



U.S. PRESIDENT'S MALARIA INITIATIVE



# SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT

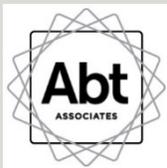
FOR NATIONWIDE IRS IN CÔTE D'IVOIRE 2020 – 2024

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Abt Associates | 6130 Executive Boulevard | Rockville, MD 20852 | T. 301.347.5000

| F. 301.913.9061

abtassociates.com

SEA FOR NATIONWIDE IRS IN CÔTE  
D'IVOIRE USING PYRETHROID, CARBAMATE,  
ORGANOPHOSPHATE,  
CLOTHIANIDIN,  
CLOTHIANIDIN/DELTAMETHRIN  
COMBINATION AND CHLORFENAPYR  
(WHEN WHO PQ LISTED) 2020 – 2024

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# ACRONYMS

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<b>BMP</b>	Best Management Practices
<b>CDC</b>	Centers for Disease Control and Prevention (U.S.)
<b>CFR</b>	Code of Federal Regulations (U.S.)
<b>COR</b>	Contracting Officer's Representative
<b>EC</b>	Environmental Compliance
<b>EMMP</b>	Environmental Mitigation and Monitoring Plan
<b>IEC</b>	Information, Education, and Communication
<b>IP</b>	Implementing Partner
<b>IRS</b>	Indoor Residual Spraying
<b>ITN</b>	Insecticide-treated Net
<b>IVM</b>	Integrated Vector Management
<b>M&amp;E</b>	Monitoring and Evaluation
<b>MOH</b>	Ministry of Health
<b>MSP</b>	Mobile Soak Pit
<b>NMCP</b>	National Malaria Control Program
<b>NSP</b>	National strategic Plan for Malaria
<b>PEA</b>	Programmatic Environmental Assessment
<b>PMI</b>	U.S. President's Malaria Initiative
<b>PPE</b>	Personal Protective Equipment
<b>PSECA</b>	Pre-Spray Environmental Compliance Assessment
<b>SBCC</b>	Social and behavior change communication
<b>SEA</b>	Supplemental Environmental Assessment
<b>SOP</b>	Spray Operator
<b>USAID</b>	United States Agency for International Development
<b>USEPA</b>	United States Environmental Protection Agency
<b>WHO</b>	World Health Organization
<b>WHO/PQ</b>	World Health Organization Prequalification

# EXECUTIVE SUMMARY

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This document has been prepared to serve as a Supplemental Environmental Assessment (SEA) for indoor residual spraying (IRS) in Côte d'Ivoire supported by the U.S. President's Malaria Initiative (PMI) for the period 2020-2024. This first document for Côte d'Ivoire was prepared in accordance with the provisions of Title 22 of the United States Code of Federal Regulations, Part 216 (22 CFR 216) regarding the use and application of pesticides. As required by the 22 CFR 216, only World Health Organization (WHO) Pre-Qualification (PQ)-listed pesticides are acceptable for IRS operations<sup>1</sup> supported by PMI. This SEA proposes to authorize the use of those WHO recommended pesticides in the pyrethroid, carbamate, organophosphate and neonicotinoid classes and a clothianidin/deltamethrin mixture, including the use of chlorfenapyr in the pyrrole class, when listed by WHO PQ. Additionally, the SEA seeks nationwide coverage of authorized PMI-supported IRS, and requests authorization of small-scale, closely supervised hut trials using new IRS insecticides, when the insecticide has been submitted for Phase III PQ evaluation, and country-level required documentation has been submitted and approved.

Malaria is a major public health problem in Côte d'Ivoire. It accounts for about 43% of outpatient visits in health facilities. Malaria incidence in 2017 was 134 cases per 1,000 in the general population, and 247 per 1,000 among children under 5 (per the NMCP 2018 annual report).

Changing or rotating insecticides of different classes over time is a leading way to manage vector resistance. In Côte d'Ivoire, entomological monitoring between April 2018 and March 2019 has demonstrated resistance for all pyrethroids, pirimiphos-methyl and bendiocarb in all sites surveyed.

In 2020, Côte d'Ivoire will conduct IRS with SumiShield 50WG (a clothianidin) and Fludora Fusion (a clothianidin/deltamethrin combination). Chlorfenapyr, a member of the pyrrole chemical class, if listed by WHO PQ and authorized by the Ministry of Agriculture for use in Côte d'Ivoire, will offer additional options for insecticide rotation.

This SEA for IRS in Côte d'Ivoire outlines the monitoring and mitigation measures that the PMI implementing partner (IP) will use to minimize or reduce any adverse impacts of pesticide application. Those measures are found in the Safer Use Action Plan (Section 6), and summarized in the Environmental Mitigation and Monitoring Plan (EMMP), found in Annex A. All PMI IRS operations in Côte d'Ivoire will be performed according to the protocols and procedures found therein. These procedures do not change with the use of different classes of authorized pesticides, with the following exceptions:

1. Pyrethroids are skin irritants, and can cause parasthesia (an abnormal sensation, typically tingling or pricking ("pins and needles"), caused chiefly by pressure on or damage to peripheral nerves). Spray operators must be cautioned against touching their skin, particularly their face, with contaminated gloves.
2. Due to the potential cumulative effects of organophosphate exposure (e.g. cholinesterase depression), team leaders and senior staff will need increased emphasis and training on their responsibility and ability to constantly monitor the appearance and behavior of their team members, and to recognize the symptoms of organophosphate exposure in order to implement response protocols. Biomonitoring is not required for the use of pirimiphos-methyl formulations for IRS at the present time, but increased vigilance is essential.

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<sup>1</sup> Pre- Qualified list-Vector Control Products <https://www.who.int/pq-vector-control/prequalified-lists/en/>

3. Pirimiphos-methyl formulations are supplied in plastic bottles, which if not controlled carefully may be used inappropriately once emptied of the insecticide. In addition, incineration of the bottles may cause harmful emissions. Because of these potential problems, the following procedures and protocols have been established:
  - a. A triple rinse for the plastic bottles has been incorporated during the insecticide mixing procedure, whereby the insecticide container is emptied into the spray tank and then three times the bottle is partly filled with clean water, capped, shaken, and emptied into the spray tank. This ensures that the insecticide is used more efficiently, and that the container is thoroughly rinsed of pesticide and therefore safe for handling and subsequent recycling/use. The risk of exposure due to insecticide residue in the container is essentially eliminated; however, the following procedures are also followed.
  - b. Containers are punctured multiple times so no one can reuse them.
  - c. Recycling programs have been established to turn the plastic into usable non-food products. Through close supervision and chain of custody, and in partnership with the NMCP, the implementing partner will ensure that the plastic remains segregated from other supplies, is used for items such as oil tanks, patio flagstones or electrical conduit, and will not be used for products that contain consumables. The recycling programs have prevented the emission of many tons of carbon dioxide and other potentially toxic chemicals from the incineration of plastic.

The PMI IP will implement the EMMP in Annex A, with guidance from PMI and the NMCP and with the assistance and involvement of the local communities. All senior staff in charge of IRS implementation will be trained to monitor operations when in the field, in order to maximize supervisory oversight and ensure the effectiveness of the mitigation measures during spray operation. The district coordinators will also monitor environmental compliance during the IRS campaign. The IP will complete the annual Environmental Mitigation and Monitoring Report Form in Annex B and submit it to PMI along with the annual End of Spray Report.

This SEA obviates the need for a letter report in 2020, but normally a letter report will be submitted annually to the Contracting Officer's Representative (COR) and Bureau Environmental Officer (BEO) prior to the spraying campaign. It will contain information regarding program changes, entomological resistance monitoring results, and program response to those results. It will also state how the program will improve on any areas of deficiency.

The following assessment draws heavily on the Programmatic Environmental Assessment (PEA) for Integrated Vector Management (IVM), updated in 2017, and many other reference documents, as noted throughout this document.

# PRINCIPAL PROPOSALS AND CLEARANCE

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1. In order to begin PMI-supported IRS in Cote d'Ivoire, PMI is seeking approval for a SEA effective for five years (2020-2024), and for the SEA to be nationwide in scope.
2. This SEA will authorize the use of all WHO-recommended pesticides in the pyrethroid, carbamate, organophosphate and neonicotinoid classes and a clothianidin/deltamethrin mixture, and also authorizes the use of chlorfenapyr when recommended by WHO PQ.
3. This SEA contains the condition that spraying will not be performed by PMI IPs within 30 meters of natural water bodies, wetlands or marshes, organic farming areas, beekeeping areas, or the core areas within protected forests, parks or habitats.
4. It is further proposed to allow for small studies or hut trials to evaluate new IRS insecticides such as chlorfenapyr, once the insecticide has been submitted for Phase III PQ evaluation, and once the required country-level documentation has been submitted and/or registration is completed.
5. The Safer Use Action Plan in Section 6 provides detailed guidance on the performance of all activities associated with IRS. The attached, updated Environmental Mitigation and Monitoring Plan (Annex A) summarizes the key required mitigation measures, as well as the monitoring and reporting requirements and schedule.
6. The preparation of this SEA renders a Letter Report unnecessary for 2020. In subsequent years, provided there are no changes to the program outside the scope of this SEA, a Letter Report will be submitted to PMI annually that will discuss significant changes in the IRS program for that particular year's spray campaign.
7. This SEA contains an updated Pesticides Procedures section, which together with the Safer Use Action Plan constitute the elements of a PERSUAP.

## APPROVAL OF ENVIRONMENTAL ACTION RECOMMENDED

### 2020 – 2024 SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT FOR PRESIDENT'S MALARIA INITIATIVE- INDOOR RESIDUAL SPRAYING (IRS) FOR MALARIA CONTROL IN CÔTE D'IVOIRE

The USAID Global Health Bureau has determined that the proposed IRS effort, as described in this SEA, responds to the needs of the community and country with respect to managing malaria in Côte d'Ivoire 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 were established to avoid and reduce any potential adverse impact. USAID has concluded that the proposed action, when executed as described in the SEA and the PEA for PMI IVM (2017), is consistent with the Government of Côte d'Ivoire's and PMI's goal of reducing malaria incidence in Côte d'Ivoire while minimizing negative impact to the environment and to human health.

The proposed actions recommended for approval in this 2020 SEA are:

1. The implementation of this first campaign using pyrethroids, carbamates, organophosphates, neonicotinoids and the clothianidin/deltamethrin combination, and/or chlorfenapyr (when PQ-listed), where appropriate, based on criteria such as transmission rate, vector susceptibility, residual effect, appropriate home and wall structure, economic factors, and ecological/human health impacts.
2. This SEA will authorize PMI-supported IRS in all geographical areas, in Côte d'Ivoire where IRS may be implemented or where PMI may provide national- or regional-level support as decided by the NMCP and PMI for the five-year period from 2020-2024.
3. This SEA authorizes small, closely supervised studies or hut trials to study new IRS insecticides such as chlorfenapyr, once the insecticide has been submitted for Phase III WHO PQ evaluation and country-level required documentation has been submitted.
4. Given the successful record of PMI in implementing IRS in Africa without significant environmental consequences, it is proposed to allow IRS in the buffer zones of environmentally protected areas, using the strict protocols and procedures contained in the PMI best management practices (BMP) manual, and observing all precautions and prescriptions in this SEA.

The Safer Use Action Plan (Section 6) and the updated Environmental Mitigation and Monitoring Plan for Côte d'Ivoire (Annex A) provide detailed guidance on the performance of all activities associated with IRS. Through the use of this and other guidance, PMI has maintained an excellent record of success in executing IRS without substantial environmental or human health impact.

Clearance Page for the 2020 Supplemental Environmental Assessment Report\_Vector Link

**CLEARANCE:**

USAID/ West Africa Mission Director:   Cleared   Date:   3/27/2020    
Daniel Moore

**CONCURRENCE:**

Dennis W Durbin (affiliate) Digitally signed by Dennis W Durbin (affiliate)  
Date: 2020.03.31 10:56:06 -04'00'  
GH/ Bureau Environmental Officer: \_\_\_\_\_ Date: \_\_\_\_\_  
Dennis W Durbin

**ADDITIONAL CLEARANCES:**

PMI/Côte d'Ivoire Resident Advisor:   SIGNED   Date:   March 23, 2020    
Pascal Zinzindohoue

USAID/Côte d'Ivoire Acting Mission Program Director:   Cleared   Date:   March 25, 2020    
William Coulibaly

Alternate COR:   Clearance by email   Date:   03/31/2020    
Allison Belemvire

USAID/Regional Environmental Advisor:   Cleared   Date:   March 24,2020    
Henry Aryeetey

# I. BACKGROUND AND PURPOSE

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## I.1. PRESIDENT'S MALARIA INITIATIVE

Launched in 2005, the goal of the U.S. President's Malaria Initiative (PMI) is to reduce malaria-related deaths by 50% in 19 high-burden countries in Africa through rapid scale-up 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 ITNs, indoor residual spraying (IRS) with insecticides, intermittent preventive treatment for pregnant women, and prompt diagnosis and treatment with use of artemisinin-based combination therapies.

In 2017 The United States Agency for International Development (USAID) awarded Abt Associates a five-year contract to contribute to the prevention of mosquito-borne diseases. Through this Task Order contract, Abt will support PMI and USAID to plan and implement an integrated vector control approach with the overall goal of reducing the burden of malaria.

The VectorLink project will continue to work closely with Ministries of Health (MOH), National Malaria Control Programs (NMCP), district health offices, local non-governmental organizations, and community leaders to support the government of Côte d'Ivoire's implementation of the National Strategic Plan (NSP) 2016 – 2020.

## I.2. PROGRAM OBJECTIVES

The project's goal for 2020 is to meet PMI's objective of covering at least 85 percent of eligible structures found in all communes/districts targeted for spraying.

The main objectives of the project for the 2020 IRS campaign are as follows:

1. Ensure that teams carry out high quality spraying on time, before the peak transmission season
2. Strengthen the capacity of seasonal spray campaign supervisors and government officials in monitoring/supervision of IRS activities
3. Strengthen the National Malaria Control Program's (NMCP) capacity in entomological and environmental compliance monitoring
4. Collect, analyze and disseminate routine epidemiological and entomological data in the high burden malaria areas, in partnership with the NMCP.

PMI/Côte d'Ivoire recommended that two (2) districts in Sakassou and Nassian will be targeted for the 2020 spray campaign using Fludora® Fusion and SumiShield® 50WG. The 2020 IRS campaigns are scheduled for 30 operational days in two rounds beginning April 20<sup>th</sup> in Sakassou and June 22<sup>nd</sup> in Nassian.

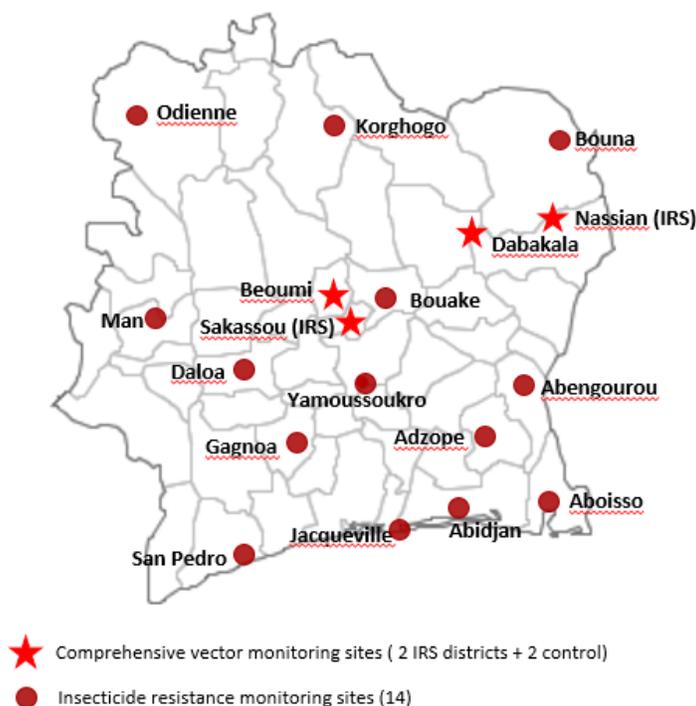
### I.3. HISTORY AND SCOPE OF MALARIA CONTROL EFFORTS IN CÔTE D’IVOIRE

The NMCP in Côte d’Ivoire was established in 1996. The previous national strategic plan covered the period of 2012-2017. This was superseded by the current plan, adopted in 2016, covering the period 2016-2020. The revised National Strategic Malaria Control Plan proposed the implementation of IRS and anti-larval control, in addition to large-scale ITN use.

The main malaria vector control method currently used in Côte d’Ivoire is the distribution and use of ITNs. ITN distribution is typically carried out through mass campaigns for universal coverage, and through routine distribution during antenatal visits and immunization of children under 1 year of age. The country’s 2016–2020 National Malaria Strategic Plan has selected IRS as an additional vector control method to reduce morbidity and mortality from malaria.

During the two last years, PMI VectorLink Côte d’Ivoire supported entomological surveillance in collecting data on the susceptibility status of *Anopheles* vector mosquitoes to the insecticides used in public health interventions in ten and fifteen sites across the country and on malaria transmission in four sites (two selected for IRS and two control sites). In 2020, the project will conduct IRS in Sakassou and Nassian and will provide capacity-building support to the national and district governments to plan and implement quality IRS in the future along with the continuous entomological monitoring.

**Figure I: Map of PMI-Supported Entomological Monitoring Sites in Côte D’Ivoire and Districts of Intervention in Côte d’Ivoire for IRS in 2020**



## I.4. NEW OR EXPANDED ACTIVITIES AND KEY CHANGES

### I.4.1. VECTOR CONTROL

#### I.4.1.1. *Entomologic monitoring and insecticide resistance management*

In 2020 PMI will support entomological monitoring in 18 sites (Abengourou, Abidjan, Aboisso, Adzope, Beoumi, Bouake, Bouna, Dabakala, Daloa, Gagnoa, Jacqueline, Korhogo, Man, Nassian, Odiene, Sakassou, San Pedro, and Yamoussoukro). The sites are located across all four ecological zones and include comprehensive monitoring (both insecticide resistance and vector bionomics monitoring) at four sites (two IRS and two control sites) and insecticide resistance monitoring at an additional 14 sites. The 2018 – 2019 results of PMI-supported entomological monitoring in Côte d'Ivoire can be found here: <https://www.pmi.gov/how-we-work/technical-areas/entomological-monitoring>

#### I.4.1.2. *Insecticide-treated nets*

The current NMCP policy in Côte d'Ivoire is to support the scaling-up of ITNs through distribution in mass campaigns and distribution during ANC and EPI visits. Three mass ITN distribution campaigns have been organized in Côte d'Ivoire.

Routine distribution of ITNs is currently being supported through funding from the Global Fund and the Ivorian government. Until December 2017, this routine distribution channel provided mosquito nets for women attending ante-natal care (ANC) and those attending the expanded program of immunizations for children 0-12 months of age. As of January 2018 and following discussion between the NMCP and PMI, the distribution of routine ITNs has been expanded to children between 1-5 years of age. The distribution of ITNs through these activities provides an opportunity to ensure vulnerable populations maintain access to ITNs between mass campaigns as well as providing opportunities for sensitization for ITN use and care practices.

