demonstrates knowledge and uses correct procedures  
• Stock records up-to-date  
• Stocks orderly, rotation system in place  
• Expiration dates observed  
• Empty sachets collected, counted and reconciled with amounts issued  
• Ratio of structures sprayed to sachets issued  
• Storehouse temperature measured and recorded  
• No leaks or spills evident  
• Insecticides not stored in same room with food, or medicine, or in inhabited spaces  
• Facility physically secure, padlocked and guarded when not in use  
• No fire, flame, smoking or eating allowed in storage areas | Storekeeper, spray team supervisors, spray team leaders, Implementing partners |
| Personnel handling OPs or carbamates experience cholinesterase inhibition (CI) due to exposure. (Symptoms include) | • For all pesticides, all storage, spray, and wash (SSW) personnel receive training in recognizing effects of pesticide poisoning, remain alert to symptoms amongst their co-workers | Training: Included in pre-campaign orientation, and in training for | • Training record  
• Pre/mid Inspection reports  
• Daily | • Demonstrated knowledge of symptoms of poisoning, emergency treatment, and referral protocol by supervisors, | FMOH, District Health Officers, Implementing partners |
<table>
<thead>
<tr>
<th>Potential Negative Impact</th>
<th>Mitigation Activities</th>
<th>Monitoring Frequency</th>
<th>Monitoring Method</th>
<th>Monitoring Indicators</th>
<th>Implementation Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>tiredness, weakness, dizziness, nausea and blurred vision, headache, sweating, tearing, drooling, vomiting, tunnel vision, and twitching, abdominal cramps, muscular tremors, staggering gait)</td>
<td>PMI will evaluate various approaches to monitoring sprayer exposure to OP pesticides and will develop protocols, based on these evaluations, for a monitoring program.</td>
<td>new personnel.</td>
<td>supervision reports.</td>
<td>team leaders, SSW personnel</td>
<td>Spray team supervisors, spray team leaders, District health officials, and Implementing partners</td>
</tr>
<tr>
<td>Acute effects of pesticide toxicity go untreated (Symptoms include tiredness, weakness, dizziness, nausea, blurred vision, headache, sweating, tearing, drooling, vomiting, tunnel vision, twitching, abdominal cramps, muscular tremors, staggering gait)</td>
<td>• Employ CI testing as needed • Team leaders, storekeepers trained to recognize symptoms and enforce treatment protocols. (e.g., medical referral) • Ensure treatment medicines are available at District health centers. • If skin itches after re-entrance into home, wash with soap and water, for eye irritation, flush eyes with water. • For respiratory irritation, leave the home for fresh air. • For ingestion, or if symptoms persist, contact program staff or go to nearest health facility.</td>
<td>Training on symptoms and responses prior to each campaign</td>
<td>Continuous observation, reinforcement and enforcement of treatment protocols</td>
<td>Demonstrated knowledge of signs and symptoms of poisoning, emergency treatment, and referral protocol by SSW personnel, and residents</td>
<td>Spray team supervisors, spray team leaders, District health officials, and Implementing partners</td>
</tr>
<tr>
<td>Exposure of SSW personnel and/or community during spray operations due to improper spray procedures Failure to realize/receive the benefits of IRS due to improper spray procedures</td>
<td>• Training of SSW personnel and health workers according to MOH and WHOPES recommendations • Proper assembly and calibration of spray equipment • Proper spray patterns • Proper cleanup and equipment</td>
<td>Once prior to campaign</td>
<td>Inspection reports Interviews Training records Supervision of operators, testing of</td>
<td>SSW personnel and health workers display knowledge by following procedures at all times Frequently agitate spray can Hold pump such that compression gage can be</td>
<td>Spray team supervisors, spray team leaders, Implementing partners</td>
</tr>
<tr>
<td>Potential Negative Impact</td>
<td>Mitigation Activities</td>
<td>Monitoring Frequency</td>
<td>Monitoring Method</td>
<td>Monitoring Indicators</td>
<td>Implementation Responsibility</td>
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</tr>
<tr>
<td>Storage procedures</td>
<td>Discipline SSW personnel who do not follow proper procedure in all aspects of operations (handling, spraying, hygiene, cleanup)</td>
<td>Continuous</td>
<td>sprayed surface.</td>
<td>seen</td>
<td>Spray team supervisors, spray team leaders, Implementing partners</td>
</tr>
<tr>
<td>SSW member or community exposure, or environmental contamination due to equipment or PPE issues</td>
<td>Use of sprayers manufactured and maintained according to WHOPES specifications</td>
<td>Continuous</td>
<td>Inspection reports</td>
<td>All PPE as specified in WHOPES recommendations in good condition and worn by all personnel in contact with pesticides</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Proper assembly and calibration of spray equipment</td>
<td></td>
<td>Observations</td>
<td>Condition of spray equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Procurement and proper use of PPE by all persons in contact with pesticides</td>
<td></td>
<td>Interview</td>
<td>Spray nozzle not dripping during spraying or transportation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Training of spray operators to refuse to spray houses that are not properly prepared</td>
<td></td>
<td></td>
<td>CI levels</td>
<td></td>
</tr>
<tr>
<td>Residential Exposure from contaminated household goods</td>
<td>IEC Campaign, instruct residents to:</td>
<td>Training and communication program prior to campaign, Spray operators require household goods removal prior to spraying domicile</td>
<td>Completed checklists</td>
<td>IEC materials developed and include specific instructions</td>
<td>District Health Office, NEMA, EPA, Implementing partners, USAID</td>
</tr>
<tr>
<td></td>
<td>Clear homes of mats or rugs, furniture, cooking implements and foodstuffs prior to spraying</td>
<td></td>
<td>Daily reports</td>
<td>IEC materials delivered in appropriate fashion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>If furniture cannot be moved out of the home, then move it to the center of the room and cover with drop cloth</td>
