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SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT

FOR NATIONWIDE IRS IN TANZANIA 2020 – 2025

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SEA FOR NATIONWIDE IRS IN TANZANIA USING PYRETHROID, CARBAMATE, ORGANOPHOSPHATE, CLOTHIANIDIN, CLOTHIANIDIN/DELTAMETHRIN COMBINATION AND CHLORFENAPYR (WHEN WHO PQ LISTED) 2020 – 2025

ENVIRONMENTAL ASSESSMENT

PROJECT/ACTIVITY DATA

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ORGANIZATIONAL/ADMINISTRATIVE DATA

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Prepared by:	Joshua Mutagahywa, Peter Chandonait
Date Prepared:	August 14, 2020
Date of signed	

ENVIRONMENTAL COMPLIANCE REVIEW DATA

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Environmental Assessment Expiration Date:	5 years from approval date
Climate Risks Addressed (#):	Low ____ Moderate __X____ High ___X___

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ACRONYMS

BMP	Best Management Practices
CDC	Centers for Disease Control and Prevention (U.S.)
CFR	Code of Federal Regulations (U.S.)
COR	Contracting Officer's Representative
EC	Environmental Compliance
EMMP	Environmental Mitigation and Monitoring Plan
MOH	Ministry of Health, Community Development, Gender, Elderly and Children
IEC	Information, Education, and Communication
IP	Implementing Partner
IRS	Indoor Residual Spraying
ITN	Insecticide-treated Net
IVM	Integrated Vector Management
M&E	Monitoring and Evaluation
MSP	mobile soak pit
NMCP	National Malaria Control Program
NSP	National Strategic Plan for Malaria
PEA	Programmatic Environmental Assessment
PMI	U.S. President's Malaria Initiative
PPE	personal protective equipment
PSECA	Pre-Spray Environmental Compliance Assessment
RMO	Regional Medical Officer
SBCC	Social and behavior change communication
SEA	Supplemental Environmental Assessment
SOP	Spray Operator
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
WHO/PQ	World Health Organization Prequalification List

SUMMARY FOR EVALUATION

PURPOSE AND SCOPE OF THE ENVIRONMENTAL ASSESSMENT

The purpose of the Environmental Assessment is to provide Agency and host country decision-makers with a full discussion of significant environmental effects of a proposed action. It includes alternatives which would avoid or minimize adverse effects or enhance the quality of the environment so that the expected benefits of development objectives can be weighed against any adverse impacts upon the human environment or any irreversible or irretrievable commitment of resources.

The U.S. President's Malaria Initiative (PMI) is engaged in indoor residual spraying (IRS) of insecticide to kill the mosquitoes that transmit malaria. The use of insecticides in this manner has resulted in a Positive Determination from the Initial Environmental Examination. A Programmatic Environmental Assessment (PEA) has been completed and updated, most recently in 2017. The PEA mandates the preparation of a Supplemental Environmental Assessment (SEA) for each country in which PMI engages in IRS, and an update of the SEA every five years. This document represents the fulfillment of that requirement for Tanzania.

1. The Tanzania Supplemental Environmental Assessment (SEA), as amended in 2017 (Amendment #1) was valid for implementing USAID-supported IRS in all areas of Tanzania for the period 2015-2020.
2. In order to continue with PMI IRS, PMI is seeking approval for a new SEA effective for five years (2020-2024), and for the SEA to be nationwide in scope.
3. This SEA will authorize the continued use of all World Health Organization-Pre-Qualification (WHO PQ)-recommended pesticides in the pyrethroid, carbamate, organophosphate, clothianidin/deltamethrin and neonicotinoid classes, and also authorizes the use of chlorfenapyr when recommended by WHO PQ.
4. The Government of Tanzania has been working towards expanding its protected area network. Some protected areas include villages and shehias that have been or are now targeted for IRS. In general, and nearly exclusively, these communities are in buffer zones of the protected areas, and IRS is permitted in the buffer zones. However, this SEA contains the condition that spraying will not be performed by PMI Implementing Partners (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.
5. 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.
6. The Safer Use Action Plan 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.
7. 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 year's spray campaign.

BUREAU ENVIRONMENTAL OFFICERS FINDINGS AND SPECIFIED CONDITIONS OF APPROVAL

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 Tanzania 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 Tanzania's and PMI's goal of reducing malaria incidence in country while minimizing negative impact to the environment and to human health.

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

1. The continuation of IRS implementation using pyrethroids, carbamates, organophosphates, neonicotinoids and the clothianidin/deltamethrin combination, and/or chlorfenapyr (when PQ-listed), where appropriate, based on criteria such as transmission season, vector susceptibility, residual effect, appropriate home and wall structure, economic factors, and ecological/human health impacts.
2. This SEA will continue coverage of all geographical areas in Tanzania 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 2021 – 2025.
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. This SEA also authorizes small-scale construction of facilities such as storerooms, insectaries, wash areas, and soak pits, needed to perform IRS in a safe and effective manner.
5. Given the successful record of PMI in implementing IRS in Africa without significant environmental consequences, it is proposed to continue 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[1], and observing all precautions and prescriptions in this SEA.