#### I.4.1.3. *Indoor Residual Spraying*

Indoor residual spraying has not been conducted on a wide scale in Côte d'Ivoire, though some private companies have conducted IRS. However, this vector control intervention is included in the National Malaria Strategic Plan 2016-2020 (NMSP 2016-2020) and the NMCP envisages using it as a knock-down approach to reduce malaria burden in some high transmission district.<sup>2</sup>

In Côte d'Ivoire indoor residual spraying started with the world wide malaria eradication program of WHO in 1949. It was stopped in the 1970s and resumed in 1988. From 2017 to date, the country has sprayed approximately 67 (with the riposte) districts throughout the country.

## I.5. MAJOR PARTNERS IN MALARIA CONTROL

The National Malaria Control Program (NMCP) prioritizes efforts to coordinate all partners active in malaria control. Key donor and technical partners supporting the NMCP include the Global Fund, the WHO, and the United Nations Children's Fund (UNICEF). The following table describes the most significant contributors to malaria control, and the opportunities for collaboration.

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<sup>2</sup> <https://www.pmi.gov/docs/default-source/default-document-library/malaria-operational-plans/fy19/fy-2019-cote-divoire-malaria-operational-plan>

**Table 1: Major Malaria Control Partners**

<b>Partner</b>	<b>Role</b>
<b>Roll Back Malaria (RBM)</b>	Technical support as part of capacity building
<b>Cooperation Allemande : KFW</b>	Supporting malaria control efforts in Côte d'Ivoire over the last decade
<b>Banque internationale pour le commerce et l'industrie de la Côte d'Ivoire BICICI</b>	
<b>Global Fund to Fight AIDS, Tuberculosis and Malaria</b>	Supporting malaria control efforts in Côte d'Ivoire over the last decade
<b>WHO</b>	Providing technical support to the NMCP for the development and updating of malaria control policy and strategy documents for Côte d'Ivoire assisting the country to ensure consistency of these documents with global malaria strategic and policy normative guidance.
<b>UNICEF</b>	Supports the National Malaria Control Program's efforts to implement effective diagnosis and treatment of malaria in the context of effective fever management among children at health facilities and at the community level

## 2. PROPOSED ACTION AND ALTERNATIVES

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

### 2.1. DESCRIPTION OF PROPOSED ACTION

The preferred action is to implement an IRS program in selected communities, choosing among the pyrethroid, carbamate, organophosphate, neonicotinoid classes and the clothianidin/deltamethrin combination, as well as chlorfenapyr when PQ-listed, considering current entomological, epidemiological, logistical, and environmental conditions. Insecticides to be used in 2020 were determined by a process explained in Pesticide Procedures (Section 5), and include neonicotinoid (Sumishield) classes and the clothianidin/deltamethrin combination (Fludora Fusion). All used insecticides are managed in accordance with both host country regulations and US 22 CFR 216.

### 2.2. NO-PROJECT ALTERNATIVE

IRS 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 goals of Côte d'Ivoire's NMCP National Strategic Plan 2016 – 2020, the Global Fund's Technical Strategy, or PMI's Strategy for 2015–2020.

### 2.3. ALTERNATIVE IRS GEOGRAPHICAL SITES CONSIDERED

In IRS implementation, areas considered highly malarious and those areas that fit within the NMCP strategic plan were considered, while lower-risk areas were not considered for IRS as an intervention. Using different criteria for selecting geographical sites would reduce the effectiveness and impact of IRS, decreasing progress towards the goals of the Côte d'Ivoire NMCP and the PMI program.

### 2.4. USE OF ALTERNATIVE INSECTICIDE(S)

For IRS to be implemented, a pesticide listed by the WHO PQ, must be selected for use. The PQ is an international institution that analyzes and recommends pesticides to be used in IRS based on their effectiveness, and toxicity to human health and the environment.

To date, the WHO PQ has recommended the use of pesticides within the following six classes of pesticides: pyrethroids, carbamates, organochlorines, organophosphates, neonicotinoids and clothianidin/deltamethrin combination. The proposed action for Côte d'Ivoire includes the use for IRS of these approved formulations including chlorfenapyr when recommended by the WHO PQ, but with the exception of organochlorines (DDT).

PMI and their IPs will monitor WHO PQ proceedings towards recommendation of new pesticides, but will seek to amend this SEA before there is any decision to use new WHO PQ recommendations, other than chlorfenapyr.

## 2.5. ALTERNATIVE TECHNOLOGIES

A full range of known, available technologies are continually considered for use by the stakeholders in malaria prevention and control efforts. It has been determined that IRS plays a significant part in malaria prevention, in concert with other technologies.<sup>3</sup> The specific focus of this PMI project is IRS and ITNs, and the role that PMI plays in Côte d'Ivoire includes IRS. If other, viable approaches were to arise that would replace or improve upon the role that IRS plays, the NMCP, PMI, and its partners would evaluate them and proceed accordingly.

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<sup>3</sup> <https://www.pmi.gov/docs/default-source/default-document-library/malaria-operational-plans/fy19/fy-2019-cote-d'ivoire-malaria-operational-plan>

## 3. AFFECTED ENVIRONMENT

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 are not put into place. 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. OVERVIEW OF CÔTE D'IVOIRE

Côte d'Ivoire is located in West Africa, encompasses an area of 322,462 km<sup>2</sup> and has 515 km of coastline fringed by a network of large lagoons. It borders Mali and Burkina Faso to the north, the Gulf of Guinea to the south, Ghana to the east, and Liberia and Guinea to the west. The political capital is Yamoussoukro, situated 248 km north of the economic capital of Abidjan.

The richness of this country is not only based on the land but also on the people. Côte d'Ivoire is home to 68 ethnic groups, contributing to a wide diversity of customs and art.

Côte d'Ivoire makes maritime claims of 200 nautical miles (370.4 km; 230.2 mi) as an exclusive economic zone, 12 nautical miles (22.2 km; 13.8 mi) of territorial sea, and a 200 nautical miles (370.4 km; 230.2 mi) continental shelf.

#### 3.1.1. ADMINISTRATIVE AND POLITICAL UNITS

Since the 2011 reorganization, Côte d'Ivoire has 14 districts, 31 regions, 108 departments and 197 of communes. Departments are devised in 510 sub-prefectures.

The two autonomous districts, Abidjan and Yamoussoukro are not subdivided into regions, but they do contain departments, sub-prefectures, and communes.

**Table 2: Administrative District and Region in Côte d'Ivoire**

Administrative District	Administrative Region
Abidjan	
Bas-Sassandra	Gbôklé
	Nawa
	San-Pédro
Comoé	Indénié-Djuablin
	Sud-Comoé
Denguélé	Folon
	Kabadougou
Gôh-Djiboua	Gôh
	Lôh-Djiboua

Administrative District	Administrative Region
Lacs	Bélier
	Iffou
	Moronou
	N'Zi
Lagunes	Agnéby-Tiassa
	Grands-Ponts
	La Mé
Montagnes	Cavally
	Guémon
	Tonkpi
Sassandra-Marahoué	Haut-Sassandra
	Marahoué
Savanes	Bagoué
	Poro
	Tchologo
Vallée du Bandama	Gbêkê
	Hambol
Woroba	Béré
	Bafing
	Worodougou
Yamoussoukro	
Zanzan	Boukani
	Gontougo

### 3.1.2. POPULATION

According to the 2014 General Population and Housing Census, Côte d'Ivoire's population was 22,671,331 in 2014, and is estimated at 26,232,692 in 2018, with 51.2 percent located in urban areas and 48.8 percent situated in rural areas. The population density is 74 habitants/ km<sup>2</sup>. Forty-three percent of the total population is less than 15 years of age, and 49 percent of the population is female. Women of childbearing age represent 24 percent of the population, while children under 5 years of age comprise 16 percent. The annual population growth rate is estimated at 2.6 percent.

## 3.2. PHYSICAL ENVIRONMENT<sup>4</sup>

The northern and southern halves of Côte d'Ivoire present two distinct landscapes: a seasonally wet-and-dry savanna landscape typical of the Sudanian zone in the north, and a humid tropical Guinean and Guineo-Congolian landscapes in the south. The southern part of the country was once entirely covered by dense tropical forest, but is now dominated by a mosaic of plantations, degraded forest, and cropland, along with patches of remaining dense forest. Until recent decades, there were greater stands of useful timber in Côte d'Ivoire than in any other West African country. The area covered by rain forest was halved between 1900 and 1960, and that trend has continued — most of the forest has now disappeared. The Tai National Park, in southwestern Côte d'Ivoire, constitutes the largest intact relic of old tropical forest in West Africa and was listed as a World Heritage Site in 1982.

### 3.2.1. CLIMATE

The climate of Côte d'Ivoire is generally warm and humid, ranging from equatorial in the southern coasts to tropical in the middle and semiarid in the far north. There are three seasons: warm and dry (November to March), hot and dry (March to May), and hot and wet (June to October). Temperatures average between 25 and 32 °C (77.0 and 89.6 °F) and range from 10 to 40 °C (50 to 104 °F).

### 3.2.2. RAINFALL PATTERNS

In Côte d'Ivoire rainfall is more abundant on the coast, with a range of 1,500 to 2,500 mm (60 and 100 inches) per year. In inland areas, rainfall is generally less intense and ranges from 1,200 to 1,500 mm (47 to 60 inches) per year, with 2,000 mm (80 in) in the small western mountainous area.

During winter, temperatures are high throughout the country. In December and January, maximum temperatures are approximately 30 °C (86 °F) on the coast, and 32/34 °C (90/93 °F) in inland areas. Inland the humidity is low since the prevailing wind, the Harmattan, blows from the desert raising dust which can veil the sky and create a characteristic haze. Along the coast, the humidity is higher, and a few showers may still occur in winter, especially in the western part, and particularly in December when the sea is a bit warmer and evaporation is higher.

By February, the temperature begins to rise in inland areas, reaching 40 °C (104 °F). On the coast, the temperature is more stable, with increased humidity. In April, showers become more frequent along the coast, while in the north, temperatures can reach 45 °C (113 °F).

Between April and May, the rains begin across the country, but they become really heavy only along the coast, where more than 200 mm (8 in) fall per month in May and June, and approximately 400 mm (16 in) in some areas. While in the north the rains reach their peak between July and September, in the center-south and along the coast, there is a decrease in rainfall, especially in August in the central and eastern part of the coast. After this period, from September to November, the rains resume without reaching again the peaks of May and June.

The period from June to September is also the one with the lowest daytime temperatures, which drop to approximately 28/30 °C (82/86 °F) in inland areas and to 26/28 °C (79/82 °F) on the coast; on the other hand, the humidity is high everywhere.

In late October and November, with the end of the rainy season, the temperatures begin to rise again in the center and north, while the rains continue to fall on the coast.

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<sup>4</sup> <https://www.climatestotravel.com/climate/ivory-coast>

Precipitation in Ivory Coast averaged 117.68 mm from 1901 until 2015, reaching an all-time high of 374.21 mm in June of 1912 and a record low of 0.04 mm in January of 1948.

### 3.3. BIOLOGICAL ENVIRONMENT

#### 3.3.1. ECO-REGIONS, TOPOGRAPHY, GEOLOGY, AND SOIL<sup>5</sup>

The southern part of Côte d'Ivoire is characterized by broad plains, dissected by three main rivers: the Sassandra, the Bandama, and the Komoé and soils are particularly fertile and agriculturally productive, even in the northern semiarid savanna. These plains and their productive soils were once forested, but are now heavily used for agriculture and plantations. The center of the country is a transition zone between forest and savanna. Most of the savannas are being encroached upon by rain-fed agriculture, especially in the north, along the borders with Mali and Burkina Faso. In northwestern Côte d'Ivoire, several highlands rise from the surrounding plateau. This mountainous region is part of the Guinean Highlands that extend from the southern Fouta Djallon through southeastern Guinea, northern Sierra Leone and Liberia, and adjacent areas of Côte d'Ivoire.

#### 3.3.2. MAJOR WATER BODIES

There are four main rivers in Côte d'Ivoire: the Cavally, Sassandra, Bandama and Comoé, all of which flow from north to south, into the Atlantic Ocean. There are also several smaller coastal rivers, which also generally flow from north to south into the Atlantic, but some discharge into lagoons before they reach the coast. In the north, there are several tributaries of the Niger and the Black Volta rivers. The Niger tributaries flow northwards towards Mali.

The highest river flows occur from April to October, with lowest flows in January and February.

There are a number of dams on some of the major rivers, related to hydroelectric schemes.

#### 3.3.3. COASTAL AND MARINE ECOREGION (IF APPLICABLE)

The following is a list of ecoregions in Ivory Coast, according to the Worldwide Fund for Nature:

- **The marine ecoregion** of Côte d'Ivoire is Gulf of Guinea
- **Terrestrial ecoregion**
  - Tropical and subtropical moist broadleaf forests
    - Eastern Guinean forests
    - Guinean montane forests
    - Western Guinean lowland forests
  - Tropical and subtropical grasslands, savannas, and shrub lands
    - Guinean forest-savanna mosaic
    - West Sudanian savanna
- Mangrove
  - Guinean mangroves

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<sup>5</sup> <https://www.worldwildlife.org/publications/marine-ecoregions-of-the-world-a-bioregionalization-of-coastal-and-shelf-areas>

- **Freshwater ecoregions**
  - Nilo-Sudan
    - Ashanti (Ghana)
    - Eburneo
    - Upper Niger
    - Volta
  - Upper Guinea
    - Mount Nimba
    - Southern Upper Guinea

Marine and coastal areas would not be impacted by IRS activities.

### 3.4. PROTECTED AREAS

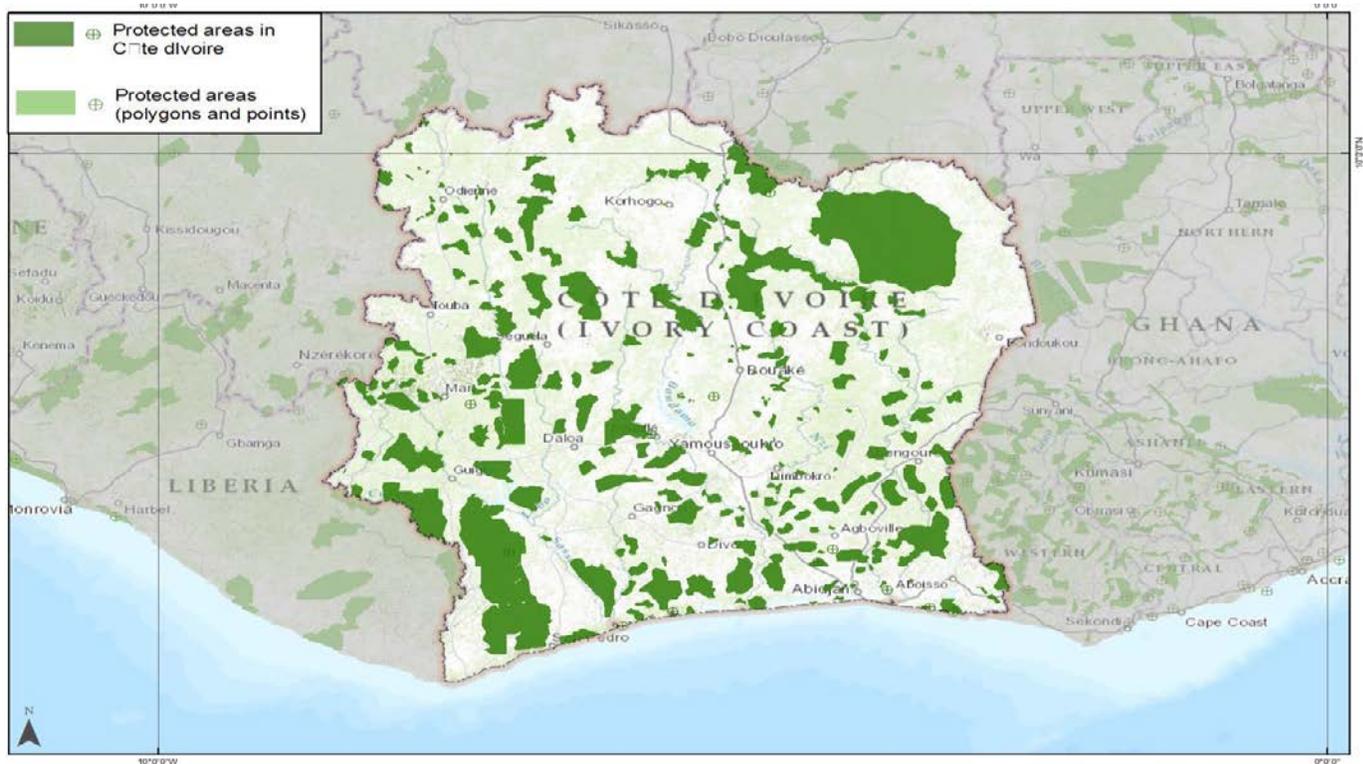
The country of Côte d'Ivoire in Africa has the following national parks and other major protected areas.

**Table 3: List of Côte d'Ivoire Protected Areas**

National Parks, Reserves, And Protected Areas of Côte d'Ivoire	Area
Assagny National Park	19,400 km <sup>2</sup>
Banco National Park	30 km <sup>2</sup>
Comoé National Park	11,500 km <sup>2</sup>
Îles Ehotilés National Park	105 km <sup>2</sup>
Marahoué National Park	1,010 km <sup>2</sup>
Mont Péko National Park (elevation 833 meters )	
Mont Sângbé National Park	950 km <sup>2</sup>
Taï National Park	3,300 km <sup>2</sup>
Mount Nimba Strict Nature Reserve	5,000 hectares in Côte d'Ivoire

The two IRS districts do not intersect with protective areas and will not be directly affected by IRS activities even if *Mont Sângbé* National Park and *Marahoué* National Park are somewhat close to IRS districts.

**Figure 2: Côte d'Ivoire Protected Areas<sup>6</sup>**



### 3.5. AGRICULTURE AND ORGANIC FARMING<sup>78</sup>

Agriculture is the main economic activity of Côte d'Ivoire.

Cote d'Ivoire is the world's largest cocoa exporter, with an average annual production of 1,200,000 tons, or 41% of the world's supply. At the national macro-economic level, the level of production achieved means that the cocoa economy provides about 40% of export earnings, and contributes 10% of the Gross Domestic Product. On a social level, about 600,000 farm managers are the driving force behind the production system, thus sustaining about 6,000,000 people from cocoa incomes<sup>9</sup>. Nine percent of the country is arable land. Other chief crops include coffee, bananas, and oil palms, which produce palm oil and kernels. Natural resources include petroleum, natural gas, diamonds, manganese, iron, cobalt, bauxite, copper, gold, nickel, tantalum, silica sand, clay, palm oil, and hydropower.

Despite the importance of agriculture in Côte d'Ivoire, the sector is confronted by several challenges including high deforestation, soil erosion, land tenure insecurity, weather variability and climate change which has manifested in the form of declining rainfall amounts, shortening length of the rainy seasons;

<sup>6</sup> World Database on Protected Areas (WDPA); <https://www.iucn.org/sites/dev/files/import/downloads/civ.pdf>

<sup>7</sup> <http://www.fao.org/3/a-be840f.pdf>

<sup>8</sup> Horticulture in Côte d'Ivoire - Opportunities for Dutch Businesses - Commissioned by the Netherlands Enterprise Agency

<sup>9</sup> <http://www.cacao.gouv.ci>

rising temperatures, increased duration and rigor of dry seasons, as well as increased incidences of floods.