<td></td>
<td></td>
<td>Residents outside house during spraying</td>
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<td></td>
<td>Food and goods outside house during spraying</td>
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<td></td>
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<td></td>
<td></td>
<td>Furniture covered during spraying</td>
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<tr>
<td>Potential Negative Impact</td>
<td>Mitigation Activities</td>
<td>Monitoring Frequency</td>
<td>Monitoring Method</td>
<td>Monitoring Indicators</td>
<td>Implementation Responsibility</td>
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<td></td>
<td>Stay outside the home during spraying and for two to four hours after spraying</td>
<td></td>
<td>IEC records, Homeowner interviews, Observations during mid-spray inspections</td>
<td>Residents stay outside for four hours after spraying</td>
<td>Village and district leaders</td>
</tr>
<tr>
<td></td>
<td>Move and keep (tie-up or cage) all animals outside the home during spraying, and for four hours after spraying</td>
<td></td>
<td>Observations</td>
<td>Residents sweep floor and dispose of waste properly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sweep up any insects killed from the spraying or any residual insecticide and drop waste in latrine pits</td>
<td></td>
<td></td>
<td>Occurrence of skin/eye/throat irritation</td>
<td></td>
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<td></td>
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<td>Prior to each campaign</td>
<td>Inspection reports, Observations</td>
<td>Houses not sprayed for lack of preparation</td>
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<tr>
<td>Failure to realize benefits of spraying due to post-spray behavior change</td>
<td>Train residents to continue using bed nets for protection against malaria, and to refrain from re-plastering or painting over the sprayed walls after spraying, re-plaster prior to spraying if necessary</td>
<td>Continuous</td>
<td>Inspection reports, Observations</td>
<td>Continued bed net use</td>
<td>Spray team supervisors, spray team leaders, Implementing partners</td>
</tr>
<tr>
<td>Staff and community exposure in vehicle used to transport spray team and/or pesticides</td>
<td>Frequent washing interior and exterior of program vehicles after pesticide transport using soap and water and PPE</td>
<td></td>
<td></td>
<td>Vehicle condition</td>
<td></td>
</tr>
<tr>
<td>SSW personnel exposure due to poor personal hygiene</td>
<td>Training and enforcement in good personal hygiene, daily washing of protective clothes and cleaning of equipment, Prohibition of eating, drinking and smoking during travel, work or before decontamination, Discipline SSW personnel that do not follow proper procedures in all aspects of operations (handling, spraying, hygiene, cleanup)</td>
<td>Training once prior to campaign, continuous reinforcement and enforcement of good personal hygiene</td>
<td>Completed checklists, Observations, Daily supervision reports.</td>
<td>Two uniforms and PPE issued to each spray operator and one set cleaned each day, No eating, drinking or smoking witnessed during operations or prior to washing, Adequate numbers of shower/bathing facilities available</td>
<td>Spray team supervisors, spray team leaders, Implementing partners</td>
</tr>
<tr>
<td>Potential Negative Impact</td>
<td>Mitigation Activities</td>
<td>Monitoring Frequency</td>
<td>Monitoring Method</td>
<td>Monitoring Indicators</td>
<td>Implementation Responsibility</td>
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</table>
| • SSW personnel and/or community exposure due to poor waste management procedures | • Procurement of barrels for progressive rinse, and wash-tubs for personal hygiene; close supervision of triple rinse and wash procedures: equipment labeled as District Health Office property to deter sale and domestic use in event of pilferage  
• Collection, counting, and comparing number of empty sachets to disbursement records, collection of worn/torn gloves and masks  
• Shipment of all wastes to authorized incinerator, destruction witnessed by implementing partner and Ministry of Health official | Once prior to campaign  
Continuous | • Waste disposal certificate  
• Post inspection reports | • Purchase records, inspection reports, waste disposal records from incinerator | District health officials, Implementing partners |
| • Exposure of residents needing physical assistance during spray operations | • Communities establish system to assist the elderly and disabled in removing self and goods from the household.  
• Spray operators enforce removal of household goods | Train operators once prior to campaign  
Continuous enforcement | • Resident feedback, inspection reports | • IEC campaign adequately addresses issues surrounding the elderly and disabled | District, County, Parish, and Village leaders |
| • Fetal/Infant Exposure due to maternal exposure on spray team  
• Fetal Exposure – Pregnant women in contact with pesticides  
• Note: Ethiopian law prohibits women from | • Training of SSW teams.  
• Pregnancy tests as eligibility criteria for SSW teams;  
• Prohibition of breastfeeding women on SSW teams;  
• Education of women regarding risks of exposure  
• Completion of consent forms | Once prior to campaign, during campaign as necessary | Medical Exam Records  
Signed consent forms  
Training records  
Team leader observations | • Pregnancy test results  
• Written confirmation from all female SSW workers that they are not breastfeeding  
• Signed consent forms from all female SSW workers  
• Number of females | Spray team supervisors, spray team leaders, District health officials, Implementing partners |
<table>
<thead>
<tr>
<th>Potential Negative Impact</th>
<th>Mitigation Activities</th>
<th>Monitoring Frequency</th>
<th>Monitoring Method</th>
<th>Monitoring Indicators</th>
<th>Implementation Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>spraying pesticide.</td>
<td>Assign pregnant women to tasks that have no occupational exposure to insecticides.</td>
<td>Continuous</td>
<td>Spray operator and supervisor, daily reports</td>