The Safer Use Action Plan (Section 7) and the updated Environmental Mitigation and Monitoring Plan for Tanzania (Annex A) provides 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.

[1] Chandonait, Peter. February 2020. *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

USAID APPROVAL OF ENVIRONMENTAL ASSESSMENT

PROJECT/ACTIVITY NAME: PMI VectorLink Project/Tanzania

Approval:

Andrew Karas, Mission Director, USAID/Tanzania	Date

Clearance:

Naomi Serbantez, USAID/Tanzania	Date

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Kristen George, USAID/PMI	Date

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Concurrence:

Dennis Durbin, GH Bureau Environmental Officer and Climate Integration Lead	Date

DISTRIBUTION:

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ENVIRONMENTAL ASSESSMENT

1.0 SUMMARY

This document has been prepared to serve as a Supplemental Environmental Assessment (SEA) for Indoor Residual Spraying (IRS) in Tanzania supported by the U.S. President's Malaria Initiative (PMI) for the period 2020-2024. This update 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[2] supported by PMI. Previous United States Agency for International Development (USAID) environmental documentation for IRS in Tanzania authorized the use of WHO PQ-recommended pesticides in the pyrethroid, carbamate and organophosphate classes nationwide from 2015 to 2020.[3] In addition, a SEA Amendment was written and approved in July 2017 that authorized the use of clothianidin, a neonicotinoid. This SEA proposes to reauthorize the use of the same four classes of insecticides, including the use of clothianidin/ deltamethrin mixture and chlorfenapyr in the pyrrole class, when listed by WHO PQ. Additionally, the SEA seeks continuation of 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 Tanzania. Although dramatic progress in malaria control has been made in recent years with the scale-up of malaria prevention and treatment interventions, nearly all 59 million (93%) residents are still at risk of infection. With 2020 funding, PMI will continue to support IRS in up to 5 high-burden Regions located in the Lake Victoria zone and selected Districts of Zanzibar where targeted IRS is being implemented. While the estimated number of structures will remain consistent (approximately 513,777), the selection of the targeted districts may change, prioritizing the highest burden areas.

Changing or rotating insecticides of different classes over time is a leading way to manage vector resistance. Susceptibility status in Tanzania have been collected from 20 sentinel sites out of 22 (90.9%) surveyed. The collected data indicates that 50% of the sites, *Anopheles gambiae* s.l. were resistant to permethrin (i.e. <90% mortality rate). Thirty percent (30%) of sentinel districts were found to have *Anopheles gambiae* s.l. populations suspected to be resistant to permethrin (mortality rate of 90% - 97%). Likewise, deltamethrin resistant mosquito populations were present in 60% of the sites.

Suspected resistance to deltamethrin was only observed in Nyasa district. Unlike permethrin and deltamethrin insecticides, malaria vectors were fully susceptible (mortality rate of >98%) to

[2]Pre- Qualified list-Vector Control Products https://www.who.int/pq-vector-control/prequalified-lists/en/

[3] Chandonait, P.J., Tanzania Supplemental Environmental Assessment: Amendment 1, September 2017. Bethesda, MD. The PMI AIRS Project, Abt Associates Inc. https://www.pmi.gov/docs/default-source/default-document-library/implementing-partner-reports/tanzania-irs-supplemental-environmental-assessment-2015-2020.pdf?sfvrsn=7, 5/21/2020

bendiocarb and pirimiphos-methyl in all sites, except Manyoni where mosquitoes exhibited resistance to pirimiphos-methyl exposure. Likewise, reduced susceptibility (suspected resistance) to pirimiphos-methyl was observed (mortality rate of 95%) in Musoma rural.[4] Prior to procurement of insecticides for IRS, resistance data are reviewed to reflect susceptibility in the IRS target areas. The evidence on susceptibility coupled with national insecticide resistance mitigation plan provide the evidence for the choice of insecticide type to be applied for a particular round of IRS.

The 2017 amendment to include new insecticides was prompted by the need to increase the available options for IRS. Clothianidin, a neonicotinoid, was listed by the WHO PQ in 2017, and a combination clothianidin/deltamethrin product, Fludora Fusion was listed in 2018. Chlorfenapyr, a member of the pyrrole chemical class, if listed by WHO PQ and authorized by the Ministry of Agriculture through TPRI for use in Tanzania, will offer additional options for insecticide rotation. In 2020/21, Tanzania will conduct IRS with Actellic® 300 CS (containing pirimiphos-methyl, an organophosphate) in one district of Bukombe covering approximately 30,000 structures, and SumiShield® 50WG (containing clothianidin) will be used in three districts of Kasulu, Kibondo and Kakonko. Fludora® Fusion (clothianidin/deltamethrin combination) will be used for the first time in the districts of Biharamulo and Ukerewe. Figure 2 of Section 9.2 depicts the PMI VectorLink Tanzania Project districts in the 2020 IRS campaign.