The country is at the forefront of Africa for many agricultural products such as cocoa, rubber, palm oil, banana, pineapple, cotton, coffee, coconut, and cola nut. While Climate Smart Agriculture practices exist in Cote d'Ivoire, most of the practices are not widely adopted. At present, a banana cocoa integration system seems to be the most adopted covering about 13% of the agricultural land. The wide spread adoption of this practice has been enabled by low technology needs, private sector engagement in the implementation and its' multiple benefits such as food, income diversification and contribution to improved resilience of the system as a whole<sup>10</sup>.

### 3.6. BEE KEEPING

Beekeeping is a widespread activity in all regions of the country. More than 515 apiaries, 2060 modern beehives, 3090 traditional hives produced 120 tons of honey and 20 tons of wax in 2015. Beekeeping is an activity in constant evolution in Côte d'Ivoire and became over the years an industry increasingly focused on providing jobs and additional income to rural people with an aim to preserve flora.

### 3.7. CONCLUSION

Cote d'Ivoire contains and represents many unique and treasured environments, and is part of our world heritage that must be preserved. The people are part of this environment, and they must be cared for as well. PMI-sponsored IRS has a strong record of IRS execution without environmental degradation, and it is highly likely that with continued adherence to the EMMP, which is key to this history of success, that implementing contractors will deliver life-saving IRS with insignificant environmental impact. Therefore, it is recommended that IRS be permitted to be allowed in the buffer zones of the protected areas that Cote d'Ivoire has, and continues to establish.

Regarding all effort of the country and in accordance of WHO guidance, a buffer zone of 30 meters will be observed between the sprayed structures and the identified hives for IRS activities.

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<sup>10</sup> <https://cgspace.cgiar.org/bitstream/handle/10568/97616/ca1322en.pdf>

# 4. ENVIRONMENTAL AND HEALTH IMPACTS

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## 4.1. POTENTIAL POSITIVE EFFECTS OF THE IRS PROGRAM

### 4.1.1. DIRECT POSITIVE EFFECTS

The direct positive impacts of the IRS program are the reductions in child and adult malaria morbidity and mortality, which 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: miscarriage; low birth weight; adverse effects on fetal neurodevelopment as a result of exposure to malaria; and 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.

### 4.1.2. INDIRECT POSITIVE EFFECTS

IRS will build human and institutional capacity by providing broad-based training to a large number of people associated with IRS operations. From this training, there will be an increase in knowledge and understanding of both IRS-specific and general health and environmental risks and impacts, as well as methods of mitigation of those risks. One of the goals of the IRS program is to build in-country capacity to the point where IRS can be conducted by national or local government, or by the self-organization of communities, without large-scale external assistance or intervention.

By reducing the malaria burden, the IRS program will improve the education level among children of school going age<sup>11</sup>, as a result of the reduction in the number of school days missed, and improve the productivity of the workforce as a result of the reduction in missed work days and days of reduced productivity<sup>12</sup>.

The IRS program will indirectly contribute to the enhancement of the local economy, in that IRS staff and workers will receive payment for their work. At least some of the money that they receive will be spent and injected into the local economy with a magnification effect, improving revenues for various businesses and per capita income.

In addition, the implementation of IRS requires certain local purchases of products and services, such as operations site building materials, rental of building space and vehicles, and hiring of local labor for the construction or renovation of storehouses and soak pits. Again, these revenues are injected into the economy with potentially positive and significant magnification effects.

The Côte d'Ivoire PMI VectorLink project views gender equality and female empowerment as development goals in their own right, as well as approaches that accelerate vector control. VectorLink Côte d'Ivoire will mainstream gender across its operations, in line with the project's gender strategy, with an emphasis on women's economic empowerment through employment in its IRS and entomology operations. To achieve this goal, the project will implement policies that promote the hiring of female seasonal workers and ensure a safe and respectful workplace for all.

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<sup>11</sup> <https://www.worldbank.org/content/dam/Worldbank/Feature%20Story/Africa/afr-marie-anne-valfort.pdf>

<sup>12</sup> <https://www.path.org/media-center/fighting-malaria-in-the-workplace/>, Accessed 7/15/19

Finally, a reduction in household pests from IRS may result in a reduction in other diseases carried by the pests.

## 4.2. POTENTIAL ADVERSE IMPACTS

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

### 4.2.1. DIRECT POTENTIAL ADVERSE EFFECTS

#### 4.2.1.1. *Contamination of Surface Watercourses and Underground Water*

During IRS implementation, it is possible to accidentally 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 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 multiple 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 pesticide disposal is strictly controlled and supervised, and the sites for soak pits are carefully chosen according to the criteria in the PMI BMPs. Secondly, most formulations of pyrethroids, organophosphates, clothianidin and carbamates move slowly through soil, and degrade quickly when exposed to sunlight, hydrolysis, or microbial action in the soil. If wash areas and soak pits are properly constructed and employed, liquid pesticide traces will be captured in the charcoal layer of the soak pit or organic matter in soil, and held until degradation by natural processes.

#### 4.2.1.2. *Potential Impacts to Non-Target Organisms from Pesticides*

Table 5 in Section 5.7 of this SEA documents the degree of toxicity of the six WHO PQ-recommended pesticide classes, to birdlife, aquatic life, and insects, as well as pesticide persistence and bio-accumulation potential.

#### 4.2.1.3. *Potential Impacts to Endangered Species*

It is USAID policy to conduct its assistance programs in a manner that is sensitive to the protection of endangered or threatened species and their critical habitats. The Initial Environmental Examination for each project, program or activity having an effect on the environment shall specifically determine whether the project, program or activity will have an effect on an endangered or threatened species, or critical habitat. If the proposed project, program or activity will have the effect of jeopardizing an endangered or threatened species or of adversely modifying its critical habitat, the Threshold Decision shall be a Positive Determination and an Environmental Assessment or Environmental Impact Statement completed as appropriate, which shall discuss alternatives or modifications to avoid or mitigate such impact on the species or its habitat. This document, along with the EMMP Annex A Environmental Mitigation and Monitoring Plan (EMMP) fulfills those requirements.

IRS is not likely to adversely impact threatened or endangered species, or their critical habitat, due to the fact that spraying activities are conducted indoors only, and are carefully structured to avoid fugitive spray to the outdoors. Any openings to the outside of the house are closed up or avoided during spray. Structures with gaps between wall coverings are ineligible for IRS. Finally, storage and disposal facilities are sited at least 100 meters from any sensitive areas such as habitat for endangered or protected species. Although IRS team may pass through these areas to reach targeted areas for spraying, mitigation measures include putting insecticides in hermetically sealed barrels. It is expected that spray operations

will be according to BMPs, and the total pesticide load on the environment is expected to be the minimum possible.

#### **SPECIAL NOTE: IMPACT ON BEES**

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. Modern methods of beekeeping have developed throughout Côte d'Ivoire. The project will identify locations where beehives are kept, and observe a 30- meter no-spray buffer zone around them. Bee-hive owners will be advised accordingly.

However specific precaution are taken and in accordance with beekeeping actors and a buffer zone of 30 meters is observed between the sprayed structures and the identified hives.

### **4.2.2. INDIRECT ADVERSE EFFECTS**

Upon termination of the IRS program, PMI will properly dispose of the IRS equipment and will no longer supervise its use. IRS equipment that may be donated to district health officials includes backpack compression sprayers, used or clean boots, PPE, wash basins, progressive rinse barrels, etc. that are still in operable condition. Improper use of this equipment could lead to contamination of the environment or adverse health effects as noted.

In general, if PMI supports the procurement or disposition of insecticide to the Government of Côte d'Ivoire, this activity is required to be mentioned in the annual Letter Report, in addition to this SEA. This type of support requires annual environmental compliance monitoring by PMI and/or the IP, requires that PMI and/or the PMI IP provide environmental training to the Government of Côte d'Ivoire in the PMI IRS BMPs, and technical assistance for insecticide selection to ensure quality/appropriateness of the product. If PMI supports the procurement, loan, or disposition of spray pumps or personal protective equipment to the Government of Côte d'Ivoire, these activities must be mentioned in the annual Letter Report, in addition to this SEA. These activities do not require environmental compliance monitoring, however, PMI and/or the PMI IP must provide training in the PMI IRS BMPs.

The conduct of IRS by District Medical Officers with communities, using properly working equipment left behind by PMI may temporarily, and in a minor way increase the total pesticide load on the environment. However, since the IRS equipment will be in operable condition and capacity has been built among the District Medical Officers, it is expected that spray operations will be according to BMPs, and the total pesticide load on the environment is expected to be less than if the donation is not made.

## **4.3. HUMAN EXPOSURE RISKS/IMPACTS**

### **4.3.1. WORKER AND RESIDENT EXPOSURE PATHWAYS**

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. Exposure risks of all WHO-recommended pesticides in relation to cancer and non-cancer endpoints are presented in IVM updated PEA 2017. 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.

### 4.3.2. PRE SPRAYING EXPOSURE PATHWAY

Preparing pesticide solutions during the IRS requires putting the pesticide in the spray pump and agitating it to ensure ample mixing with the water. The process of mixing the pesticide can lead to exposures via inhalation, dermal contact, and incidental ingestion, from releases of pesticide vapors and liquids. 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.

### 4.3.3. EXPOSURE DURING SPRAYING

Inhalation of aerosol droplets 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 organophosphates, 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.

Pyrethroids are skin irritants, and can cause parasthesia (an abnormal sensation, typically tingling or pricking (“pins and needles”), caused chiefly by pressure on or damage to peripheral nerves.) Spray operators must be cautioned against touching their skin, particularly their face, with contaminated gloves. This caution also applies during clean-up and disposal operations.

### 4.3.4. EXPOSURE DURING DISPOSAL (INCLUDING PROGRESSIVE RINSING)

Disposal is a key issue with IRS intervention that uses 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 of residents who come in contact with the soil or water in which the pesticide was disposed. Once the pesticide gets into the soil, it can migrate to groundwater, which may be used as a water supply via household wells. In this manner, ingestion exposure can occur from drinking contaminated surface water. Residents may also be exposed to this contaminated water by dermal contact when it is used for cleaning or cooking purposes.

### 4.3.5. 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.

## 4.4. PESTICIDE- AND PROCESS-SPECIFIC POTENTIAL HEALTH IMPACTS

The potential health impacts of the insecticide products that can be used for IRS are described in detail in the PMI Programmatic Environmental Assessment for Integrated Vector Management Programs for Malaria Vector Control (2012 and 2017 Updates). A summary of these effects is given in Annex E of this SEA.

## 4.5. CUMULATIVE IMPACT

Organophosphates are the pesticides with the highest potential for cumulative impacts. Pyrethroids, carbamates, clothianidin and most organophosphate formulations break down readily in the environment, limiting the risk of cumulative environmental impact, especially if disposal sites are well chosen and BMPs are followed.

However, repeated human exposures to organophosphates result in cumulative cholinesterase depression, with increasingly severe effects. For this reason it is exceptionally important that PPE be worn properly and at all times when pesticide contact is possible. It is also incumbent upon team leaders to monitor the health of their spray operators on a daily basis, and to look for any signs of cholinesterase depression. Formulations of the organophosphate pirimiphos-methyl have been used for several years and in several countries without any report of observed symptoms of cholinesterase depression.

There are indications that the capsule suspension form of Actellic is more resistant to environmental degradation than either Actellic emulsifiable concentrate or the other WHO PQ-recommended pesticides. This may result in a temporary build-up of concentration within the soak pit prior to degradation.<sup>13</sup>

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<sup>13</sup> Mitchell, David, et al, (2015).

# 5. PESTICIDE PROCEDURES

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The PMI document Integrated Vector Management Programs for Malaria Vector Control Programmatic Environmental Assessment updated in 2017 analyzed all WHO and WHO-PQ recommended insecticides, and takes in consideration 12 factors when a project includes “assistance for the procurement or use, or both, of pesticides.” As the PMI Côte d’Ivoire IRS program includes assistance in both of these aspects, it is subject to this regulation. This section therefore addresses each of the 12 factors for the IRS Malaria Control Program in Côte d’Ivoire for all WHO-recommended pesticides in the pyrethroid, carbamate, organophosphate, neonicotinoid classes and the clothianidin/deltamethrin combination; as well as chlorfenapyr (pyrrole class) when recommended by the WHO PQ for the period 2020-2024.

## 5.1. THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY’S REGISTRATION STATUS OF THE REQUESTED PESTICIDE

All WHO-recommended pesticides registered and/or accepted for use for IRS or a similar use in the United States and the host country government, will be preferred in this IRS project. These include pesticides in the pyrethroid, carbamate, organophosphate and neonicotinoid classes, as well as the pyrrole class when PQ listed. Some of the pesticides on the WHO PQ list are not registered with the United States Environmental Protection Agency (USEPA) for economic, technical, or regulatory reasons. This is due to the fact that there is a very limited market in the US for IRS, and as a result, registrations for this use of these pesticides have been voluntarily withdrawn, or never filed. However, US 22 CFR 216.3(b) (1) (iii) allows the use of pesticides not registered for the same or similar use by USEPA, provided that:

1. The proper assessments are performed.
2. The assessments include an evaluation of the factors in Sections 5.1–5.12 of this document.
3. Notification is provided to, and authorization received from, the host country government for the use of the pesticide in country.

PMI works closely with host country government, with full and clear disclosure, as well as providing any necessary assistance in the mitigation of risk from the use of these WHO PQ pesticides. This SEA, supported by the PMI IVM PEA, and distributed to Ministries of Health, Environment, and Agriculture, provides the assessment, notification, and mitigation requirements of U.S. regulations. PMI is therefore empowered, upon acceptance of this document and the receipt of formal authorization from a competent Côte d’Ivoire authority, to use in Côte d’Ivoire all WHO PQ-recommended pesticides in the pyrethroid, carbamate, organophosphate and neonicotinoid classes, and the clothianidin/deltamethrin combination; as well as chlorfenapyr when recommended by the WHO PQ.

## 5.2. THE BASIS FOR SELECTION OF THE REQUESTED PESTICIDES

In addition to the above criteria, insecticide selection for any PMI supported program is subject to the following considerations.

### 5.2.1. PRIMARY CRITERIA FOR CHOOSING PESTICIDES

**Approval by the WHO:** Only insecticides recommended by the WHO/PQ team or by USEPA can be used in IRS. Certain pesticides in the organophosphate, carbamate, pyrethroid, neonicotinoid,

organochlorine classes and the clothianidin/deltamethrin combination are WHO PQ-recommended for use in IRS. Chlorfenapyr is not yet recommended by WHO, but authorization is requested in this SEA to use it for hut trials, and for IRS when and if it receives a WHO PQ listing<sup>14</sup>.

**Registered for use in Côte d'Ivoire:** In the case where the insecticide proposed for use in IRS is not registered in Côte d'Ivoire, PMI will work with manufacturers and distributors, as well as the Ministry of Health to obtain special authorization/homologation for the use of the pesticide. All WHO-recommended insecticides are accepted for use in Côte d'Ivoire by the competent authority which is the Ministry of Agriculture.

Residual effect for a period longer than, or at least equal to, the average duration of the malaria transmission season in the area: Most pyrethroids, carbamates, clothianidin 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.

**Appropriate for use on the wall surfaces of the selected location:** In Côte d'Ivoire the majority of the houses in rural settings are still made up of mud wall surfaces, mud bricks, cement bricks and burnt bricks. Pyrethroids, carbamates, clothianidin and organophosphates are known to function well on these surfaces, 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 sensitivity to a given insecticide. In Côte d'Ivoire the results confirmed that there is high resistance to pyrethroids. These findings suggest that clothianidin based products are the only insecticide option for IRS in the four districts identified for potential deployment of IRS, with the exception of Gagnoa where the vector was also susceptible to pirimiphos-methyl.

**Monitoring Vector Susceptibility to Insecticides in Côte d'Ivoire:** In 2020, VectorLink Côte d'Ivoire, in collaboration with Centre Suisse de Recherche Scientifique (CSRS), NMCP, and the three national research institutes, will conduct annual insecticide susceptibility monitoring in 18 sites including the two IRS sites, two IRS controls, and 14 sentinel sites where different ITNs were distributed over years.

The objectives of the entomological surveillance were:

- To identify the vector species, composition, and density;
- To determine vector biting and resting behavior;
- To determine the quality of spraying and insecticide decay rate following spray operations; and
- To ascertain vector susceptibility to key classes of insecticides,.

Entomological surveillance plays a critical role as it allows vector control programs to make informed decisions. The impact of IRS on vector density, resting and feeding behavior will help identify effective insecticides against local vectors to guide vector control programming.

**Ecological impact:** Côte d'Ivoire boasts of a diverse wildlife throughout the country, but especially in the national parks and protected areas, and it is extremely important that IRS does not in any way diminish this biodiversity. The potential ecological impact of the WHO PQ pesticides is well documented, most recently in the 2017 PMI IVM PEA. However, if BMPs for IRS are strictly followed, the release to the environment, and therefore the impact to the environment, should be negligible.

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<sup>14</sup> <http://www.who.int/pq-vector-control/prequalified-lists/en/>

More information on ecological impact of the proposed pesticides is found in Section 5.7 as well as other sections of this document.

Climate impacts of insecticides have been identified using screening tools and integrated in the Work Plan development, with an action plan to ensure that climate risks are properly accounted for, and addressed.

**Human health impact:** The 2012 and 2017 updated IVM PEA assessed cancer and non-cancer risks associated with all WHO PQ-recommended insecticides by process (e.g., mixing insecticide, spraying, residing in sprayed house) and pathway (e.g., inhalation, dermal, ingestion), and cancer risks by process and pathway where available (mainly for DDT and select pyrethroids). In general, pyrethroids and carbamates pose fewer non-cancer risks via any pathway than organophosphates when risks are assessed, but the risks of organophosphates can be managed by following standard PMI IRS procedures and protocols (BMPs).

### 5.2.2. SECONDARY SELECTION CRITERIA

- Unit cost of insecticide
- Timely delivery of the insecticide to the preferred point of delivery
- Appropriate packaging for safety and standard delivery tools
- Technical assistance with training and troubleshooting by supplier

## 5.3. THE EXTENT TO WHICH THE PROPOSED PESTICIDE USE IS PART OF AN INTEGRATED PEST MANAGEMENT PROGRAM

Integrated pest management 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.”

Integrated pest management is often used in an agricultural context, but similar in nature is the concept of Integrated Vector Management (IVM). The major characteristics of IVM include:

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

Use of IVM for the control of the malaria vector population is practiced using two primary interventions, insecticide-treated nets and indoor residual spraying. Environmental management for malaria control is limited to some-common sense safeguards, such as limiting standing water, which can serve as a breeding ground for mosquitoes. PMI does not support environmental management as a malaria vector control method. Because of the life-cycle requirements and the adaptability shown by malaria vectors, these practices have not demonstrated large-scale effectiveness.

PMI strategy has been that IRS will be implemented as a component of IVM for malaria control. 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.