<td>Residents outside house during spraying, Residents stay outside for four hours after spraying Number of houses not sprayed due to resident immobility</td>
<td>Spray team leaders and supervisors, residents, spray personnel</td>
</tr>
<tr>
<td>Exposure of aged, infirm, pregnant women or fetus, due to inability to leave the home during spraying</td>
<td>Prohibition of spraying in homes where seriously infirm or immobile persons, or pregnant women are living who cannot move outside the home and stay outside the home during, and 4 hours after spraying</td>
<td>Continuous</td>
<td>Observations, Mid inspection reports, Daily supervision reports,</td>
<td>Evidence/absence of environmental contamination (fish, bird, or bee kills), discoloration or turbidity of water</td>
<td>Spray team leaders, supervisors, district environmental officers, Implementing partner's ECO</td>
</tr>
<tr>
<td>Pesticide contamination of water resources, (groundwater, rivers, streams, lakes)</td>
<td>Do not store pesticides within 100 meters of water resources. Do not spray any residences or establish triple rinse/wash facilities within 30 meters of water resources (other interventions should be implemented such as LLINs or wall lining) Do not dispose of any pesticides anywhere other than IRS triple rinse wash system</td>
<td>Continuous</td>
<td>Completed checklists, observations</td>
<td>Individual organism fatalities or impairment</td>
<td>Spray team leaders, supervisors, district environmental officers, Implementing partner's ECO</td>
</tr>
<tr>
<td>Loss of biodiversity due to pesticide contamination</td>
<td>Do not store pesticide within 100 m, nor spray or wash within 30 m sensitive areas or critical habitat (sensitive areas and critical habitats must be identified before activities commence)</td>
<td>Continuous</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Potential Negative Impact</td>
<td>Mitigation Activities</td>
<td>Monitoring Frequency</td>
<td>Monitoring Method</td>
<td>Monitoring Indicators</td>
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<tr>
<td>• Farm, aquaculture or apiary contamination</td>
<td>• Train farmers, fish farmers and beekeepers in target areas to guard against contamination of agri/aquaculture or apiary equipment, and to ensure sweeping and disposal of floor residue and dead after IRS in pit latrines prior to storing equipment in home. • Train SSW workers on the dangers of pesticides to food, fish, birds, and bees</td>
<td>Once prior to campaign</td>
<td>• Training records • Pre inspection reports • Observations</td>
<td>• Number of post-spraying complaints from agri-aquaculture or apiary practitioners in target area • Reports of fish or bee kills</td>
<td>Spray team leaders and supervisors, spray personnel, Implementing partners</td>
</tr>
<tr>
<td>• Spray operations have no/reduced impact on vector due to pesticide quality</td>
<td>• Collect insecticide samples and test to ensure quality control • Supervise and monitor pesticide make-up procedures</td>
<td>Periodic spot sampling Continuous monitoring by spray team leaders and supervisors</td>
<td>• Spray operator daily reports,</td>
<td>• Pesticide meets specifications • Spray operator usage reports reflect proper house/sachet ratio</td>
<td>Implementing partners, team leaders and supervisors</td>
</tr>
<tr>
<td>• Loss of efficacy of pesticides due to continuous or inappropriate use</td>
<td>• Use pesticide rotation or mosaicing protocol to minimize development of resistance to insecticides. Avoid agricultural use of health-based pesticides.</td>
<td>Continuously re-assess pesticide to be used based on entomological monitoring</td>
<td>• Resistance test results</td>
<td>• Protocol developed</td>
<td>Implementing partners.</td>
</tr>
<tr>
<td>• Vector develops resistance to insecticide used</td>
<td>• Change pesticide used</td>
<td>Monitoring resistance before, during, and after each campaign.</td>
<td>• Entomologist report</td>
<td>• Monitoring results presented in end-of-round report</td>
<td>Implementing partners</td>
</tr>
<tr>
<td>• SSW worker or community exposure, or environmental contamination due to negligence</td>
<td>• Take disciplinary action against SSW workers that do not follow proper procedure in all aspects of operations (handling, spraying, hygiene, cleanup) up to and including discharge fromContinuous monitoring throughout campaign, immediate action</td>
<td></td>
<td>• Daily supervisor, Reports • Disciplinary</td>
<td>• Good hiring and management practices • Adequate supervisor to team leader to spray</td>
<td>Spray team supervisors, spray team leaders, Implementing partners, District Officials</td>
</tr>
<tr>
<td>Potential Negative Impact</td>
<td>Mitigation Activities</td>
<td>Monitoring Frequency</td>
<td>Monitoring Method</td>
<td>Monitoring Indicators</td>
<td>Implementation Responsibility</td>
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<tr>
<td></td>
<td>duties</td>
<td>upon discovery of non-conformance with procedures</td>
<td>• reports</td>
<td>operator ratio • Number and severity of incidents reported</td>
<td>District health teams, Implementing partners</td>
</tr>
<tr>
<td>• Community exposure, or environmental contamination post-campaign due to inadequate de-mobilization</td>
<td>• Pesticide storage areas, spray equipment, overalls, PPE, wash equipment, etc. are cleaned with soap and water at end of campaign and are securely stored • Transfer any unused pesticide to district secured warehouse for disposal if expired, or use in subsequent spray round(s).</td>
<td>Once at end of campaign</td>
<td>• Supervision reports, • End of campaign report, • Post inspection checklists</td>
<td>• Presence of adequate facilities for end of campaign cleaning and storage • Visual observance of proper de-mobilization • All equipment cleaned and properly stored</td>
<td></td>
</tr>
<tr>
<td>• Community exposure due to residuals in vehicles used for pesticide transport</td>
<td>• End-of-program cleaning/decontamination of interior and exterior of vehicles</td>
<td>Once after campaign</td>
<td>• Observations • Interviews • End of spray compliance report.</td>
<td>• Interiors and exteriors of vehicles cleaned</td>
<td>Drivers/Rental company</td>
</tr>
</tbody>
</table>
ANNEX B: GENERAL PRINCIPLES IN THE MANAGEMENT OF ACUTE POISONING

Skin Decontamination

Decontamination must proceed concurrently with whatever resuscitative and antidotal measures are necessary to preserve life. Shower patient with soap and water, and shampoo hair to remove chemicals from skin and hair. If there are any indications of weakness, ataxia, or other neurologic impairment, remove the victim’s clothing, have the victim lie down, and give the victim a complete bath and shampoo using copious amounts of soap and water. Check for pesticide sequestered under fingernails or in skin folds and wash these areas.

Flush contaminating chemicals from eyes with copious amounts of clean water for 10-15 minutes. If eye irritation is present after decontamination, ophthalmologic consultation is appropriate.

Persons attending the victim should avoid direct contact with heavily contaminated clothing and vomitus. Contaminated clothing should be promptly removed, bagged, and laundered before returning to the patient. Shoes and other leather items cannot usually be decontaminated and should be discarded. Note that pesticides can contaminate the inside surfaces of gloves, boots, and headgear. Decontamination should especially be considered for emergency personnel (such as ambulance drivers) at the site of a spill or contamination. Wear rubber gloves while washing pesticide from skin and hair of patient. Latex and other surgical or precautionary gloves usually do not provide adequate protection from pesticide contamination.

Airway Protection

Ensure that a clear airway exists. Suction any oral secretions using a large bore suction device if necessary. Intubate the trachea if the patient has respiratory depression or if the patient appears obtunded or otherwise neurologically impaired. Administer oxygen as necessary to maintain adequate tissue oxygenation. In severe poisonings, mechanically supporting pulmonary ventilation for several days may be necessary.

Note on Specific Pesticides: There are several special considerations with regard to certain pesticides. In OP and carbamate poisoning, adequate tissue oxygenation is essential prior to administering atropine.

Gastrointestinal Decontamination

A joint position statement has recently been released by the American Academy of Clinical Toxicology and the European Association of Poisons Centres and Clinical Toxicologists on various methods of gastrointestinal decontamination. A summary of the position statement accompanies the description of each procedure.

1. Gastric Lavage. If the patient presents within 60 minutes of ingestion, lavage may be considered. Insert an orogastric tube and follow with fluid, usually normal saline. Aspirate back the fluid in an attempt to remove any toxicant. If the patient is neurologically impaired, airway protection with a cuffed endotracheal tube is indicated prior to gastric lavage. Lavage performed more than 60 minutes after ingestion has not proven to be beneficial and runs the risk of
inducing bleeding, perforation, or scarring due to additional trauma to already traumatized tissues. It is almost always necessary first to control seizures before attempting gastric lavage or any other method of GI decontamination. Studies of poison recovery have been performed mainly with solid material such as pills. There are no controlled studies of pesticide recovery by these methods. Reported recovery of material at 60 minutes in several studies was 8 percent to 32 percent. There is further evidence that lavage may propel the material into the small bowel, thus increasing absorption.

**Note on Specific Pesticides:** Lavage is contraindicated in hydrocarbon ingestion, a common vehicle in many pesticide formulations.

**Position Statement:** Gastric lavage should not be routinely used in the management of poisons. Lavage is indicated only when a patient has ingested a potentially life-threatening amount of poison and the procedure can be done within 60 minutes of ingestion. Even then, clinical benefit has not been confirmed in controlled studies.

2. **Activated Charcoal Adsorption.** Activated charcoal is an effective absorbent for many poisonings. Volunteer studies suggest that it will reduce the amount of poison absorbed if given within 60 minutes. There are insufficient data to support or exclude its use if time from ingestion is prolonged, although some poisons that are less soluble may be absorbed beyond 60 minutes. Clinical trials with charcoal have been done with poisons other than pesticides. There is some evidence that paraquat is well absorbed by activated charcoal. Charcoal has been anecdotally successful with other pesticides.

**DOSAGE OF ACTIVATED CHARCOAL:**

- Adults and children over 12 years: 25-100 g in 300-800 mL water.
- Children under 12 years: 25-50 g per dose.
- Infants and toddlers under 20 kg: 1 g per kg body weight.

Many activated charcoal formulations come premixed with sorbitol. Avoid giving more than one dose of sorbitol as a cathartic in infants and children due to the risk of rapid shifts of intravascular fluid. Encourage the victim to swallow the adsorbent even though spontaneous vomiting continues. Antiemetic therapy may help control vomiting in adults or older children. As an alternative, activated charcoal may be administered through an orogastric tube or diluted with water and administered slowly through a nasogastric tube. Repeated administration of charcoal or other absorbent every 2-4 hours may be beneficial in both children and adults, but use of a cathartic such as sorbitol should be avoided after the first dose. Repeated doses of activated charcoal should not be administered if the gut is atonic. The use of charcoal without airway protection is contraindicated in the neurologically impaired patient.