#### 5.4. THE PROPOSED METHOD OR METHODS OF APPLICATION, INCLUDING AVAILABILITY OF APPROPRIATE APPLICATION AND SAFETY EQUIPMENT

IRS under PMI funds involves spraying a WHO recommended insecticides with long-lasting residual activity on indoor wall and ceiling surfaces where mosquitoes usually rest. The pesticide then dries up and can leave 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.

WHO-recommended pesticides in the pyrethroid, carbamate, organophosphate, neonicotinoid classes and the clothianidin/deltamethrin combination; as well as chlorfenapyr (pyrrole class) when recommended by the WHO PQ 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 in 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 maintain proper functioning of the pump, reuse leftover pesticide on the following day, and guard against release of and/or exposure to pesticides. They also follow the manufacturer's recommendations to ensure their proper operation and calibration.

#### 5.5. ACUTE AND LONG-TERM TOXICOLOGICAL HAZARDS ASSOCIATED WITH THE PROPOSED USE, AND MEASURES AVAILABLE TO MINIMIZE SUCH HAZARDS

The IVM PEA assessed the toxicity of WHO-recommended IRS insecticides to non-target organisms, including mammals, birds, fish, bees, and other aquatic organisms. The table below provides graphic information on the toxicity and some of the other characteristics of the WHO PQ pesticides. In general, most of them are toxic to bees, fish, and other aquatic organisms, and less so to mammals and birds.

“Indoor” being an important operative word in IRS, the risks to biodiversity from spray operations are minimal if PMI BMPS are followed. The BMPs have been designed to prevent any significant release to the environment, and a strong, automated, smart-phone-based supervisory system ensures that BMPs are followed or non-compliance is immediately corrected. The reader is referred to Annex E of the 2017 IVM PEA, and to Chapter 5 of this SEA for greater detail about pesticide toxicity.

**Table 1: The Degree of Toxicity of the WHO PQ-Recommended IRS Pesticide**

IRS Insecticide	Mammal	Bird	Fish	Other Aquatic	Bee	Persistence	Bio-accumulation
Alpha-cypermethrin (P)	Low Toxicity	Low Toxicity	High Toxicity	High Toxicity	High Toxicity	Medium to High Toxicity	High Toxicity
Bendiocarb (C)	Medium to High Toxicity	High Toxicity	Medium to High Toxicity	Medium to High Toxicity			
Bifenthrin (P)	Medium to High Toxicity	Medium to High Toxicity	High Toxicity	High Toxicity	High Toxicity	Data Not Found	Low Toxicity
Cyfluthrin (P)	Medium to High Toxicity	Low Toxicity	High Toxicity	High Toxicity	High Toxicity	High Toxicity	Medium to High Toxicity
DDT (OC)	Low to Medium Toxicity	Low Toxicity	High Toxicity	High Toxicity	Low Toxicity	High Toxicity	High Toxicity
Deltamethrin (P)	Medium to High Toxicity	Low Toxicity	High Toxicity	High Toxicity	High Toxicity	Medium to High Toxicity	High Toxicity
Etofenprox (P)	Low Toxicity	Low Toxicity	High Toxicity	High Toxicity	High Toxicity	Low Toxicity	Low Toxicity
Fenitrothion (OP)	Low Toxicity	High Toxicity	Low Toxicity	High Toxicity	High Toxicity	Low Toxicity	Medium to High Toxicity
Lambda-cyhalothrin (P)	High Toxicity	Low Toxicity	High Toxicity	High Toxicity	High Toxicity	Medium to High Toxicity	High Toxicity
Malathion (OP)	Low to Medium Toxicity	Medium to High Toxicity	Low Toxicity	Low to Medium Toxicity	High Toxicity	Low Toxicity	Low Toxicity
Pirimiphos-methyl (OP)	Medium to High Toxicity	Low Toxicity	High Toxicity	High Toxicity	Medium to High Toxicity	High Toxicity	Low Toxicity
Propoxur (C)	High Toxicity	High Toxicity	Low Toxicity	High Toxicity	High Toxicity	Low to Medium Toxicity	Low to Medium Toxicity
Chlorfenapyr (PR)	Medium to High Toxicity	High Toxicity	High Toxicity	High Toxicity	High Toxicity	Medium to High Toxicity	Low to Medium Toxicity
Clothianidin (N)	Medium to High Toxicity	Low to Medium Toxicity	Low Toxicity	Medium to High Toxicity	High Toxicity	High Toxicity	Low Toxicity

Source: IVM PEA 2012 and 2017

**Key**

High Toxicity	High Toxicity
Medium to High Toxicity	Medium to High Toxicity
Medium Toxicity	Medium Toxicity
Low to Medium Toxicity	Low to Medium Toxicity
Low Toxicity	Low Toxicity
Data Not Found	Data Not Found

**5.5.1. 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 loading into tanks, spray application, clean-up, and final disposal, as well as after spraying 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 used and exposure results. Cholinesterase inhibition results in overstimulation of the nervous system, with symptoms that include nausea, dizziness, confusion, and at

very high exposures respiratory paralysis and death (U.S. EPA, 2000b). The two classes of insecticides differ in their impacts 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.

Pyrethroids are skin irritants, and can cause parasthesia (an abnormal sensation, typically tingling or pricking (“pins and needles”), caused chiefly by pressure on or damage to peripheral nerves.) Spray operators must be cautioned against touching their skin, particularly their face, with contaminated gloves.

However, all potential environmental threats are noted and monitored along with planned mitigations measures for the safe use of pesticides. Details of specific environmental threats and activities needing precaution are listed with mitigation measures in Section 6 and Annex A.

## 5.6. 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. Complete selection criteria can be found in Section 5.2 of this SEA. 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 vector 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.

### 5.6.1. VECTOR RESISTANCE

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).

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 Centre Suisse de Recherche Scientifique (CSRS) in collaboration with the PMI-supported VectorLink Côte d’Ivoire project, and the results from this ongoing program are the primary determinants of the choice of pesticide and other supplementary actions. In 2020, VectorLink Côte d’Ivoire, in collaboration with CSRS (the sub-contractor), will conduct annual insecticide susceptibility monitoring in 18 sites including the two IRS sites, two IRS controls, and 14 sentinel sites where different ITNs were distributed over years. The NMCP and the three national research institutes will support CSRS on all entomological data collections<sup>15</sup>.

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<sup>15</sup> 2020 PMI VectorLink Côte d’Ivoire Work Plan

Pyrethroids, carbamates, clothianidin 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 11 months, based on various field trials. For this reason, pyrethroids have traditionally made the best choice for extended seasons. However, in order to manage vector resistance, it has proven to be necessary to switch the class of pesticides used in IRS.

In Côte d'Ivoire vector susceptibility studies shows resistance to pirimiphos methyl and bendiocarb in all sites surveyed, except in Gagnoa. For clothianidin, the tests completed in 9 sites showed susceptibility in 7 sites and particularly all the IRS potential sites recorded full susceptibility to the insecticide. This is important as far as the country is embarking in the implementation of IRS as an additional vector control strategy. In a prospect of extending IRS to other district where malaria prevalence would be increasing, the current data would guide insecticide selection with a possible rotation of pirimiphos methyl and clothianidin in Gagnoa.

In Côte d'Ivoire a total of 26,110 mosquitoes, were collected over five months (November 2018 to March 2019) using the three collection methods. The results of the vector susceptibility tests of *An. gambiae* s.l. indicated that:

- Resistance was observed to the diagnostic dose of all pyrethroids, pirimiphos methyl and bendiocarb in all sites surveyed.
- The intensity of resistance tested indicated moderate resistance of *An. gambiae* s.l. to pirimiphos methyl (100% at 5x diagnostic dose) while the resistance to the pyrethroids was very high in all the sites where the tests were completed.
- Daloa and Jacqueline recorded the highest pyrethroid resistance intensity with less than 40% mortality at 10x the diagnostic doses of the three pyrethroids
- The pre-exposure of mosquitoes to PBO before deltamethrin, permethrin and alpha-cypermethrin yielded partial increase of the mortality in most of the sites surveyed. PBO + deltamethrin showed the highest increase in mortality among the three pyrethroids in all the sites, followed by PBO + alpha-cypermethrin. Although full susceptibility was not recorded after the pre exposure to PBO, the significant increase observed indicates that P450s may be involved in the insecticide resistance of the *An. gambiae* s.l. from most of the sites except Daloa, Gagnoa and Jacqueline.

## 5.6.2. VECTOR BEHAVIOR

In Côte d'Ivoire *Anopheles gambiae* s.l. showed variable biting behavior across the four districts. The densities of *An. gambiae* s.l. were overall higher outdoor in Bocanda (53.3%), Gagnoa (72.2%) and Sakassou (53.9%) compared to indoor. On the other hand, *An. gambiae* s.l. was generally endophilic in Jacqueline (52.9%).

Overall, *An. gambiae* females biting activities were highest between 10:00 pm and 03:00 am across the five months, indoors and outdoors in all sites. The biting rates peaked between 10:00 pm and 12:00 pm outdoors, and 00:00 am and 02:00 am indoors for Sakassou and between 01:00 am and 03:00 am for Gagnoa both indoors and outdoors. Overall, Bocanda recorded a biting peak time of around 3:00 am outdoors and 01:00 am indoors. Jacqueline showed several peak biting times during the five months of collection both indoors and outdoors

Residual Efficacy  
The residual efficacy of the pesticide being used for IRS is crucial to evaluating the overall effectiveness of IRS. The wall surface to which the pesticide is applied is a factor affecting residual efficacy, and must be taken into account. It is important that bioassays on various wall surfaces 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 on a given sprayed surface.

PMI VectorLink Côte d'Ivoire will conduct wall cone bioassays in the same nine houses as the original quality assurance tests on a monthly basis until the efficacy of the sprayed insecticide drops below 80 percent for two consecutive months. Pesticide Quality

A fourth 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 will be taken prior to shipment to Côte d'Ivoire and analyzed for the concentration of the active ingredient. In all PMI VectorLink warehouses the temperature is monitored and controlled as much as possible to avoid temperatures that could alter the chemistry or the characteristics of the pesticide.

### 5.6.3. RESIDUAL EFFICACY<sup>16</sup>:

The project technical manager will evaluate the quality of spraying within one week of the start of the spray campaign in nine structures per health district (three houses, ideally with different wall surfaces, in each of three villages per IRS health district) using WHO wall cone bioassays. One non-sprayed structure will be used as control in each of the village selected for a total of three controls per health district.

PMI VectorLink will conduct wall cone bioassays in the same nine houses as the original quality assurance tests on a monthly basis until the efficacy of the sprayed insecticide drops below 80 percent for two consecutive months. The tested surfaces will be marked and the same surfaces will be tested every month to assess the residual efficacy of both insecticides. In addition to the susceptible strain, wild mosquitoes may be tested monthly in Nassian and Sakassou whenever possible (assuming larvae are available). Larvae and pupae will be collected from the field a week before each testing period, and reared to adulthood in a field laboratory to be tested in parallel with the susceptible strain brought from the insectary.

## 5.7. COMPATIBILITY OF THE PROPOSED PESTICIDE WITH TARGET AND NON-TARGET ECOSYSTEMS

The pesticides proposed for use 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 WHO PQ recommended pesticides are incompatible with the non-target ecosystems (humans, animals, and the environment), in that, if released to the 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 inside walls and ceilings of dwellings, and do not come in contact with humans, animals, or the environment. IRS implementation is also planned to minimize and responsibly manage liquid wastes through the reuse of leftover pesticides, the triple rinsing of equipment, and the daily washing of PPE to

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<sup>16</sup> 2020 PMI VectorLink Côte d'Ivoire Work Plan.

remove trace pesticide. Wherever possible, recycling is incorporated into the waste management plan, particularly in the case of plastic bottles used for pesticide containers. Where it is not feasible to recycle materials, they are washed thoroughly and either given away or disposed of in a landfill, or contaminated solid wastes are incinerated in an approved incinerator that will destroy the pesticide and prevent environmental contamination (see Section 6.1.1.1). The Environmental Mitigation and Monitoring Plan, in Annex A, details the measures that have been and will be enacted to prevent contamination of ecosystems. In addition, there are solid and liquid waste management plans contained in the Safer Use Action Plan of this SEA (Chapter 6).

## 5.8. THE CONDITIONS FOR PESTICIDE USE

Chapter 3 of this document provides a detailed account of the environmental conditions in Côte d'Ivoire under which the pesticide is to be used. IRS is scheduled to be performed prior to the rainy season in each location to maximize the effectiveness of IRS, and to avoid logistical complications from the degradation of transportation infrastructure due to flooding and washout.

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 or where bee-keeping or natural bee habitats are established, threatened and endangered species etc. In addition, bird-nesting habitat will be protected, and all insecticides will be kept away from all water habitats and resources. Prior to spraying, geographical reconnaissance will include identification of households in sensitive areas, and the IP will train sprayers to identify houses that should not be sprayed. IRS will be prohibited within 30 meters of sensitive ecosystems. If pesticide drift is observed, spraying will be halted until the cause has been determined. Drift could be a result of spraying an inappropriate surface with gaps that allow pesticide to escape, so the wall surface must be evaluated for fitness for spraying, and the structure disqualified if unfit. Alternatively, if drift is caused by excessive wind (especially from spraying eaves outdoors) operators must wait until wind conditions subside. The IP will consult with the other in-country organizations to implement entomological monitoring activities regarding the application of pesticides in or 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 stricter, in which case the SEA will have precedence. Strict supervisory control will also be established to prevent contamination of agricultural products.

## 5.9. THE AVAILABILITY AND EFFECTIVENESS OF OTHER PESTICIDES OR NON-CHEMICAL CONTROL METHODS

In Côte d'Ivoire, as in many countries, a full range of malaria control methods are employed, and in some circumstances one method may be favored over another. However, PMI has determined that IRS is part of the overall effort and will be used to decrease malaria morbidity and mortality in Côte d'Ivoire and in many other countries.

This IRS program is limited to using those pesticides that are on the WHO PQ list of recommended pesticides. WHO currently recommends 17 formulations from five chemical classes for IRS, each with a specific dosage regime, duration of effectiveness, and safety rating.<sup>17, 18, 19</sup> Each of these agents has been

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<sup>17</sup> Najera JA, Zaim M (2002). Malaria vector control – Decision-making criteria and procedures for judicious use of insecticides. WHO, Geneva, WHO/CDS/ WHOPES PQ/2002.5. (Document available at: [www.who.int/ctd/WHOPES\\_PQ/docs/JudiciousUseRev.pdf](http://www.who.int/ctd/WHOPES_PQ/docs/JudiciousUseRev.pdf) )

<sup>18</sup> Chlorfenapyr is currently under consideration to be included. The 17th WHOPES PQ Working Group (2014) recommended that, considering the potential efficacy of chlorfenapyr to kill pyrethroid-resistant *Anopheles*,

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. One goal of this SEA is to broaden the options for pesticide use to six recommended pesticide classes (including chlorfenapyr in the pyrrole class), to combat periodic resistance development.

Nonchemical means of malaria vector control are examined and discussed briefly under Section 5.3, Integrated Pesticide/Vector Management (IPM/IVM), but are generally not effective on a large scale for malaria vector control. 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 (e.g., hoof prints or tire ruts).

## 5.10. CÔTE D'IVOIRE'S ABILITY TO REGULATE OR CONTROL THE DISTRIBUTION, STORAGE, USE, AND DISPOSAL OF THE REQUESTED PESTICIDE

In Côte d'Ivoire, the Ministry of Agriculture is the competent authority for *registration* of insecticides for public health use. All WHO PQ insecticides have country approval and are allowed for use in public health.

### 5.10.1. RELEVANT INSTITUTIONS

Many institutions, such as the National Agency Of Environment, the Coordination of Environmental Program, and the Agriculture Directorate are active in Côte d'Ivoire, and have achieved quasi-regulatory status in environmental management, monitoring, and control. Importation, transport and usage of all pesticides must be approved before importation or use in Cote d'Ivoire. Approval is granted by a decree of the Minister of Agriculture based on the recommendation of the Pesticide Committee, which comprises representatives of several Ministries. Applications for new pesticide approvals should be addressed to the Minister of Agriculture using the metric system, describing the toxicity and uses of the product.

### 5.10.2. LAWS AND REGULATIONS

Law n°96-766 of October 3<sup>rd</sup> 1996 establishing the Environment Code: The purpose of the law is to demonstrate a willingness to fulfill international obligations and above all to preserve its environment. Otherwise Côte d'Ivoire has integrated the right to a healthy and universally recognized environment (Act establishing Côte d'Ivoire n° 2000-513 of August 1<sup>st</sup> 2000)

All programs and projects must complete an environmental assessment before any implementation. The VectorLink project should conduct an environmental screening which the result will be to determine, by the National Agency of Environment (ANDE), the status of the project regarding this regulation and to obtain environmental agreement.

Réf. Letter N° 0183 MINAGRI/DGPSA/DPVCQ of March 15<sup>th</sup>, 2013 is a reference letter from the Ministry of Agriculture which provides guidance on the importation, transportation and usage of pesticide in Côte d'Ivoire.

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further evidence be gathered in Phase II to assess the efficacy of indoor residual application of chlorfenapyr 240 SC against malaria vectors, following the WHO guidelines for IRS.

<sup>19</sup> <http://www.who.int/pq-vector-control/prequalified-lists/en/>

Côte d'Ivoire has ratified most of the major international environmental conventions including the Algiers Convention on the Conservation of Nature and Natural resources (Law 70-004), the Convention on Biological Diversity (Law 95-013), the International Convention on Trade in Endangered Species (CITES) (Law 75-014), the Ramsar Convention on Wetlands of International Importance (Law 98-004), the World Heritage Convention (ratified 9/12/82), the UN Convention on the Law of the Sea (ratified in October 2000) and the Climate Change Convention (Law 98-020)<sup>20</sup>.

## 5.11. 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. PMI has developed guidelines for IRS operations (“Best Management Practices (BMP) for Indoor Residual Spraying in Vector Control Interventions,” updated 2020), and provides a training manual, the Spray Operator Pocket Guide (Were, 2014). Other resources include the *Manual on Sound Management of Pesticides and Diagnosis and Treatment of Pesticide Poisoning*,<sup>21</sup> USAID PMI’s IVM PEA (USAID, 2017 Update), as well as this SEA, all of which provide precautions and recommendations on many aspects of IRS operations. The IRS BMP manual and the PMI IVM PEA requirements are the primary references and have precedence, but the other documents may be used as a reference. It is not incumbent upon the IP 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 Côte d'Ivoire. The IP 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,<sup>22</sup> storekeepers, and team leaders are trained on all aspects of IRS operation. Areas of training will include planning of IRS, household preparations, recordkeeping, community mobilization, rational/judicious use of insecticides including sprayer and PPE cleaning, personnel management, and environmental aspects of IRS – including geographical reconnaissance, and data recording and analysis.
- The training of temporary workers recruited from local areas and trained as spray team members (operators, team leaders, and wash persons). New operators will receive five to seven days of training prior to the spray operations.

More information on the training that will be provided is in Section 6, the Safer Use Action Plan.

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<sup>20</sup> Côte d'Ivoire Environmental Code

<sup>21</sup> WHO-UNEP Sound Management of Pesticides and Diagnosis and Treatment of Pesticide Poisoning: A Resource Tool. World Health Organization, Geneva. 332 Pages. Document also accessible at: [http://www.who.int/WHOPES/PQ/recommendations/IPCS/Pesticide\\_ok.pdf](http://www.who.int/WHOPES/PQ/recommendations/IPCS/Pesticide_ok.pdf)

<sup>22</sup> These are usually health-related government staff within the targeted district (health assistants/educators/inspectors, nursing assistants, and community development assistants).