**Note on Specific Pesticides:** The use of charcoal without airway protection should be used with caution in poisons such as OPs, carbamates, and organochlorines if they are prepared in a hydrocarbon solution.

**Position Statement:** Single-dose activated charcoal should not be used routinely in the management of poisoned patients. Charcoal appears to be most effective within 60 minutes of ingestion and may be considered for use for this time period. Although it may be considered 60 minutes after ingestion, there is insufficient evidence to support or deny its use for this time period. Despite improved binding of poisons within 60 minutes, only one study suggests that there is improved clinical outcome. Activated charcoal is contraindicated in an unprotected airway, a GI tract not anatomically intact, and when charcoal therapy may increase the risk of aspiration of a hydrocarbon-based pesticide.
Seizures: Lorazepam is increasingly being recognized as the drug of choice for status epilepticus, although there are few reports of its use with certain pesticides. Emergency personnel must be prepared to assist ventilation with lorazepam and any other medication used to control seizures. See dosage table below. For organochlorine compounds, use of lorazepam has not been reported in the literature. Diazepam is often used for this, and is still used in other pesticide poisonings.

<table>
<thead>
<tr>
<th>DOSAGE OF DIAZEPAM:</th>
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<tr>
<td>• Adults: 5-10 mg IV and repeat every 5-10 minutes to maximum of 30 mg.</td>
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<tr>
<td>• Children: 0.2 to 0.5 mg/kg every 5 minutes to maximum of 10 mg in children over 5 years, and maximum of 5 mg in children under 5 years.</td>
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<tr>
<th>DOSAGE OF LORAZEPAM:</th>
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<tr>
<td>• Adults: 2-4 mg/dose given IV over 2-5 minutes. Repeat if necessary to a maximum of 8 mg in a 12 hour period.</td>
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<tr>
<td>• Adolescents: Same as adult dose, except maximum dose is 4 mg.</td>
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<tr>
<td>• Children under 12 years: 0.05-0.10 mg/kg IV over 2-5 minutes. Repeat if necessary .05 mg/kg 10-15 minutes after first dose, with a maximum dose of 4 mg.</td>
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</table>

Caution: Be prepared to assist pulmonary ventilation mechanically if respiration is depressed, to intubate the trachea if laryngospasm occurs, and to counteract hypotensive reactions.

Phenobarbital is an additional treatment option for seizure control. Dosage for infants, children, and adults is 15-20 mg/kg as an IV loading dose. An additional 5 mg/kg IV may be given every 15-30 minutes to a maximum of 30 mg/kg. The drug should be pushed no faster than 1 mg/kg/minute.

For seizure management, most patients respond well to usual management consisting of benzodiazepines, or phenytoin and phenobarbital.
## Annex C: Summary of Acute Exposure Symptoms and Treatment of WHO Pesticides

### Summary of Acute Exposure Symptoms and Treatment of WHO-recommended Carbamates

<table>
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<tr>
<th>Carbamates</th>
<th>Human side effects</th>
<th>Treatment</th>
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<tr>
<td>Bendiocarb</td>
<td>Excessive sweating, headache, nausea, blurred vision, chest pain, vomiting, excessive salivation, and slurred speech. Severe intoxication causes narrowed pupils, muscle twitching, spasms, intestinal convulsions, diarrhea, and labored respiration.</td>
<td>The affected person should stop work immediately, remove any contaminated clothing and wash the affected skin with soap and clean water. The whole contaminated area (including the eyes, if necessary) should be flushed with large quantities of clean water. The patient should be kept at rest and immediate medical aid obtained. Administer Atropine.</td>
</tr>
<tr>
<td>Propoxur</td>
<td>Excessive sweating, headache, nausea, blurred vision, chest pain, vomiting, excessive salivation, and slurred speech. Severe intoxication causes narrowed pupils, muscle twitching, spasms, intestinal convulsions, diarrhea, and labored respiration.</td>
<td>The affected person should stop work immediately, remove any contaminated clothing and wash the affected skin with soap and clean water. The whole contaminated area (including the eyes, if necessary) should be flushed with large quantities of clean water. The patient should be kept at rest and immediate medical aid obtained. Administer Atropine.</td>
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<tr>
<td>Organophosphates</td>
<td>Human side effects</td>
<td>Treatment</td>
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<tr>
<td>Malathion</td>
<td>Malathion is an indirect cholinesterase inhibitor. The primary target of malathion is the nervous system; it causes neurological effects by inhibiting cholinesterase in the blood and brain. Exposure to high levels can result in difficulty breathing, vomiting, blurred vision, increased salivation and perspiration, headaches, and dizziness. Loss of consciousness and death may follow very high exposures to malathion.</td>
<td>Oral exposure to malathion should be treated with rapid gastric lavage unless the patient is vomiting. Dermal exposures should be treated by washing the affected area with soap and water. If the eyes have been exposed to malathion, flush them with saline or water. People exposed to malathion who exhibit respiratory inefficiency with peripheral symptoms should be treated via slow intravenous injection with 2–4 mg atropine sulfate and 1,000–2,000 mg pralidoxime chloride or 250 mg toxogonin (adult dose). Exposure to high levels of malathion that result in respiratory distress, convulsions, and unconsciousness should be treated with atropine and a re-activator. Morphine, barbiturates, phenothiazine, tranquillizers, and central stimulants are all contraindicated.</td>
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<tr>
<td>Fenitrothion</td>
<td>Fenitrothion is the most toxic to man of the insecticides approved for residual house spraying, and has a relatively low margin of safety. Absorbed through the gastrointestinal tract as well as through intact skin and by inhalation. It is also a cholinesterase inhibitor.</td>
<td>Dermal exposure to fenitrothion should be treated by removing contaminated clothing, rinsing the skin with water, washing the exposed areas with soap and water, then seeking medical attention. If fenitrothion gets into the eyes, they should be rinsed with water for several minutes. Contact lenses should be removed if possible and medical attention should be sought. Ingestion of fenitrothion should be treated by rinsing the mouth and inducing vomiting if the person is conscious. Inhalation exposures require removal to fresh air and rest in a half-upright position. Artificial respiration should be administered if indicated and medical attention should be sought.</td>
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<tr>
<td>Organophosphates</td>
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<td>Treatment</td>
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<tr>
<td>Pirimiphos-methyl</td>
<td>Pirimiphos-methyl is also a cholinesterase inhibitor. Early symptoms of poisoning may include excessive sweating, headache, weakness, giddiness, nausea, vomiting, stomach pains, blurred vision, constricted pupils, slurred speech, and muscle twitching. Later there may be convulsions, coma, loss of reflexes, and loss of sphincter control.</td>
<td>OP poisoning is a medical emergency and requires immediate treatment. All supervisors and individual spraymen (in the case of dispersed operations) should be trained in first-aid and emergency treatment of OP intoxication. The affected person should stop work immediately, remove any contaminated clothing, wash the affected skin with soap and clean water and flush the skin with large quantities of clean water. Care must be taken not to contaminate others, including medical or paramedical workers. Automatic injectors loaded with atropine sulfate and obidoxime chloride can be made available in the field whenever relatively toxic OP insecticides are used in areas without easy access to medical care. Atropine sulfate. Administer atropine sulfate intravenously or intramuscularly if intravenous injection is not possible. Glycopyrrolate has been studied as an alternative to atropine and found to have similar outcomes using continuous infusion.</td>
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</table>
### Summary of Acute Exposure Symptoms and Treatment for Pyrethroids