## 5.12. THE PROVISIONS MADE FOR MONITORING THE USE AND EFFECTIVENESS OF THE PESTICIDE

Entomological monitoring is firmly established in the PMI Côte d'Ivoire Work Plan, and is used for insecticide decision-making, as well as monitoring the effectiveness of applied insecticides. The elements of this monitoring have been laid out in previous sections.

Two kinds of measurements are needed to provide a complete understanding of the effectiveness of pesticide that is being used for IRS. Direct methods measure the efficacy of the pesticide, that is, the degree to which the pesticide is able to kill the targeted mosquito vectors, and involve entomological evaluations of pesticide- contact bioassays and related pesticide resistance methodologies as recommended by WHO. The second means of measurement relates to the primary goal of reducing the local disease burden. These efforts require specialized entomological and epidemiological skills and the assessment of the impact of vector control operations, and possibly the assessment 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 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, ceiling) composition. The tests for insecticide efficacy are detailed in section 5.6.

Pesticide manufacturers are well aware that duration of effectiveness is important, and in some cases they are reworking their formulations to provide greater longevity. This is the case for pirimiphos-methyl (organophosphate), which has been formulated as a capsule suspension (CS) that may extend the effectiveness of the application out to six months. However this insecticide will be not used in 2020.

## 6. SAFER USE ACTION PLAN

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This section outlines the safer use action plan aligning with the 2020 BMPs proposed for the potential adverse impacts outlined in Section 5. 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 and facilities for the storage and disposal of pesticides and contaminated waste. The mitigation measures, along with monitoring and reporting information, are compiled in the EMMP found in Annex A.

### 6.1. IMPLEMENTATION CONDITIONS

During implementation, PMI/Côte d'Ivoire and its PMI IRS IPs will adhere to the conditions detailed in this Safer Use Action Plan, and in the EMMP, Annex A of this report.

#### 6.1.1. QUANTIFICATION OF PESTICIDE REQUIREMENTS

The PMI IRS IP will conduct an annual logistics assessment for all targeted districts for planning and procurement of the correct quantity of materials, including insecticides. Purchase of insufficient pesticide will lead to shortages, delays, and possibly the inability to spray all targeted areas. Purchase of too much pesticide may lead to expiration of the pesticide before it can be used up, which creates serious storage and disposal problems.

#### 6.1.2. 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, and at the same time expose the residents and spray operators to hazards related to altered toxicological characteristics.

The PMI program will procure the insecticide from a reputable supplier. Pesticide batches will be analyzed for the concentration of the active ingredient prior to shipment to Côte d'Ivoire. Additional sampling and testing may be performed upon arrival. Delivery of all insecticide to the central warehouse will be supervised by PMI before the insecticide is dispatched to the districts where spray operations will be concentrated.

#### 6.1.3. PESTICIDE TRANSPORT

After the receipt of insecticide at the central warehouse, insecticides are transported to the district warehouses by road, and in some areas, over water in boats. During transportation, there is a risk of vehicle accidents and consequent insecticide spillage. It is essential that the vehicle type and speed of transport be matched to the conditions; drivers must take no chances.

A lockable box truck is the expected vehicle to transport insecticides over land from central to district stores. If box trucks are not available, Chief of Party or ECO will notify the VectorLink Technical Project Manager and the Director of Environmental Compliance to receive instructions for an alternative security mechanism. All vehicles must be in good condition and pass the Pre-Contract Vehicle Inspection performed by the Environmental Compliance Officer (ECO) or a qualified designate, using a smart phone.

Prior to long-distance transport of the insecticide from the customs warehouse or VectorLink Côte d'Ivoire central storage facility, drivers will be trained on general issues surrounding the insecticide and how to handle emergency situations such as accidents or spillage. Training for long-distance transport will include the following information:

- Purpose of the insecticide (indoor use for malaria protection, not for agricultural or any

other outdoor use)

- Toxicity of the insecticide
- Security issues, including implications of unauthorized access to or use of the insecticide
- Hazardous places along the routes to be taken, and mitigation measures
- Steps to take in case of an accident, spill, or emergency (according to BMP standards)
- Combustibility, and toxicity of the combustion byproducts of insecticide

Drivers hired for intra-district transport of insecticide and spray team members during the spray campaign will receive training in:

- Operator transportation best practices and vehicle requirements from PMI IRS BMP #2, Worker and Resident Health and Safety
- Health and safety as provided to spray operators, with the exception of sprayer operation and spray practice
- Handling an accident, spill, or emergency according to BMP standards
- Handling vehicle contamination
- Vehicle decontamination procedures

Figure 3 below provides a list of eight key responses to mitigate the impact of an insecticide spill.

**Figure 3: Emergency Response to a Spill**

### **IN CASE OF INSECTICIDE SPILLS**

1. Control, contain, and clean up the spill.
2. Don protective clothing prior to attempting to clean the spills.
3. It is imperative to avoid fire as a result of the accident, and a fire extinguisher should be deployed just in case. The engine must be shut off and smoking in the area strictly prohibited.
4. Onlookers and bystanders must be kept away from the accident site.
5. If the crew has come in contact with the pesticides, they must remove contaminated clothing immediately and wash the pesticide off their skin.
6. For major spills send for help immediately; Drivers must have a charged cell phone and an emergency number for use in such cases.
7. People must be kept away and the spill covered with earth, sand, etc., no attempt should be made to wash away the spill with water or other substances.
8. Vehicles that are used for transporting large quantities of pesticides are required to be equipped with a bucket of sand, sawdust or soil, a shovel, and fire extinguisher.

Because vehicles used for insecticide transportation can be used for the transport of other goods, it is important to ensure that vehicles are decontaminated after use. 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 and water.

If pesticide is transported over water, BMP #4, Insecticide Transport (PMI IRS BMP Manual, 2020) must be followed in every detail.

#### **6.1.4. QUALIFICATION OF WAREHOUSES (STORAGE FACILITIES)**

IRS pesticides can cause adverse impacts to human health, animals, and the natural environment if not properly stored according to PMI BMPs. Before insecticides are procured or transported to the spray areas, suitable warehouse(s) must be assessed to ensure that they can meet BMP standards. During the geographical reconnaissance and logistics assessments, the need for new district warehouses or rehabilitation of previously used district warehouses to meet PMI IRS BMP standards for pesticide storage will be assessed. The standards include:

- Located at least 30 meters from flood plains, wetlands and water bodies, markets, schools, dwellings, beehives, and protected areas. Warehouses may not be located in the buffer zones of protected areas, or in schools while in session.
- Spacious enough to store insecticides in bulk and to store other IRS commodities separately
- Providing a separate space for the storekeeper's office
- Well ventilated and allowing for air circulation

- Built of concrete or other solid material
- Impervious flooring, or floor must be completely covered by a leak-free tarpaulin
- Watertight roofing
- Barred and screened windows
- Preferably two exits from the pesticide storage area for emergency purposes
- A fire extinguisher

In addition to the above, all facilities used for storage, distribution, and transportation of insecticide products should comply with relevant requirements of Côte d'Ivoire pesticide regulations. During the logistical needs assessment, the PMI IRS IP will identify warehouses at the district level that can meet these requirements. PMI cannot provide funds for the construction of new buildings, but can assist in the modification or renovation of existing facilities. In Côte d'Ivoire, IRS will be implemented in partnership with the Ministry of Health/NMCP; therefore, some warehouses are located on District Medical Office property for logistic and security purposes. There is also the possibility of using some public and community facilities such as youth entertainment spaces. This would meet the eligibility criteria of the project requirements.

### 6.1.5. QUALIFICATION OF LIQUID WASTE DISPOSAL FACILITIES (WASH AREAS, SOAK PITS, AND EVAPORATION TANKS)

Pyrethroids, organophosphates, neonicotinoids, and carbamates degrade quickly when exposed to environmental action such as photolysis, hydrolysis, and bacterial action. If wash areas and soak pits are properly constructed in appropriate locations and used according to BMPs, liquid pesticide waste will be captured in the charcoal layer of the soak pit and held until it breaks down by these natural processes.

Site considerations for locating IRS cleaning and waste facilities (progressive rinse, wash areas, soak pits, and tanks) include soil type, topography, vertical distance to ground water, and proximity to schools, lakes, streams, and other sensitive areas. Ideally, disposal facilities should be located adjacent to the storage facilities, where they can be more easily protected and monitored. However, the setting or the function of buildings provided for storage are not always appropriate for siting a wash area, so it may need to be placed some distance away. Due to access limitations and distance to some spray sites, it may be more feasible to locate a small wash facility in an appropriate area near the spray site.

Soak pits must be located at least 30 meters from any sensitive areas such as water bodies, flood plains, habitat, schools and other public buildings, areas protected by regulations, mining extraction sites, and areas of high groundwater. They should be located on relatively high ground to increase the vertical distance to groundwater. The general area should be level, but the wash area must be constructed to slope gently toward the soak pit or toward the collection point that is piped to the soak pit/evaporation tank.

Although the soak pit captures the majority of pesticide from wash waters, small amounts may pass through and enter the soil below. Soil characteristics affect how pesticides move through the soil, and how they break down by environmental or microbiological degradation. Clay soils have a high capacity to absorb many pesticides, but if hard-packed may have limited percolation abilities. Sandy soils have a much lower capacity to absorb pesticides, but liquids percolate rapidly. Where possible, locate facilities on fine textured soils with organic content and good absorptive properties to capture and degrade trace amounts of pesticide. Hard-packed clay or rocky soils are not appropriate.

Pesticides may move in water runoff as compounds dissolve in water or attach to soil particles. Facilities should be located on high, level ground to minimize exposure to runoff. Avoid steep slopes or natural runoff flow lines. Where necessary, curbs or berms will be constructed around wash areas to divert

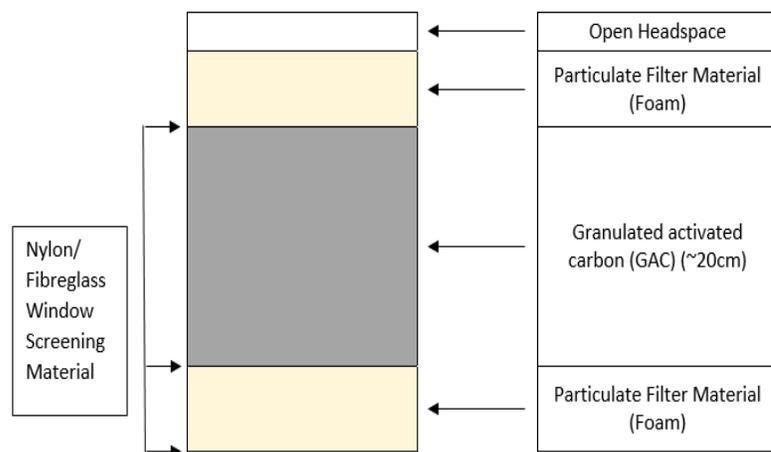
storm water runoff away from the soak pit, and to contain any spills or overflows. In very rainy areas or seasons, it may be necessary to cover the soak pit and wash area with a tarpaulin when not in use, to prevent flooding of the soak pit and subsequent runoff of pesticide-contaminated water.

### Mobile Soak Pit (MSP)

To reach certain targeted spray areas, operators must travel a great distance, and they may not be able to return at the end of the day to a centralized wash area for clean-up. Sometimes the operators will spend several days in the field, finding lodging and food in the villages where they finish their work for the day. The next day, they either continue to work at the same village, or travel on to the next targeted spray area. Working this way can reduce transportation requirements, shorten the working day, and result in greater productivity. However, operators need a different system for clean-up at the end of the day.

In this situation, the operators carry a MSP filter, wash barrels, and a tarpaulin with them, and construct a temporary wash facility at a suitable site within the village where they will stay. The MSP filter is a 20-25 L bucket with highly adsorbent activated carbon that removes pesticide contamination from the wash water, so that the water that exits to the ground is purified. For more information on the mobile soak pit, please see the PMI BMP manual.<sup>23</sup>

**Figure 4: Mobile Soak Pit Layers**



## 6.1.6. WAREHOUSE & STORAGE RISK MANAGEMENT

In order to mitigate risks associated with pesticide storage, the following will serve as warehouse/storage best management practices:

- A trained storekeeper will manage each facility and will wear gloves, a mask, overalls, and boots when in the pesticide area of storage.
- No smoking or eating will be allowed within 30 meters of the pesticide storeroom.
- Pesticide storage facilities must have thermometers installed for daily temperature recording.
- Basins, soap and clean water will be available at all times in all the facilities.
- Recommended pesticide stacking position and height in the warehouse as provided in the

<sup>23</sup> Chandonait, Peter. February 2015. President's Malaria Initiative BMP Manual Best Management Practices (BMP) For Indoor Residual Spraying (IRS) In Vector Control Interventions. Bethesda, MD. PMI | VectorLink Project, Abt Associates.

FAO Storage and Stock Control Manual will be followed.

- A fire extinguisher will be available in the storage facilities and all site workers will be trained on how to use this device.
- Warning notices will be placed outside of the store with a skull and crossbones pictogram and warnings in the local language.
- Insecticides must be lifted off of the floor via pallets or shelves, and separated from the walls of the storeroom by 9-12 inches.
- First aid kits must be fully stocked and available in all the central warehouses and secondary stores. Security and inventory management of first aid supplies is mandatory.

#### **6.1.6.1. Accidental Warehouse Fires**

Inhalation of toxic fumes in the event of a storehouse fire is a major risk of IRS. The risk can be minimized, however, by following BMPs for storage, including prohibiting lighted materials in or near the warehouse or in the vicinity of pesticides during transport to/from vehicles, providing fire extinguishers, and proper ventilation of storerooms.

#### **6.1.7. FETAL EXPOSURE (PREGNANCY TESTING)**

All female candidates for spray teams will be tested for pregnancy before being recruited into the spray operations, and every 30 days until operations end. Provided their work history has been acceptable, females who have been hired and later found to be pregnant will be reassigned 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.

#### **6.1.8. SPRAY OPERATOR EXPOSURE**

The individuals recruited for IRS campaigns will receive intensive training on the use, operation, calibration and repair of the spray pumps, including hands-on exercises prior to the beginning of the spraying campaign. They will also be trained 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 the IRS Training Guide for Spray Operations (USAID, 2009) and the 2015 IRS BMP manual. Potential spray operators must also pass written and practical tests at the end of training.

Training for 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 IP's headquarters within 24 hours. The incident report must be received from the IP's Technical Project Manager by PMI COR within 48 hours.

For malathion and fenitrothion organophosphates, it may be necessary to monitor the level of acetyl cholinesterase in any worker who may have been exposed to contamination. Occupational exposures to organophosphate insecticides are measurable using blood cholinesterase testing and urinary excretion of chemical biomarkers. PMI has evaluated various approaches for monitoring sprayer exposure to organophosphates, and has determined that biomonitoring is not required when using pirimiphos-methyl. Moreover, the WHO PQ Working Group recommendations stated that "provided that operational guidelines are followed, routine cholinesterase monitoring of spray men during IRS programs is not required" for Actellic CS.

### 6.1.9. BENEFICIARY EXPOSURE

Residential exposure will also 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 beneficiary exposure incidents.

NMCP, DMOs, and the PMI IRS IP and other partners will work with relevant institutions at all levels to carry out an IEC/BCC campaign to sensitize residents to IRS activities, in accordance with WHO guidelines and also the Côte d'Ivoire National Malaria Strategic Plan 2016 – 2020 and PMI Malaria Operational Plans. The IEC campaign (as well as IRS project leaders and Ministry of Health/NMCP Officers) 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 cover with impermeable material.
- Residents must stay at least 10 meters from the home during spraying, and for two hours after spraying.
- Move and keep all animals at least 10 meters from 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 before allowing re-entry by children and animals.
- Do not relater or paint over the sprayed walls after spraying.
- Keep using bed nets for additional 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, or if symptoms of other types of exposure persist, contact program staff or go to nearest health facility that has the appropriate medical intervention.

If spraying during the rainy season, the teams should adhere to the following Contingency Plan, which will minimize exposure of household effects.

- Each spray operator must be given adequate covering material (3m by 3m minimum), which should then be used to cover household effects that have been moved to the center of the room (rather than outdoors) because it has started to rain. More than one sheet may be required, depending on the size of structures and the amount of belongings.
- Household effects can also be moved into structures that are not targeted to be sprayed, e.g., an isolated kitchen or domestic animal shelter.
- Household effects can alternatively be moved to one room that will not be sprayed on that particular day, but on 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 middle of spraying, stop the spraying activities; resume when the rain stops and the skies clear.

### 6.1.10. PESTICIDE EXPOSURE AND TREATMENT

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

PMI IP will confirm that all the health facilities around the spray sites have in their store the recommended treatment drugs, and that all the staff responsible for administering emergency treatment for pesticide exposure receive appropriate training. Annex E provides additional information on symptoms and treatment protocols.

### 6.1.11. SOLID AND LIQUID CONTAMINATED WASTE MANAGEMENT

Non-contaminated wastes, or those that can be cleaned thoroughly with soap and water, will be recycled whenever possible, or disposed of in a municipal landfill if there is no appropriate recycling outlet.

Liquid contaminated wastes will be disposed of on a daily basis in soak pits that are carefully sited and designed according to the criteria in this Safer Use Action Plan and 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. Thus, there should be no contaminated liquid waste to deal with at the end of the spray season.

Contaminated solid wastes are incinerated in incinerators that are capable of destroying the pesticide and preventing environmental contamination.

Incinerators recommended for disposal of contaminated wastes fall into two categories:

- Basel Convention technical standards, for all insecticides that do not contain greater than 1% chlorine
- WHO/FAO standards, which apply if using DDT or insecticides that contain >1% chlorine

For wastes containing less than 1% chlorine:

- The recommended combustion temperature is >850 °C.
- An after-burner is required, with a residence time of at least two seconds.
- The incinerator must have emission control, including particulate matter filters.
- Ash and slag produced by high-temperature incineration of pesticides are best incorporated into concrete and buried in a secure location. In Côte d'Ivoire, as such solid wastes will be incinerated in a private incinerator, ash and slag will be incorporated into cement blocks and buried.

For wastes containing greater than 1% chlorine:

- The recommended combustion temperature is between 1100 and 1300 °C.
- An after-burner is required, with a residence time of at least two seconds.
- A quench rinse that causes a rapid temperature drop to below 250 °C is needed for the gas stream.
- The incinerator must have emission control, including particulate matter filters.

- Ash and slag produced by high-temperature incineration of pesticides are best incorporated into concrete and buried in a secure location. In Côte d'Ivoire, as such solid wastes are not incinerated in a PMI-owned incinerator and the IP does not have control over the ash and slag, VectorLink can only recommend this disposition.

Incineration is not recommended for polyvinyl chloride or other chlorinated wastes such as gloves and boots. Gloves and boots no longer usable for IRS can be easily decontaminated with soap and water and then offered to spray team members, or disposed of as normal non-hazardous waste.