<table>
<thead>
<tr>
<th>Pyrethroids</th>
<th>Human side effects</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bifenthrin</td>
<td>Acute exposure symptoms include skin and eye irritation, headache, dizziness, nausea, vomiting, diarrhea, excessive salivation, fatigue, irritability, abnormal sensations of the face and skin, and numbness. No skin inflammation or irritation observed; however can cause a reversible tingling sensation. Incoordination, irritability to sound and touch, tremors, salivation, diarrhea, and vomiting have been caused by high doses.</td>
<td>Depends on the symptoms of the exposed person. Casual exposures require decontamination and supportive care. Wash affected skin areas promptly with soap and warm water. Medical attention should be sought if irritation or paresthesia occurs. Eye exposures should be treated by rinsing with copious amounts of water or saline.</td>
</tr>
<tr>
<td>Deltamethrin</td>
<td>Acute exposure symptoms include skin and eye irritation, headache, dizziness, nausea, vomiting, diarrhea, excessive salivation, fatigue, irritability, abnormal sensations of the face and skin, and numbness.</td>
<td>If exposed immediately remove any contaminated clothing. Soak any liquid contaminant on the skin clean affected area with soap and warm water. Rinse copiously with water when eye exposures occur or 4 percent sodium bicarbonate. Vomiting should not be induced following ingestion exposures, but the mouth should be rinsed.</td>
</tr>
<tr>
<td>Lambda-Cyhalothrin</td>
<td>Skin exposure leads to transient skin sensations such as periorbital facial tingling and burning. Can irritate the eyes, skin, and upper respiratory tract. Oral exposure can cause neurological effects, including tremors and convulsions. Ingestion of liquid formulations may result in aspiration of the solvent into the lungs, resulting in chemical pneumonitis.</td>
<td>Dermal exposure should be treated by removing contaminated clothing and washing the exposed areas with soap and water. Eyes should be rinsed with water for several minutes. Vomiting should not be induced following ingestion. Inhalation exposures require removal to fresh air and rest.</td>
</tr>
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<td>Pyrethroids</td>
<td>Human side effects</td>
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<tr>
<td>Alpha-cypermethrin</td>
<td>Acute exposure symptoms include skin rashes, eye irritation, itching and burning sensation on exposed skin, and paraesthesia. Acute inhalation exposures may cause upper and lower respiratory tract irritation. Ingestion of alpha-cypermethrin is also harmful.</td>
<td>Dermal exposure should be treated by removing contaminated clothing and washing the exposed areas with soap and water. Eyes should be rinsed with water for several minutes. Vomiting should not be induced following ingestion. Inhalation exposures require removal to fresh air and rest.</td>
</tr>
<tr>
<td>Cyfluthrin</td>
<td>Acute occupational or accidental exposure results in burning, itching, and tingling of the skin. Reported systemic symptoms included dizziness, headache, anorexia, and fatigue. Vomiting occurs most commonly after ingestion of pyrethroids. Less commonly reported symptoms include tightness of the chest, paresthesia, palpitations, blurred vision, and increased sweating. In serious cases, coarse muscular fasciculations (twitching), convulsions, and coma.</td>
<td>If exposed immediately remove any contaminated clothing. Soak any liquid contaminant on the skin clean affected area with soap and warm water. Rinse copiously with water when eye exposures occur or 4 percent sodium bicarbonate. Vomiting should not be induced following ingestion exposures, but the mouth should be rinsed.</td>
</tr>
<tr>
<td>Etofenprox</td>
<td>Acute occupational or accidental exposure results in burning, itching, and tingling of the skin. Reported systemic symptoms included dizziness, headache, anorexia, and fatigue. Vomiting occurs most commonly after ingestion of pyrethroids. Less commonly reported symptoms include tightness of the chest, paresthesia, palpitations, blurred vision, and increased sweating. In serious cases, coarse muscular fasciculations (twitching), convulsions, and coma.</td>
<td>If exposed immediately remove any contaminated clothing. Soak any liquid contaminant on the skin clean affected area with soap and warm water. Rinse copiously with water when eye exposures occur or 4 percent sodium bicarbonate. Vomiting should not be induced following ingestion exposures, but the mouth should be rinsed.</td>
</tr>
</tbody>
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ANNEX D: EMMP REPORT FORM