Empty plastic containers should not be incinerated, due to the difficulty inherent in burning them cleanly and the nuisance and toxic emissions that may result. Once punctured to prevent reuse, plastic bottles can be triple-rinsed and recycled at an appropriate facility, or landfilled.

Cardboard boxes previously containing intact insecticide sachets or bottles are not considered contaminated waste. In many cases uncontaminated boxes can be recycled, or can also be disposed of as normal non-hazardous wastes. Incineration is not recommended for cardboard boxes unless they have been contaminated by pesticide leakage or used for the storage of other contaminated wastes. In Côte d'Ivoire, the incineration of masks and empty sachets of insecticides from IRS activities will be handled by RMG unit plant. RMG is the main agreed company that has been working with the government and some private industry since past years.

The EMMP in Annex A gives further details on the steps and measures that will be taken to prevent negative impacts on the non-target ecosystems from liquid and solid IRS waste materials and disposal practices.

# Annex A: Environmental Mitigation and Monitoring Plan (EMMP)

PMI VECTORLINK CÔTE D'IVOIRE PROJECT (AID-OAA-TO-I7-00027)

Category of Activity	Describe specific environmental threats of your organization's activities	Description of Mitigation Measures for these activities	Who is responsible for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
<b>1. Education, Technical Assistance, Training</b>	Activities involving studies, education, technical assistance, training, or information transfer, except to the extent they directly affect the environment (such as construction of facilities), are recommended for categorical exclusion.	N/A – Categorical Exclusion	N/A	N/A	N/A	N/A
<b>2. Research and Development</b>	Entomological surveillance and vector control research use laboratory equipment, chemical reagents, insecticides, and entomological	<ul style="list-style-type: none"> <li>Implement laboratory environmental, health, and safety (EHS) manuals with standard operating procedures (SOPs), or use existing SOPs, for laboratory operations in accordance with country-specific compliance mechanisms.</li> </ul>	Laboratory personnel within the respective country, with oversight provided by Abt Associates technical experts.	<ul style="list-style-type: none"> <li>EHS manual/Standard operating procedures (SOPs) implemented per PMI and country-specific requirements</li> </ul>	<ul style="list-style-type: none"> <li>Review of EHS manual/SOPs to ensure it is appropriate, and complies with PMI, WHO and country-specific</li> </ul>	<ul style="list-style-type: none"> <li>Routine site visits, as needed, to ensure accordance with operating plan</li> </ul>

Category of Activity	Describe specific environmental threats of your organization's activities	Description of Mitigation Measures for these activities	Who is responsible for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
	surveillance supplies that have the potential to cause adverse health and environmental impacts if not properly managed. These materials require special care and management to minimize their expiration and/or damage.	<ul style="list-style-type: none"> <li>• Implement SOPs for the safe storage, transport, and use of equipment, chemical reagents, insecticides, and supplies in conformance with international best practices (e.g., WHO, FAO) and host country requirements.</li> <li>• Provide training to workers on the approved SOPs or Waste Management Plan (WMP) developed for properly handling and disposing of wastes.</li> </ul>		<ul style="list-style-type: none"> <li>• Training of staff in activities related to the laboratory EHS manual/SOPs</li> </ul>	<p>recommendations for safety, use of personal protective equipment(if needed), spill prevention, and training.</p> <ul style="list-style-type: none"> <li>• Review training materials and logs to verify trainings were conducted</li> <li>• Confirm during routine visits that SOPs are being effectively implemented and that workers are reporting EHS incidents</li> <li>• Include date of visits, findings and any non-compliance issues in the annual EMMR</li> </ul>	

Category of Activity	Describe specific environmental threats of your organization's activities	Description of Mitigation Measures for these activities	Who is responsible for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
					<ul style="list-style-type: none"> <li>• Include photographs from site visits</li> </ul>	
<b>3. Public Health Commodities</b>	N/A	N/A	N/A	N/A	N/A	N/A
<b>4. Small-Scale Construction</b>	<ul style="list-style-type: none"> <li>• Lack of necessary permits and assessments in place in advance</li> <li>• Improper siting or construction techniques causing: <ul style="list-style-type: none"> <li>- Deterioration of human and social environments:</li> <li>- Erosion or sedimentation</li> <li>- Creation of disease vector habitat</li> </ul> </li> <li>• Use of construction equipment can cause injuries to workers and bystanders.</li> <li>• Construction activities during</li> </ul>	<ul style="list-style-type: none"> <li>• Obtain all needed authorizations prior to construction: permits, environmental and social impact assessments, etc.</li> <li>• Retain competent, licensed professionals to design and supervise construction</li> <li>• Establish health, safety and environmental obligations in all contracts.</li> <li>• Complete a site emergency action plan</li> <li>• Provide safety training to all workers using construction equipment</li> <li>• Identify closest health care facility to handle injuries</li> <li>• Asbestos, lead based paints and other toxic materials will not be used under any circumstances. If the presence of asbestos is suspected in a facility to be renovated, the</li> </ul>	Abt Associates technical overseers and Environmental Compliance Officers, with assistance from USAID Mission personnel. Contractors	<ul style="list-style-type: none"> <li>• Permits on file</li> <li>• Construction contracts are in place for engaged professionals and reflect requirements of USAID guidelines for small-scale construction</li> <li>• Waste management plan in place and being followed to identify and characterize all waste streams from the project with the proposed final disposal option</li> <li>• SOPs implemented</li> </ul>	<ul style="list-style-type: none"> <li>• Review all demolition, emergency, safety, waste management, and construction plans and contracts prior to renovations.</li> <li>• Provide continual oversight of operations by regular site inspection visits. Review WMP to ensure it is adequate</li> <li>• Review records to verify trainings/ briefings were conducted</li> </ul>	Pre-, mid- and post construction. Inspect construction sites at least weekly

Category of Activity	Describe specific environmental threats of your organization's activities	Description of Mitigation Measures for these activities	Who is responsible for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
	<p>renovation of facilities may generate debris and wastes that contain both non-hazardous and hazardous materials that require proper disposal. This includes chemicals, solvents, and any materials containing toxics, such as asbestos, lead-based paint, and formaldehyde.</p> <ul style="list-style-type: none"> <li>• Exposure to hazardous building materials during renovation activities can result in health impacts to workers.</li> <li>• Waste produced during the construction or refurbishment work can be</li> </ul>	<p>facility must be tested before rehabilitation works begins. Should asbestos be present, then the work must be carried out in conformity with host country requirements and with guidance to be provided by the Implementing Partner. All results of the testing for asbestos shall be communicated to the COR</p> <ul style="list-style-type: none"> <li>• Develop and follow a waste management plan (WMP). Identify authorized recycling or disposal facilities prior to generation of waste.</li> <li>• Minimize the generation of waste by: <ul style="list-style-type: none"> <li>- Correctly assessing material needs (not over-buying)</li> <li>- Reducing amount of packaging used by suppliers</li> <li>- Reusing material on site, such as use of discarded materials for leveling ground and filling trenches, etc.</li> </ul> </li> <li>• Designate secure on-site waste storage facilities</li> </ul>		<ul style="list-style-type: none"> <li>• Staff briefings on activities related to SOPs</li> </ul>		

Category of Activity	Describe specific environmental threats of your organization's activities	Description of Mitigation Measures for these activities	Who is responsible for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
	<p>harmful to the environment and human health.</p> <ul style="list-style-type: none"> <li>• Use of environmentally unsustainable construction materials such as wood can lead to environmental degradation</li> <li>• Lack of personal protective equipment may lead to accidents, injuries, or exposure of workers.</li> <li>• Construction activities may produce noise and air pollution</li> <li>• Construction activities can create standing water and breeding habitats for disease vectors.</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure all workers are trained and dispose of wastes properly.</li> <li>• Complete and track hazardous waste manifests for all shipments</li> <li>• Source all construction material from an ecologically safe provider.</li> <li>• Contractor must provide and all workers must use personal protective equipment (PPE) such as hardhats, footwear, dust mask, safety glasses and reflective vests, as needed.</li> <li>• Ensure first aid and spill clean-up kits are easily available</li> <li>• Contractors must comply with the "Small-Scale Construction" chapter of the USAID Sector Environmental Guidelines (<a href="https://www.usaid.gov/environmental-procedures/sectoral-environmental-social-best-practices/seg-construction/pdf">https://www.usaid.gov/environmental-procedures/sectoral-environmental-social-best-practices/seg-construction/pdf</a>).</li> <li>• Contractor will provide drinking water, latrine and a handwashing station to workers.</li> </ul>				

Category of Activity	Describe specific environmental threats of your organization's activities	Description of Mitigation Measures for these activities	Who is responsible for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
		<ul style="list-style-type: none"> <li>Contractors will arrange working hours to minimize disruption to the community.</li> <li>If needed, construct drainage canals and infiltration pits for management of storm water and prevention of soil erosion.</li> <li>Post-construction: ensure leftover materials have been properly disposed of.</li> </ul>				
<b>5. Small-Scale Water and Sanitation</b>	N/A	N/A	N/A	N/A	N/A	N/A
<b>6. Nutrition</b>	N/A	N/A	N/A	N/A	N/A	N/A
<b>7. Vector Control - IRS</b>	I. Health and environmental impacts may result due to inadequate quality control of insecticides (i.e. procuring non-approved insecticides, improper storage, or poor inventory management).	<ul style="list-style-type: none"> <li>Insecticide selection for any USAID-supported malaria program is subject to the criteria listed in the USAID Programmatic Environmental Assessment, country SEAs, and host country requirements.</li> <li>Procurement and inventory logs must be maintained.</li> <li>Ensure storage facility and personal protective equipment (PPE) are appropriate for the active ingredient used and in accordance with approved SOPs.</li> </ul>	District Coordinator (DC), Operations Manager (OM), Abt Environmental Compliance Officer (ECO), Abt Vector Control Manager (VCM), Storekeepers (These positions are representative of	<ul style="list-style-type: none"> <li>PMI BMPs reviewed and implemented</li> <li>Procurement and inventory logs maintained</li> <li>Proper PPE used by workers, if needed.</li> <li>Operations facilities are sited appropriately</li> </ul>	<ul style="list-style-type: none"> <li>Inspection of facilities, conditions, PPE use, and logs</li> <li>Review of waste management records and storekeeper performance checklists.</li> <li>Verify that inspection reports and storage</li> </ul>	<ul style="list-style-type: none"> <li>Daily monitoring by storekeeper or site supervisor</li> <li>Weekly monitoring by DC</li> <li>Monthly review of procurement logs and inventories by OM</li> </ul>

Category of Activity	Describe specific environmental threats of your organization's activities	Description of Mitigation Measures for these activities	Who is responsible for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
		<ul style="list-style-type: none"> <li>Distribute insecticides to facilities that can manage such commodities safely in storage, use, and disposal (i.e. in a manner generally equivalent to Implementing Partner's own SOPs/WMP)</li> </ul>	the responsibilities required, but may not reflect the exact job title.)	<ul style="list-style-type: none"> <li>All insecticide management records are reviewed and maintained</li> </ul>	<p>records are properly maintained and document verification in the annual EMMR.</p> <ul style="list-style-type: none"> <li>ECO performs mid-application inspections. Verify that inspection reports are properly maintained and document verification in the annual EMMR</li> </ul>	
	2. Occupational risks for workers involved in IRS campaigns.	<ul style="list-style-type: none"> <li>Inspect and certify vehicles used for insecticide or team transport prior to contract.</li> <li>Train drivers</li> <li>Ensure availability of cell phone, personal protective equipment (PPE) and spill kits during insecticide transportation.</li> <li>Initial and 30-day pregnancy testing for female candidates</li> </ul>	DC, OM, ECO, Chief of Party, and Abt Associates technical experts within the respective country	<p>a. Transport vehicles have a valid inspection certificate on-board.</p> <p>b. Drivers have a certificate of training completion.</p> <p>c. Transport vehicles are equipped with cell</p>	<p>a-c. ECO inspection of vehicles in the field.</p> <p>d-e. ECO inspection of health records at operations sites.</p> <p>f-h. ECO performs pre-application inspections of</p>	<p>a-c. 2 inspections per week.</p> <p>d-e. One inspection per campaign, additional inspection if new hires or more than 30 application days.</p> <p>f-h. ECO pre-</p>

Category of Activity	Describe specific environmental threats of your organization's activities	Description of Mitigation Measures for these activities	Who is responsible for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
		<p>for jobs with potential insecticide contact.</p> <ul style="list-style-type: none"> <li>• Health test all spray team members for duty fitness.</li> <li>• Procure, distribute, and train all workers with potential insecticide contact on the use of PPE.</li> <li>• Train operators on mixing insecticides and the proper use and maintenance of application equipment.</li> <li>• Provide adequate facilities and supplies for end-of-day cleanup.</li> <li>• Enforce application and clean-up procedures.</li> </ul>		<p>phone, spill kit, and PPE.</p> <p>d. Records are kept of pregnancy testing for all female team members.</p> <p>e. Records are kept of medical exam results for all team members.</p> <p>f. Operators wear complete PPE during application and clean-up, according to SOP requirements.</p> <p>g. Operators mix insecticide properly, and equipment does not leak.</p> <p>h. All facilities are compliant, and materials required for clean-up are present.</p> <p>i. Inspections are performed as scheduled,</p>	<p>inventories and training records, and mid-application inspections of PPE use and operator performance.</p> <p>i. Monitoring of on-line database for submission of inspection reports.</p>	<p>application inspections 2 per campaign, ECO mid-application inspections 5 times per week.</p> <p>i. Weekly</p>

Category of Activity	Describe specific environmental threats of your organization's activities	Description of Mitigation Measures for these activities	Who is responsible for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
				corrective action is taken as needed.		
	3. Health and safety risks for residents of treated houses (e.g., risks from skin contact and/or ingestion of insecticides)	<p>a. Implement Information, Education and Communication (IEC) campaigns to inform homeowners of responsibilities and precautions, including washing itchy skin and going to health clinic if symptoms develop and do not subside</p> <p>b. Ensure health facility staff are aware of insecticide poisoning management</p>	IEC officers, OM, ECO, host country Ministry of Health/Environment officials.	a. Review IEC materials and records and execute pre-application IEC campaigns	a. Review IEC materials and records to verify IEC pre-application campaigns were conducted and homeowners were informed of responsibilities and precautions	a. Review IEC materials once per campaign
	4. Nearby residents may be exposed to insecticides if insecticides are not securely stored to prevent theft and misuse incidents, including the illegal resale of insecticides.	<ul style="list-style-type: none"> <li>• Storage facilities and transportation vehicles must be physically secured to prevent theft.</li> <li>• Maintain records of all insecticide receipts, issuance, and return of empty containers.</li> <li>• Conduct analysis comparing number of houses treated vs. number of containers used.</li> <li>• Examine houses treated to confirm application</li> <li>• Perform physical inventory counts during the application season.</li> </ul>	Storekeepers, District coordinators, sector managers, logistics coordinator, OM, ECO	<ul style="list-style-type: none"> <li>• Storage facilities and transportation vehicles are secured.</li> <li>• All insecticide management records are reconciled.</li> </ul>	<ul style="list-style-type: none"> <li>• Inspection of storage facilities and transportation vehicles.</li> <li>• Inspection of insecticide management records. Storekeeper performance checklists.</li> <li>• ECO mid-campaign inspections.</li> </ul>	<ul style="list-style-type: none"> <li>• Daily monitoring by storekeeper or site supervisor. Weekly monitoring by District Coordinator</li> <li>• Examine houses during campaign according to schedule in SOPs.</li> </ul>

Category of Activity	Describe specific environmental threats of your organization's activities	Description of Mitigation Measures for these activities	Who is responsible for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
						<ul style="list-style-type: none"> <li>Physical inventory counts twice per campaign per store room.</li> </ul>
	<p>5. Ecological risk to non-target species and water bodies from use of insecticides</p>	<ul style="list-style-type: none"> <li>For shipments of insecticide over water, sachets/ bottles will be packed in 220 liter open top barrels with a water-tight top and a locking ring, or in a similar durable container. Waterproof labeling must be affixed to the barrel, with the identity of the pesticide, number of bottles inside, the weight, the type of hazard posed by the contents, and the personal protective equipment to be worn when handling the barrel.</li> <li>Train applicators on the SEA operational requirements, SOPs, PMI BMPs, and approved WMP, developed for the safe and effective storage, distribution, application, and disposal of insecticides</li> <li>Ensure application equipment and PPE are appropriate for the active ingredient used and</li> </ul>	DC, OM, ECO	<ul style="list-style-type: none"> <li>Training materials and records</li> <li>Equipment is maintained and operated to eliminate leaks.</li> <li>Applicators only mix and apply insecticides according to SOPs</li> </ul>	<ul style="list-style-type: none"> <li>Review training materials and records to verify trainings were conducted</li> <li>Conduct inspections during operations.</li> <li>Verify that inspection and incident reports are properly maintained and document verification in the annual EMMR. Include any issues identified during inspections in</li> </ul>	<ul style="list-style-type: none"> <li>Inspect work records once per campaign</li> <li>Inspections during operations 3 times per week</li> <li>Review training materials once per campaign</li> </ul>

Category of Activity	Describe specific environmental threats of your organization's activities	Description of Mitigation Measures for these activities	Who is responsible for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
		<p>in accordance with approved SOPs, and maintain equipment to avoid leaks.</p> <ul style="list-style-type: none"> <li>• Maintain application equipment</li> <li>• No application of insecticides within 30 yards of beekeeping sites</li> </ul>			the annual EMMR	
	6. Environmental risk from disposal of liquid and solid wastes	<ul style="list-style-type: none"> <li>• Handling, treatment, and disposal of nonhazardous (general waste) and hazardous wastes must be in accordance with the approved WMP/SOPs and the PMI BMPs. The WMP, which outlines SOPs for managing waste processes, must be in accordance with PMI best practices and host country requirements</li> <li>• Choose sites for disposal of liquid wastes, including fixed and mobile soak pit sites according to PMI BMPs</li> <li>• Construct fixed and mobile soak pits with charcoal according to the BMPs to adsorb insecticide from rinse water</li> <li>• Maintain soak pits as necessary during season</li> </ul>	DC, OM, ECO	<ul style="list-style-type: none"> <li>• WMP implemented and disposal sites inspected and certified before campaigns.</li> <li>• Disposal sites near operations sites are appropriate according to PMI BMPs</li> <li>• Soak pits are constructed according to PMI BMPs</li> <li>• Soak pits perform properly throughout the application season</li> </ul>	<ul style="list-style-type: none"> <li>• Review WMP/SOPs to ensure it conforms to PMI BMPs and WMP is available on site</li> <li>• Pre-application inspections. Verify that inspection reports are properly maintained and document verification in the annual EMMR. Include any issues identified during inspections in the annual EMMR</li> </ul>	<ul style="list-style-type: none"> <li>• Pre-application inspections: once per campaign</li> <li>• Mid- and post-application inspections: twice per campaign</li> <li>• Review of WMP/SOPs during campaign</li> </ul>

Category of Activity	Describe specific environmental threats of your organization's activities	Description of Mitigation Measures for these activities	Who is responsible for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
		<ul style="list-style-type: none"> <li>• Monitor waste storage and management during campaign</li> <li>• Monitor disposal procedures post-campaign</li> </ul>		<ul style="list-style-type: none"> <li>• Wastes are stored and managed according to PMI BMPs</li> <li>• Waste disposal is conducted in accordance with the WMP/SOPs and records maintained</li> </ul>	<ul style="list-style-type: none"> <li>• Mid- and post-application inspections and monitoring. Verify disposal practices in inspection reports and document in the annual EMMR. Include any issues identified during inspections in the annual EMMR.</li> <li>• Review WMP/SOPs to for effectiveness and maintain on site</li> </ul>	

Category of Activity	Describe specific environmental threats of your organization's activities	Description of Mitigation Measures for these activities	Who is responsible for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
	7. Improper incineration of wastes and disposal of residual ash can pose a threat to air quality, soil, and the water supply and result in environmental and public health hazards.	<ul style="list-style-type: none"> <li>• Wastes will only be disposed in incinerators that comply with PMI BMPs Collect and maintain treatment and disposal documents and records on file</li> <li>• Country-level USAID EC documentation must contain guidance on proper disposal of wastes</li> <li>• The IP will identify the location and the type of incinerator(s) or other disposal technology to be used. The location and incinerator specs will be provided to the AOR and BEO prior to commencing disposal activities and included in the annual EMMR.</li> </ul>	COR, Abt ECO, Abt Technical Experts	<ul style="list-style-type: none"> <li>• Incinerator specifications</li> <li>• Maintenance of treatment and disposal records</li> <li>• Reg 216 documentation for incinerator procurement and management services reviewed by COR and GH BEO.</li> </ul>	<ul style="list-style-type: none"> <li>• Review incineration records and document in the annual EMMR</li> </ul>	<ul style="list-style-type: none"> <li>• Review incinerator specifications prior to disposal arrangement</li> <li>• Annual review of disposal records</li> </ul>
<b>7. Vector Control - Testing of Insecticide-Treated Nets.</b>	1. Risk of theft from storerooms, followed by unintended use.	1. Store nets only in storerooms secured with sturdy doors, locks, and barred windows.	Environmental Compliance Officer, USAID Mission	1. Storerooms are secure with sturdy doors, locks, and barred windows.	1. Inspection of storeroom for required features	1-2. Once per activity (e.g., campaign) or per fiscal semester.

Category of Activity	Describe specific environmental threats of your organization's activities	Description of Mitigation Measures for these activities	Who is responsible for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
<b>7. Vector Control – Distribution of Insecticide-treated Nets</b> Applies only in countries where VectorLink distributes ITNs to beneficiaries and is responsible for ITN transport, storage, distribution, disposal and/or SBC activities.	1. Misuse of non-expired ITNs (i.e., nets used for non-public health purposes such as fishing)	Where there is evidence of misuse for fishing, assess the extent of misuse and collaborate across sectors (Ministries of Health, Environment, and Agriculture) to develop a sustainable, locally relevant solution	Abt Associates ECO and country senior staff where ITNs are delivered at scale and fishing occurs.	Key messages in place to reinforce appropriate ITN use, particularly in areas where ITNs are delivered at scale and fishing is practiced.	Verification of key messages.	Continuously when personnel are in the field
	2. Reduced efficacy of LLINs due to improper storage	Store LLINs in dry, ventilated facilities	ECO, store manager	Confirmed evidence of ITN storage consistent with country-specific and established guidelines	Visual observation and evidence (photos) of storage capacity, security, conditions	Continuous observation
	3. Pilferage of LLINs and consequential human and environmental exposure	Store in a secure facility to prevent theft or unauthorized access. Post guard or use barred windows as needed	ECO, store manager	Visual and physical evidence of the security of windows and doors	Visual observation and physical testing of the security of windows and doors	Continuous by store manager, bi-annual by ECO
	4. Contamination of edible or potable materials due to contact with ITNs	Do not store LLINs with food, feed, or potable water supplies	Store manager, ECO	Presence or absence of sensitive materials stored with LLINs	Visual observation	Continuous monitoring by store manager, 4 times/yr by ECO
	5. Worker safety (handling LLINs that are not individually packaged)	Provide worker training on the proper handling of LLINs	ECO, store manager	ITN handling knowledge assessed among distribution agents	Interviews with workers	Prior to engaging workers for distribution of nets.

Category of Activity	Describe specific environmental threats of your organization's activities	Description of Mitigation Measures for these activities	Who is responsible for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
	6. Human and environmental impacts of washing LLINs	Ensure that SBCC materials and outreach activities are coordinated with ITN distribution activities during campaigns, and include guidelines on how to properly wash and maintain LLINs (e.g., discourage disposal of wash water in sensitive ecosystems, discourage washing and rinsing LLINs in water bodies)	IEC coordinator, ECO	Key messages developed to reinforce correct ITN wash practices	Review of ITN key messages with campaign/health personnel	Upon distribution of nets, 4 times/yr. by ECO
	7. Human and environmental impacts of bags and baling materials used to package LLINs	Ensure that SBCC messages inform campaign distributors and local communities about the potential harm to human health and environment if bags and baling materials are reused; support the development of a communication plan that provides messages on best practices for handling and disposing of bags and baling materials.	IEC coordinator, ECO	Presence or absence of SBC materials on best practices included in MOH communication plans or materials developed with VectorLink support.	Visual observation of MOH plans, materials developed with VectorLink support	Annually.
<b>8. Emergency Response</b>	N/A	N/A	N/A	N/A	N/A	N/A

# ANNEX B: ENVIRONMENTAL MITIGATION AND MONITORING REPORT FORM

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PMI VECTOR LINK CÔTE D'IVOIRE PROJECT

Implementing Organization: Abt Associates

Geographic location of USAID-funded activities:

Period covered by this Reporting Form and Certification:

List each Mitigation Measure from column 3 in the EMMP (EMMT Part 2 of 3)	Status of Mitigation Measures	List any outstanding issues relating to required conditions	Remarks
<p><b>2. Research and Development</b></p> <ul style="list-style-type: none"> <li>• Implement laboratory environmental, health, and safety (EHS) manuals with standard operating procedures (SOPs), or use existing SOPs, for laboratory operations in accordance with country-specific compliance mechanisms.</li> <li>• Implement SOPs for the safe storage, transport, and use of equipment, chemical reagents, insecticides, and supplies in conformance with international best practices (e.g., WHO, FAO) and host country requirements.</li> <li>• Provide training to workers on the approved SOPs or Waste Management Plan (WMP) developed for properly handling and disposing of wastes.</li> </ul>			
<p><b>4. Small-Scale Construction</b></p> <ul style="list-style-type: none"> <li>• Obtain all needed authorizations prior to construction: permits, environmental and social impact assessments, etc.</li> <li>• Retain competent, licensed professionals to design and supervise construction</li> <li>• Establish health, safety and environmental obligations in all contracts.</li> <li>• Complete a site emergency action plan</li> <li>• Provide safety training to all workers using construction equipment</li> <li>• Identify closest health care facility to handle injuries</li> <li>• Asbestos, lead based paints and other toxic materials will not be used under any circumstances. If the presence of asbestos is suspected in a facility</li> </ul>			

List each Mitigation Measure from column 3 in the EMMP (EMMT Part 2 of 3)	Status of Mitigation Measures	List any outstanding issues relating to required conditions	Remarks
<p>to be renovated, the facility must be tested before rehabilitation works begins. Should asbestos be present, then the work must be carried out in conformity with host country requirements and with guidance to be provided by the Implementing Partner. All results of the testing for asbestos shall be communicated to the COR</p> <ul style="list-style-type: none"> <li>• Develop and follow a waste management plan (WMP). Identify authorized recycling or disposal facilities prior to generation of waste.</li> <li>• Minimize the generation of waste by: <ul style="list-style-type: none"> <li>- Correctly assessing material needs (not over-buying)</li> <li>- Reducing amount of packaging used by suppliers</li> <li>- Reusing material on site, such as use of discarded materials for leveling ground and filling trenches, etc.</li> </ul> </li> <li>• Designate secure on-site waste storage facilities</li> <li>• Ensure all workers are trained and dispose of wastes properly.</li> <li>• Complete and track hazardous waste manifests for all shipments</li> <li>• Source all construction material from an ecologically safe provider.</li> <li>• Contractor must provide and all workers must use personal protective equipment (PPE) such as hardhats, footwear, dust mask, safety glasses and reflective vests, as needed.</li> <li>• Ensure first aid and spill clean-up kits are easily available</li> </ul>			

List each Mitigation Measure from column 3 in the EMMP (EMMT Part 2 of 3)	Status of Mitigation Measures	List any outstanding issues relating to required conditions	Remarks
<p>Contractors must comply with the “Small-Scale Construction” chapter of the USAID Sector Environmental Guidelines  <a href="https://www.usaid.gov/environmental-procedures/sectoral-environmental-social-best-practices/seg-construction/pdf">https://www.usaid.gov/environmental-procedures/sectoral-environmental-social-best-practices/seg-construction/pdf</a> )</p> <ul style="list-style-type: none"> <li>• Contractor will provide drinking water, latrine and a handwashing station to workers.</li> <li>• Contractors will arrange working hours to minimize disruption to the community.</li> <li>• If needed, construct drainage canals and infiltration pits for management of storm water and prevention of soil erosion.</li> <li>• Post-construction: ensure leftover materials have been properly disposed of.</li> </ul>			
<p><b>7a. Indoor Residual Spraying</b></p> <ul style="list-style-type: none"> <li>• Insecticide selection for any USAID-supported malaria program is subject to the criteria listed in the USAID Programmatic Environmental Assessment, country SEAs, and host country requirements.</li> <li>• Procurement and inventory logs must be maintained.</li> <li>• Ensure storage facility and personal protective equipment (PPE) are appropriate for the active ingredient used and in accordance with approved SOPs.</li> <li>• Distribute insecticides to facilities that can manage such commodities safely in storage, use, and</li> </ul>			

List each Mitigation Measure from column 3 in the EMMP (EMMT Part 2 of 3)	Status of Mitigation Measures	List any outstanding issues relating to required conditions	Remarks
disposal (i.e. in a manner generally equivalent to Implementing Partner's own SOPs/WMP)			
<ul style="list-style-type: none"> <li>• Inspect and certify vehicles used for insecticide or team transport prior to contract.</li> <li>• Train drivers</li> <li>• Ensure availability of cell phone, personal protective equipment (PPE) and spill kits during insecticide transportation.</li> <li>• Initial and 30-day pregnancy testing for female candidates for jobs with potential insecticide contact.</li> <li>• Health test all spray team members for duty fitness.</li> <li>• Procure, distribute, and train all workers with potential insecticide contact on the use of PPE.</li> <li>• Train operators on mixing insecticides and the proper use and maintenance of application equipment.</li> <li>• Provide adequate facilities and supplies for end-of-day cleanup.</li> <li>• Enforce application and clean-up procedures.</li> </ul>			
<ul style="list-style-type: none"> <li>• Implement Information, Education and Communication (IEC) campaigns to inform homeowners of responsibilities and precautions, including washing itchy skin and going to health clinic if symptoms develop and do not subside</li> <li>• Ensure health facility staff are aware of insecticide poisoning management</li> </ul>			

List each Mitigation Measure from column 3 in the EMMP (EMMT Part 2 of 3)	Status of Mitigation Measures	List any outstanding issues relating to required conditions	Remarks
<ul style="list-style-type: none"> <li>• Storage facilities and transportation vehicles must be physically secured to prevent theft.</li> <li>• Maintain records of all insecticide receipts, issuance, and return of empty containers.</li> <li>• Conduct analysis comparing number of houses treated vs. number of containers used.</li> <li>• Examine houses treated to confirm application</li> <li>• Perform physical inventory counts during the application season.</li> </ul>			
<ul style="list-style-type: none"> <li>• For shipments of insecticide over water, sachets/ bottles will be packed in 220 liter open top barrels with a water-tight top and a locking ring, or in a similar durable container. Waterproof labeling must be affixed to the barrel, with the identity of the pesticide, number of bottles inside, the weight, the type of hazard posed by the contents, and the personal protective equipment to be worn when handling the barrel.</li> <li>• Train applicators on the SEA operational requirements, SOPs, PMI BMPs, and approved WMP, developed for the safe and effective storage, distribution, application, and disposal of insecticides</li> <li>• Ensure application equipment and PPE are appropriate for the active ingredient used and in accordance with approved SOPs, and maintain equipment to avoid leaks.</li> <li>• Maintain application equipment</li> <li>• No application of insecticides within 30 yards of beekeeping sites</li> </ul>			

List each Mitigation Measure from column 3 in the EMMP (EMMT Part 2 of 3)	Status of Mitigation Measures	List any outstanding issues relating to required conditions	Remarks
<ul style="list-style-type: none"> <li>• Handling, treatment, and disposal of nonhazardous (general waste) and hazardous wastes must be in accordance with the approved WMP/SOPs and the PMI BMPs. The WMP, which outlines SOPs for managing waste processes, must be in accordance with PMI best practices and host country requirements</li> <li>• Choose sites for disposal of liquid wastes, including fixed and mobile soak pit sites according to PMI BMPs</li> <li>• Construct fixed and mobile soak pits with charcoal according to the BMPs to adsorb insecticide from rinse water</li> <li>• Maintain soak pits as necessary during season</li> <li>• Monitor waste storage and management during campaign</li> <li>• Monitor disposal procedures post-campaign</li> </ul>			
<ul style="list-style-type: none"> <li>• Wastes will only be disposed in incinerators that comply with PMI BMPs Collect and maintain treatment and disposal documents and records on file</li> <li>• Country-level USAID EC documentation must contain guidance on proper disposal of wastes</li> <li>• The IP will identify the location and the type of incinerator(s) or other disposal technology and include the location and incinerator specs in the annual Environmental Mitigation and Monitoring Report.</li> </ul>			

List each Mitigation Measure from column 3 in the EMMP (EMMT Part 2 of 3)	Status of Mitigation Measures	List any outstanding issues relating to required conditions	Remarks
<b>7b. Testing of ITNs</b> <ul style="list-style-type: none"> <li>• Store nets only in storerooms secured with sturdy doors, locks, and barred windows.</li> </ul>			
<b>7c. Distribution of ITNs</b> <ul style="list-style-type: none"> <li>• Where there is evidence of misuse for fishing, assess the extent of misuse and collaborate across sectors (Ministries of Health, Environment, and Agriculture) to develop a sustainable, locally relevant solution</li> </ul>			
<ul style="list-style-type: none"> <li>• Store LLINs in dry, ventilated facilities</li> </ul>			
<ul style="list-style-type: none"> <li>• Store in a secure facility to prevent theft or unauthorized access. Post guard or use barred windows as needed</li> </ul>			
<ul style="list-style-type: none"> <li>• Do not store LLINs with food, feed, or potable water supplies</li> </ul>			
<ul style="list-style-type: none"> <li>• Provide worker training on the proper handling of LLINs</li> </ul>			
<ul style="list-style-type: none"> <li>• Ensure that SBCC materials and outreach activities are coordinated with ITN distribution activities during campaigns, and include guidelines on how to properly wash and maintain LLINs (e.g., discourage disposal of wash water in sensitive ecosystems, discourage washing and rinsing LLINs in water bodies)</li> </ul>			
<ul style="list-style-type: none"> <li>• Ensure that SBCC messages inform campaign distributors and local communities about the potential harm to human health and environment if bags and baling materials are reused; support the development of a communication plan that provides messages on best practices for handling and disposing of bags and baling materials.</li> </ul>			

# ANNEX C:

## PUBLIC CONSULTATION & PREPARATION METHODOLOGY

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This SEA was prepared by the PMI VectorLink Regional Environmental Compliance Manager, Sana Diop Dieng, under the supervision of Peter Chandonait, PMI VectorLink Director of Environmental Compliance and Safety. A short-term technical assistance trip was made to Côte d'Ivoire, in order to meet with major stakeholders and gather the information necessary for the SEA preparation. During the first week, the RECM met with the USAID Mission in Côte d'Ivoire to discuss the purpose of the visit and to receive any relevant guidance with regard to the SEA.

She also visited the relevant government partners including the NMCP, the National Agency of Environment (Agence National de l'Environnement) and the Directorate of Plant Protection (Direction de la Protection des Végétaux CQ) to receive their input and feedback about their recent experience with our IRS program, as well as to gather any information about stakeholders' impressions and acceptance of IRS.

The trip was also the occasion to work with the VectorLink Côte d'Ivoire newly posted in their role on Environmental Assessment, the supervision through mobile phones and other environmental compliance topics. In the field, the RECM made a visit to Sakassou and Nassian in order to meet with relevant stakeholders, to do the initial PSECA and to construct a soak pit with the team. Field visits consisted of meeting with districts' and health centers' officials, Regional directorate of Environment and other administrative responsible.

Additional visits for the week included prospection of a central store in Abidjan and Sakassou, and visits to the incineration company for contaminated wastes.

The RECM trained the VectorLink team on the use of VectorLink EC tools in the field on use of supervisory tools like Pre Season Environmental Compliance Assessment (PSECA) and rehabilitation plan, wash area and soak pit construction, logistical need assessments and classroom topics included EC quantification, mHealth usage, side effect management, Pre contract vehicle inspection.

The RECM had briefing and debriefing meetings with local PMI/USAID and NMCP. During those meeting objectives of the STTA and activities done were presented for observations/recommendations to complete the trip and documents and mainly to discuss on challenges uncured by the project.

The table in Annex D comprises the names of the people who were interviewed during the preparation of the SEA.

# ANNEX D: NAMES OF PARTICIPANTS

## NAMES AND POSITIONS OF THE STAKEHOLDERS INTERVIEWED

<b>STRUCTURE</b>	<b>NOM &amp;PRENOMS</b>
PNLP	Dr Dougoune Bi M.
	Dr Kokraset
	Dr Bleu
	Koffi Amani
	Dr Djro
	Dr Djidjoho
	Dr MIYIGBENA P.
PMI/vectorlink	Dr ZINZINDOHOUE Pascal
	Dr KOUADION Blaise
	Dr MAKENZI
RMG	Mr. Ebrotie
Alm AO	Mr. Kouassi Laurent
	Mme Bery
DPVCQ	Mr Fataye
	Mr. BONI
	Mme Coulibali
ANDE	Mr KOUASSI
Coordination des Programmes et projets du ministere de l'Environnement	Dr Say
	Mme VI Amenan
	Mr Zadi

<b>STRUCTURE</b>	<b>NOM &amp;PRENOMS</b>
SAKASSOU	Dr BROU (DDS)
	Mr ANIAN
	Mr. COULIBALI Torna B.
	Mr. Tembely YAYE
	Mr. KOUAKOU Koffi Maurice
	Attebi Boga R.
	Agbo Niamba Aime
	OSSOHOU N'KPOME Patrice
	LOGAHGON F.
	Boaffo Kanga Amon
	Kouassi Angbonan
Direction Regionale du Ministere de l'Environnement de Bouake	Djeha K. Augustin
Nassian	Dr BROUA (DDS)
	Mr. SILUE ( SG Prefecture)
	Dr GNAHORE

# ANNEX E:

## SUMMARY OF ACUTE EXPOSURE SYMPTOMS & TREATMENT OF IRS PESTICIDES

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### Summary of Acute Exposure Symptoms and Treatment of WHO-Recommended Carbamate

Carbamates	Human Side Effects	Treatment
Bendiocarb	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.	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.
Propoxur	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.	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.