Please see Annual EMMP Report Form next page
Implementing Organization:
Geographic location of USAID-funded activities:
Period covered by this Reporting Form and Certification:

<table>
<thead>
<tr>
<th>Potential Negative Impact</th>
<th>Mitigation Activities</th>
<th>Status of Mitigation Activity</th>
<th>List any Outstanding Issues related to Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver and/or community exposure, or environmental contamination due to improper transport of pesticide</td>
<td>• Driver training according to FAO recommendations&lt;br&gt;• Provision of appropriate equipment (reliable vehicle with side walls capable of negotiating rugged roads, tie-downs, packing materials, tarps, spill clean-up kit)&lt;br&gt;• Cautious driving while transporting chemicals&lt;br&gt;• Checking for and repairing leaks from spray equipment prior to transport&lt;br&gt;• In case of accident, completion of accident and corrective action report</td>
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<tr>
<td>Environmental contamination due to improper siting or construction of storage and wash facilities</td>
<td>• Use site qualification checklist. Locate storage and wash facilities on high ground, above floodplains, away from sensitive receptors (water bodies, birds, bees, fish, children, etc.). Provide berms around pesticide storage if necessary.&lt;br&gt;• Use appropriate construction materials as specified in FAO recommendations</td>
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<tr>
<td>Storekeeper and/or community exposure or environmental</td>
<td>• Provision of secure storage facilities&lt;br&gt;• Training of storekeepers, team leaders and supervisors according to FAO</td>
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<tr>
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| contamination due to improper storage or pilferage Storekeeper and/or community exposure or environmental contamination due to improper storage or pilferage | • recommendations  
  • Daily tracking of insecticide sachets issued, used, and returned  
  • Storage procedures according to PMI BMPs  
  • Storekeepers trained to not issue pesticides for agricultural or any other unauthorized use | | |
| Personnel handling OPs or carbamates experience cholinesterase inhibition (CI) due to exposure. (Symptoms include tiredness, weakness, dizziness, nausea and blurred vision, headache, sweating, tearing, drooling, vomiting, tunnel vision, and twitching, abdominal cramps, muscular tremors, staggering gait) | • For all pesticides, all storage, spray, and wash (SSW) personnel receive training in recognizing effects of pesticide poisoning, remain alert to symptoms amongst their co-workers and respond appropriately.  
  • PMI will evaluate various approaches to monitoring sprayer exposure to OP pesticides and will develop protocols, based on these evaluations, for a monitoring program. | | |
| Acute effects of pesticide toxicity go untreated (Symptoms include tiredness, weakness, dizziness, nausea, blurred vision, headache, sweating, tearing, drooling, vomiting, tunnel vision, twitching, abdominal cramps, muscular tremors, staggering gait) | • Employ CI testing as needed  
  • Team leaders, storekeepers trained to recognize symptoms and enforce treatment protocols. (e.g., medical referral)  
  • Ensure treatment medicines are available at District health centers.  
  • If skin itches after re-entrance into home, wash with soap and water, for eye irritation, flush eyes with water.  
  • For respiratory irritation, leave the home for fresh air.  
  • For ingestion, or if symptoms persist, contact program staff or go to nearest health facility. | | |
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</table>
| Exposure of SSW personnel and/or community during spray operations due to improper spray procedures Failure to realize/receive the benefits of IRS due to improper spray procedures | • Training of SSW personnel and health workers according to MOH and WHOPES recommendations  
• Proper assembly and calibration of spray equipment  
• Proper spray patterns  
• Proper cleanup and equipment storage procedures  
• Discipline SSW personnel who do not follow proper procedure in all aspects of operations (handling, spraying, hygiene, cleanup) | •                                                                                                     | •                             |
| SSW member or community exposure, or environmental contamination due to equipment or PPE issues | • Use of sprayers manufactured and maintained according to WHOPES specifications  
• Proper assembly and calibration of spray equipment  
• Procurement and proper use of PPE by all persons in contact with pesticides | •                                                                                                     | •                             |
| Residential Exposure from contaminated household goods                                      | • Training of spray operators to refuse to spray houses that are not properly prepared  
• IEC Campaign, instruct residents to:  
  • Clear homes of mats or rugs, furniture, cooking implements and foodstuffs prior to spraying  
  • If furniture cannot be moved out of the home, then move it to the center of the room and cover with drop cloth  
  • Stay outside the home during spraying and for two to four hours after spraying | •                                                                                                     | •                             |
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<tr>
<td>Move and keep (tie-up or cage) all animals outside the home during spraying, and for four hours after spraying</td>
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<td>Sweep up any insects killed from the spraying or any residual insecticide and drop waste in latrine pits</td>
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<td>Failure to realize benefits of spraying due to post-spray behavior change</td>
<td>Train residents to continue using bed nets for protection against malaria, and to refrain from re-plastering or painting over the sprayed walls after spraying, re-plaster prior to spraying if necessary</td>
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<tr>
<td>Staff and community exposure in vehicle used to transport spray team and/or pesticides</td>