## Summary of Acute Exposure Symptoms and Treatment of WHO-Recommended Organophosphates

Organophosphate	Human Side Effects	Treatment
Malathion	<p>Malathion is an indirect cholinesterase inhibitor. The primary target of malathion is the nervous system; it causes neurological effects by inhibiting cholinesterase.</p> <p>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.</p>	<p>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 solution 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).</p> <p>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, tranquilizers, and central nervous system stimulants are all contraindicated.</p>
Fenitrothion	<p>Fenitrothion is the most toxic to humans of the insecticides recommended for residual house spraying, and has a relatively low margin of safety.</p> <p>It is absorbed through the gastrointestinal tract as well as through intact skin and by inhalation and a cholinesterase inhibitor.</p>	<p>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.</p> <p>Contact lenses should be removed if possible and medical attention should be sought.</p> <p>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.</p>
Pirimiphos-methyl	<p>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.</p>	<p>Organophosphate poisoning is a medical emergency and requires immediate treatment. All supervisors and individual spray operators (in the case of dispersed operations) should be trained in first-aid and emergency treatment of organophosphate intoxication.</p> <p>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.</p> <p>Atropine sulfate: Administer atropine sulfate intravenously, or intramuscularly if intravenous injection is not possible.</p> <p>Glycopyrolate has been studied as an alternative to atropine and found to have similar outcomes using continuous infusion.</p>

### Summary of Acute Exposure Symptoms and Treatment of WHO-Recommended Pyrethroids

Pyrethroids	Human Side Effects	Treatment
Bifenthrin	<p>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.</p> <p>No skin inflammation or irritation observed; however, can cause a reversible tingling sensation.</p> <p>Incoordination, irritability to sound and touch, tremors, salivation, diarrhea, and vomiting have been caused by high doses.</p>	<p>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.</p> <p>Medical attention should be sought if irritation or paresthesia occurs. Eye exposures should be treated by rinsing with copious amounts of water or saline.</p>
Deltamethrin	<p>Deltamethrin is a powerful broad-spectrum synthetic pyrethroid. It is of moderate toxicity to mammals as it is rapidly metabolized and does not accumulate. It poses low risk to humans when used at levels recommended for its designed purpose. Deltamethrin exhibits its toxic effects by affecting the way the nerves and brain normally function by interfering with the sodium channels of nerve cells.</p> <p>Typical symptoms of acute exposure are irritation of skin and eyes and neurological effects such as severe headaches, dizziness, nausea, anorexia, vomiting, diarrhea, excessive salivation, fatigue, irritability, abnormal sensations of the face and skin, and numbness. Tremors and convulsions have been reported in severe poisonings. Inhaled deltamethrin has been shown to cause reversible cutaneous paresthesia (a burning, tingling, or stinging of the skin). Limited data exist for humans following chronic exposures. However, the following effects are suspected to be a result of chronic exposures in</p>	<p>If exposed immediately remove any contaminated clothing. Soak any liquid contaminant on the skin; clean affected area with soap and warm water.</p> <p>Rinse copiously with water when eye exposures occur, or with 4% sodium bicarbonate.</p> <p>Vomiting should not be induced following ingestion exposures, but the mouth should be rinsed.</p>

Pyrethroids	Human Side Effects	Treatment
	<p>humans: choreoathetosis, hypotension, prenatal damage, and shock. Chronic occupational exposure to deltamethrin causes skin and eye irritation. IARC has classified deltamethrin as “not classifiable as to its carcinogenicity in humans.”</p>	
<p>Lambda-cyhalothrin</p>	<p>Skin exposure leads to transient skin sensations such as periorbital facial tingling and burning.</p> <p>Can irritate the eyes, skin, and upper respiratory tract. Oral exposure can cause neurological effects, including tremors and convulsions.</p> <p>Ingestion of liquid formulations may result in aspiration of the solvent into the lungs, resulting in chemical pneumonitis.</p>	<p>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.</p>
<p>Alpha-cypermethrin</p>	<p>Acute exposure symptoms include skin rashes, eye irritation, itching and burning sensation on exposed skin, and paresthesia.</p> <p>Acute inhalation exposures may cause upper and lower respiratory tract irritation. Ingestion of alpha-cypermethrin is also harmful.</p>	<p>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.</p>
<p>Cyfluthrin</p>	<p>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 twitching, convulsions, and coma.</p>	<p>If exposed, immediately remove any contaminated clothing. Soak any liquid contaminant on the skin; clean affected area with soap and warm water.</p> <p>Rinse copiously with water when eye exposures occur, or with 4% sodium bicarbonate. Vomiting should not be induced following ingestion exposures, but the mouth should be rinsed.</p>

<b>Pyrethroids</b>	<b>Human Side Effects</b>	<b>Treatment</b>
Etofenprox	<p>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 twitching, convulsions, and coma may occur.</p>	<p>If exposed, immediately remove any contaminated clothing. Soak any liquid contaminant on the skin; clean affected area with soap and warm water.</p> <p>Rinse copiously with water when eye exposures occur, or with 4% sodium bicarbonate. Vomiting should not be induced following ingestion exposures, but the mouth should be rinsed.</p>

## Summary of Acute Exposure Symptoms and Treatment for Chlorfenapyr

Human side effects	Treatment
<p>As chlorfenapyr is a rather new product there are not many cases of poisonings where the symptoms were described. One patient first exhibited general fatigue, hyper-perspiration, nausea, and vomiting. He was initially diagnosed as being dehydrated.</p> <p>Another patient initially presented with hyper-perspiration, headache, and cough. Symptomatic management was initiated, but after seven days she suffered neurological and respiratory deterioration, causing her death.</p>	<p>Symptoms following exposure should be observed in a controlled setting until all signs and symptoms have been fully resolved. If the substance was ingested, control any seizures first. Chlorfenapyr can produce abnormalities of the hematopoietic system, liver, and kidneys. Do not use emetics.</p> <p>Monitoring complete blood count, urinalysis, and liver and kidney function tests is suggested for patients with significant exposure. If respiratory tract irritation or respiratory depression is evident from inhalation, monitor arterial blood gases, chest x-ray, and pulmonary function tests.</p> <p>Significant esophageal or gastro-intestinal tract irritation or burns may occur following ingestion. Consider gastric lavage after ingestion of a potentially life-threatening amount of poison if it can be performed soon after ingestion (generally within 1 hour). Protect airway by placement in Trendelenburg and left lateral decubitus position or by endotracheal intubation.</p> <p>Activated charcoal binds most toxic agents and can decrease their systemic absorption if administered soon after ingestion. Immediate dilution with milk or water may be of benefit in caustic or irritant chemical ingestions. Rinse mouth and administer 5 ml/kg up to 200 ml of water for dilution if the patient can swallow, has a strong gag reflex, and does not drool.</p> <p>Observe patients with ingestion carefully for the possible development of esophageal or gastrointestinal tract irritation or burns. If signs or symptoms of esophageal irritation or burns are present, consider endoscopy to determine the extent of injury.</p> <p>Carefully observe patients with inhalation exposure for the development of any systemic signs or symptoms, and administer symptomatic treatment as necessary. If exposure is to the eyes, immediately irrigate exposed eyes with copious amounts of room temperature water (better with 0.9% saline solution) for at least 15 minutes. If irritation, pain, swelling, lacrimation, or photophobia persist, the patient should be seen in a health care facility.</p> <p>For dermal exposure, remove contaminated clothing and wash exposed area thoroughly with soap and water. A physician may need to examine the area if irritation or pain persists.</p>

## Summary of Acute Exposure Symptoms of Exposure to and Treatment of Clothianidin

Human Side Effects	Treatment
<p>Clothianidin is a systemic insecticide belonging to the nitroguanidine subgroup of nicotinoid insecticides. It is also referred to as a chloronicotinyl or neonicotinoid.<sup>i</sup> Clothianidin and other neonicotinoids act on the central nervous system of insects as an agonist of acetylcholine, the neurotransmitter that stimulates nAChR, targeting the same receptor site (AChR) and activating post-synaptic acetylcholine receptors but not inhibiting AChE. The acute health risks to humans from exposure to clothianidin are minimal due to its low mammalian toxicity. Extrapolation from test results on animals to humans suggests that clothianidin is moderately toxic through oral exposure, but toxicity is low through skin contact or inhalation. Mild to moderate poisoning can cause nausea, vomiting, diarrhea, abdominal pain, dizziness, headache, and mild sedation. While clothianidin may cause slight eye irritation, it is not expected to be a skin sensitizer or irritant.</p> <p>Large deliberate ingestions have caused agitation, seizures, metabolic acidosis, coma, hypothermia, pneumonitis, respiratory failure, hypotension, ventricular dysrhythmias, and death.</p> <p>Rare caustic injury to the esophagus has been reported. This is likely due to the solvent component (N-methyl-2-pyrrolidone) of the insecticide, as opposed to the neonicotinoid itself. Clothianidin does not damage genetic material, nor is there evidence that it causes cancer in rats or mice; it is unlikely to be a human carcinogen. Submitted data also indicate that no significant adverse environmental impacts are expected to occur from the use of clothianidin.</p>	<p><b>MANAGEMENT OF MILD TO MODERATE TOXICITY</b></p> <p>Treatment is symptomatic and supportive. Administer IV fluids for hypotension.</p> <p><b>MANAGEMENT OF SEVERE TOXICITY</b></p> <p>Treatment is symptomatic and supportive. Treat hypotension with IV fluids; add vasopressors if hypotension persists. Treat dysrhythmias per ACLS guidelines. Consult a gastroenterologist for patients with pain on swallowing; drooling; or other evidence of caustic injury to evaluate for esophageal damage. Atropine should be considered if a patient is bradycardic, or experiencing cholinergic symptoms because these insecticides are frequently mixed with organophosphate and carbamate pesticides.</p>

## Summary of Acute Exposure Symptoms and Treatment of WHO-recommended Clothianidin/deltamethrin Combination

Clothianidin/Deltamethrin combination	
Human side effects	Treatment
<p>Local:, Skin and eye paresthesia which may be severe, Usually transient with resolution within 24 hours, Skin, eye and mucous membrane irritation, Cough, Sneezing</p> <p>Systemic:, discomfort in the chest, Tachycardia, Hypotension, Nausea, Abdominal pain, Diarrhea, Vomiting, Blurred vision, Headache, anorexia, Somnolence, Coma, Convulsions, Tremors, Prostration, Airway hyper reaction, Pulmonary edema, Palpitation, Muscular fasciculation, Apathy, Dizziness</p>	<p><b>Systemic treatment:</b> Initial treatment: symptomatic. Monitor: respiratory and cardiac functions. In case of ingestion gastric lavage should be considered in cases of significant ingestions only within the first 2 hours. However, the application of activated charcoal and sodium sulfate is always advisable. Keep respiratory tract clear. Oxygen or artificial respiration if needed. In case of convulsions, a benzodiazepine (e.g. diazepam) should be given according to standard regimens. If not effective, phenobarbital may be used. <b>Contraindication:</b> atropine.</p> <p><b>Contraindication:</b> derivatives of adrenaline. There is no specific antidote. Recovery is spontaneous and without sequelae.</p> <p>In case of skin irritation, application of oils or lotions containing vitamin E may be considered.</p>
Environmental Impacts	
<p>In terrestrial environments, deltamethrin is not expected to be mobile, because it binds tightly to soil particles. It is insoluble in water, and recommended application rates are low.</p> <p>Volatilization from moist soils and biodegradation are major fate processes. However, volatilization is lessened by deltamethrin's tendency to adsorb to soil particles. As with other synthetic pyrethroids, deltamethrin degrades rapidly in soil and plants. It does not bioaccumulate in terrestrial systems. Very little leaching to groundwater is expected, because deltamethrin binds tightly to soil and is practically insoluble in water. Volatilization is a major environmental fate process in surface waters, but is lessened by soil adsorption. Deltamethrin breaks down quickly in water, with reported half-lives of 2–4 hours. It has a high potential to bioconcentrate in aquatic organisms.</p>	

# ANNEX F: CÔTE D'IVOIRE CRM

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## BUREAU FOR GLOBAL HEALTH CLIMATE RISK MANAGEMENT SCREENING TEMPLATE The PMI VectorLink Project

### 1. Program/Activity Data

Program/Activity Number	AID-OAA-TO-17-00027
Program/Activity Title	The President's Malaria Initiative (PMI) VectorLink Project
Country/Region	World Wide
USG Foreign Assistance Framework	PMI 2015-2020 Malaria Strategy
Period Covered	Sept 2017 – Sept 2022
Life of Project Amount	\$472 million
Screening prepared By	Allison Belemvire, Malaria Technical Advisor
Management Unit Contact Person	Kristen George, COR
Current Date	January 30, 2020

## 2. Climate Risk Ratings

This document serves to document the results of the Climate Resiliency Screening conducted to evaluate the potential climate risks of the described activities. In accordance with the [Mandatory Reference for ADS Chapter 201 on Climate Change in USAID Strategies](#), USAID must conduct climate risk management screening for all new projects, and activities, as of October 1<sup>st</sup>, 2016.<sup>24</sup>

### *Background*

The President's Malaria Initiative (PMI) VectorLink Project is a five year task order awarded to Abt Associates on September 29, 2017. The purpose of the PMI VectorLink Project is to support PMI in planning and implementing indoor residual spraying (IRS) programs and other proven, life-saving, malaria vector control interventions with the overall goal of reducing the burden of malaria in Africa. The four objectives are as follows: 1) Direct implementation of and/or technical assistance for implementation of IRS and other malaria vector control interventions, 2) Supporting entomological and epidemiological monitoring for strategic decision-making, 3) Procurement of insecticides for IRS and support for the delivery and storage of vector control commodities, and 4) Support for innovation in malaria vector control interventions. The PMI VectorLink project is a follow-on to the PMI AIRS project, and thus, the approved CRM for that project was used as the basis for this document. In addition, the USAID Climate Risk Screening and Management Tools were consulted to assess the project and determine the appropriate risks and best approaches to mitigate those risks. This CRM screening was completed by the COR and project management team responsible for overseeing the PMI VectorLink Project.

For 2020, PMI VectorLink Côte d'Ivoire will conduct IRS in two districts, Sakassou and Nassian, in April and June, respectively and will provide capacity-building support to the national and district governments to plan and implement quality IRS in the future alongside with the continuous entomological monitoring.

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<sup>24</sup> Climate Risk Ratings are defined as:

- Low climate risk: Climate change is unlikely to significantly impact achievement of development outcomes relative to other stressors and development challenges.
- Moderate or high climate risk: Climate change is likely or highly likely to significantly impact achievement of development outcomes.

**CLIMATE RISK MANAGEMENT SUMMARY TABLE**  
**The PMI VectorLink Côte d'Ivoire Project**

<b>Project Elements</b>	<b>Potential Climate Risk</b>	<b>Climate Risk Rating<sup>25</sup></b>	<b>How Risks are Addressed at the Project Level</b>	<b>Further Analysis or Actions for Activity Design or Implementation</b>	<b>Opportunities to Strengthen Climate Resilience</b>
Indoor residual spraying activities to reduce the morbidity and mortality of malaria	Long-term weather pattern changes can affect vector distribution and affected populations, thus requiring careful analysis and potential shifts in where IRS operations are targeted.	Moderate risk	Monitor vector distribution and malaria outbreaks. Refocus activities based on ento/epi data to ensure appropriate targeting of IRS.	N/A	Expand the collection of context indicators to include climate related data to better connect changes in vector populations with climate variability where feasible.
	Lack of water for mixing insecticide and end of day clean up, due to shifting precipitation patterns.	Moderate risk	Ensure alternative water supplies are available (i.e. budget for water storage tanks, transportation, etc.).	N/A	N/A

<sup>25</sup> Climate Risk Ratings are defined as:

- Low climate risk: Climate change is unlikely to significantly impact achievement of development outcomes relative to other stressors and development challenges.
- Moderate or high climate risk: Climate change is likely or highly likely to significantly impact achievement of development outcomes

Project Elements	Potential Climate Risk	Climate Risk Rating <sup>25</sup>	How Risks are Addressed at the Project Level	Further Analysis or Actions for Activity Design or Implementation	Opportunities to Strengthen Climate Resilience
	Inaccessibility of sites (i.e. roads/bridges wash away) and unavailability of households (i.e. farming fields), due to unpredictable, earlier start of the rainy season start	Moderate risk	Monitor weather patterns. Ensure adaptability of spray calendar (i.e. half day sprays, budget for mop-up days, etc.). Consider alternative transportation (i.e. horse carts, boats).	N/A	N/A
	Severe weather (i.e. drought, floods) impact electricity, cell networks and internet in offices and field sites.	Moderate risk	Ensure alternative energy sources (i.e. generators and solar panels) and maintain an alternate communication plan in case of emergency.	N/A	Explore utilization of solar panels as an energy source which would help to reduce emissions.
	Increased temperatures can impact spray teams' ability to deliver IRS (i.e. heat exhaustion)	Moderate risk	Ensure daily health monitoring checklists are implemented and seasonal workers are aware of signs and risks of heat exhaustion. Further update BMPs to allow for intake of nourishment. Ensure IRS operations occur in the morning through mid-day to avoid increased temperatures to the greatest extent possible.	N/A	

Project Elements	Potential Climate Risk	Climate Risk Rating <sup>25</sup>	How Risks are Addressed at the Project Level	Further Analysis or Actions for Activity Design or Implementation	Opportunities to Strengthen Climate Resilience
Entomological monitoring to monitor malaria activities	Inaccessibility to access ento sentinel sites (i.e. roads/bridges wash away), due to unpredictable weather patterns	Moderate risk	Monitor weather patterns. Consider alternative transportation (i.e. horse carts, boats).	N/A	
	Unavailability of wild caught mosquitoes/larvae due to unpredictable rains (i.e. drought, or flooding of breeding sites) inhibiting the ability to collect necessary quantities of field mosquitoes for entomological testing	Moderate risk	Consider feasibility of using Kisumu strain, laboratory reared mosquitoes.	N/A	
	Severe weather (i.e. drought, floods) impact electricity, cell networks and internet in offices and field sites.	Moderate risk	Ensure alternative energy sources (i.e. generators and solar panels) and maintain an alternate communication plan in case of emergency.	N/A	Explore utilization of solar panels as an energy source which would help to reduce emissions.

Project Elements	Potential Climate Risk	Climate Risk Rating <sup>25</sup>	How Risks are Addressed at the Project Level	Further Analysis or Actions for Activity Design or Implementation	Opportunities to Strengthen Climate Resilience
Long lasting insecticide treated bednet distribution and monitoring to reduce the malaria burden	Long-term weather pattern changes can affect vector distribution and affected populations.	Moderate risk	Monitor vector distribution and malaria outbreaks. Refocus activities based on ento/epi data to ensure appropriate targeting of bednets.	N/A	
	Increased temperatures can decrease bednet usage	High risk	Monitor bednet usage and reinforce social behavioral change communication messages.	N/A	
	Inaccessibility of distribution sites (i.e. roads/bridges wash away) due to unpredictable or severe weather	Moderate risk	Monitor weather patterns. Consider alternative transportation and distribution plans.	N/A	

NOTE: Low climate risk does not require the development of specific plans to address climate risk. However, moderate to high climate risk requires appropriate consideration and response to the potential risk. In some cases, the program may decide to accept the risk and will document the justification.

# ANNEX G: REFERENCES

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