<td>Frequent washing interior and exterior of program vehicles after pesticide transport using soap and water and PPE</td>
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<td>SSW personnel exposure due to poor personal hygiene</td>
<td>Training and enforcement in good personal hygiene, daily washing of protective clothes and cleaning of equipment</td>
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<td>Prohibition of eating, drinking and smoking during travel, work or before decontamination</td>
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<td></td>
<td>Discipline SSW personnel that do not follow proper procedures in all aspects of operations (handling, spraying, hygiene, cleanup)</td>
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<tr>
<td>SSW personnel and/or community exposure due to poor waste management procedures</td>
<td>Procurement of barrels for progressive rinse, and wash-tubs for personal hygiene; close supervision of triple rinse and wash procedures: equipment labeled as District Health Office property to deter sale and domestic</td>
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<td></td>
<td>use in event of pilferage</td>
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<td></td>
<td>- Collection, counting, and comparing number of empty sachets to disbursement records, collection of worn/torn gloves and masks</td>
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<td></td>
<td>- Shipment of all wastes to authorized incinerator, destruction witnessed by implementing partner and Ministry of Health official</td>
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<tr>
<td>• Exposure of residents needing physical assistance during spray operations</td>
<td>- Communities establish system to assist the elderly and disabled in removing self and goods from the household.</td>
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<td></td>
<td>- Spray operators enforce removal of household goods</td>
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<tr>
<td>• Fetal/Infant Exposure due to maternal exposure on spray team</td>
<td>- Training of SSW teams.</td>
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<tr>
<td>• Fetal Exposure – Pregnant women in contact with pesticides</td>
<td>- Pregnancy tests as eligibility criteria for SSW teams;</td>
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<td>• Note: Ethiopian law prohibits women from spraying pesticide.</td>
<td>- Prohibition of breastfeeding women on SSW teams;</td>
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<td>- Education of women regarding risks of exposure</td>
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<td>- Completion of consent forms</td>
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<td>- Assign pregnant women to tasks that have no occupational exposure to insecticides.</td>
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<td>• Exposure of aged, infirm, pregnant women or fetus, due to inability to leave the home during spraying</td>
<td>- Prohibition of spraying in homes where seriously infirm or immobile persons, or pregnant women are living who cannot move outside the home and stay outside the home during, and 4 hours after spraying</td>
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<tr>
<td>• Pesticide contamination of water resources, (groundwater, rivers,</td>
<td>- Do not store pesticides within 100 meters of water resources. Do not spray any residences or establish triple</td>
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<tr>
<td>• Loss of efficacy of pesticides due to continuous or inappropriate use</td>
<td>• Use pesticide rotation or mosaicing protocol to minimize development of resistance to insecticides. Avoid agricultural use of health-based pesticides.</td>
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<tr>
<td>• Vector develops resistance to insecticide used</td>
<td>• Change pesticide used</td>
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<tr>
<td>• SSW worker or community exposure, or environmental contamination due to negligence</td>
<td>• Take disciplinary action against SSW workers that do not follow proper procedure in all aspects of operations (handling, spraying, hygiene, cleanup) up to and including discharge from duties</td>
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</tbody>
</table>
| • Community exposure, or environmental contamination post-campaign due to inadequate de-mobilization | • Pesticide storage areas, spray equipment, overalls, PPE, wash equipment, etc. are cleaned with soap and water at end of campaign and are securely stored  
  • Transfer any unused pesticide to district secured warehouse for disposal if expired, or use in subsequent spray round(s). |                              |                                               |
| • Community exposure due to residuals in vehicles used for pesticide transport              | • End-of-program cleaning/decontamination of interior and exterior of vehicles           |                              |                                               |
ANNEX E: EMMP CERTIFICATION FORM

Please see certification form next page
USAID/RWANDA PMI IRS
ENVIRONMENTAL MITIGATION AND MONITORING PLAN
REPORTING FORM AND CERTIFICATION

Certification

I certify the completeness and the accuracy of the Environmental Mitigation and Monitoring Plan Reporting Form for activities funded by USAID/________ as described above and covered by PMI IRS SEA ______-______ for which I am responsible:

Effective Dates

_________________________  __________________________
Signature                  Date

_________________________
Print Name

_________________________
Organization

BELOW THIS LINE FOR USAID USE ONLY

USAID/________ Mission Clearance of EMMP Reporting Form and Certification:

Agreement Officer's Technical Representative: ______________________ Date: ____________

Mission Environmental Officer: ________________________________ Date: ____________
ANNEX F: REFERENCES

Abt Associates. February 2012. AIRS Rwanda Assessment of Obsolete Insecticide Wastes in 60 PMI-supported Districts. USAID


Abt Associates. August 2012. Assessment and Recommendations: Storage, Stock Control, and Inventory Management. USAID.


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USAID President’s Malaria Initiative, Rwanda, *Malaria Operation Plan FY 2013*