This SEA for IRS in Tanzania outlines the monitoring and mitigation measures that the PMI IP will use to minimize or reduce any adverse impacts of pesticide application. Those measures are found in the Safer Use Action Plan (Section 7), and summarized in the Environmental Mitigation and Monitoring Plan (EMMP), found in Annex A. All PMI IRS operations in Tanzania 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. Deltamethrin, found in Fludora Fusion, is a skin irritant, 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.

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:

[4] The President's Malaria Initiative (PMI)/Africa Indoor Residual Spraying Project. December 2017. Mainland Tanzania Insecticide Resistance Monitoring, 2017. Bethesda, MD. PMI Africa IRS (AIRS) Project Indoor Residual Spraying (IRS 2) Task Order Six, Abt Associates Inc. https://www.pmi.gov/docs/default-source/default-document-library/implementing-partner-reports/tanzania-2017-mainland-insecticide-resistance-monitoring-final-report.pdf ,5/21/2020

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 use. The risk of exposure due to insecticide residue in the container is essentially eliminated; however, the following procedures are also followed.

b. Returned containers are punctured by storekeepers daily multiple times so no one can reuse them.

c. Recycling programs have been established to turn the plastic into usable non-food containers. Through close supervision and chain of custody, and in partnership with the Tanzania NMCP and the National Environmental Management Council (NEMC) and Zanzibar Environmental Management Authority (ZEMA), the IP will ensure that the plastic remains segregated from other supplies, is used for items such as oil tanks, patio flagstones or electrical conduits, and will not be used for products that contain consumables. One month post IRS stock taking, all plastic wastes will have been issued to shortlisted vendors for plastic handling and recycling. 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 (Annex A), with guidance from PMI, NEMC, ZEMA ZAMEP 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.

1.1 PROJECT DESCRIPTION

The focus of this global project is to reduce the morbidity and mortality of malaria and other vector borne diseases, by implementing IRS and integrated vector control activities. The expected duration of the project is August 2017 – August 2022 and the approximate project funding amount is $471 million.

The U.S. President's Malaria Initiative (PMI) VectorLink Project was awarded to Abt Associates on September 30, 2017. The purpose of the 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 project continued to work in 24 PMI countries, including Tanzania, plus one USAID malaria-focus country for a total of 25 countries. In addition to the IRS-centric nature of this project, additional activities included expanded entomological monitoring, continued technical support to insecticide-treated net (ITN) campaigns and durability monitoring, pilot and scale-up of new IRS products, and visualizations using epidemiological, entomological, and coverage data to determine the best application of available vector control (VC) tools within each country context.

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 ensure that government, the private sector, and communities are able to sustain and lead future IRS and malaria control programs in their respective countries.

1.2 PROJECT CONTEXT

Global Burden of Malaria. Malaria is responsible for a tremendous health and economic burden in sub-Saharan Africa and Southeast Asia. Global annual cases stand at 214 million and deaths at an estimated 438,000.[5] of which 90% are in Africa and 85% are children under five. The economic burden of malaria is high, falling heavily on poor, rural populations. Malaria exacerbates the impacts of HIV/AIDs and interferes with educational attainment, and thus has effects lasting beyond the illness itself.

Malaria has been one of the major public health problems in Tanzania causing tremendous morbidity and mortality every year. The following table reflects the malaria statistics based on the Tanzania Malaria Operational Plan.

[5]World Health Organization Malaria Report 2015https://www.who.int/malaria/publications/world-malaria-report-2015/report/en/ ,5/21/20150

Table 1: Malaria Situation in Tanzania 2012 – 2017.[6]

Indicator	2012	2013	2014	2015	2016	2017
Total # Cases	370,132	4,175,982	7,899,934	8,275171	6,463,414	5,930,380
Total # Confirmed Cases	202,432	2,364,993	5,085,281	6,014,718	5,540,054	5,655,349
Total # Clinical Cases	167,700	1,810,989	2,814,653	2,260,453	923,340	295,922
Total # malaria deaths	7,812	8,526	5,368	6,311	5,143	4,422
Data Completeness (%)	20%	42%	76%	90%	94%	98%

Some available data indicates some achievements in malaria control in Tanzania, Results from 2017 Tanzania Malaria Indicator Survey (TMIS) revealed that 7.3% of children < 5 years, in Mainland Tanzania and Zanzibar had tested positive using MRDT. This was lower compared to 9% of 2015/16. Malaria prevalence varied among regions with 1% in the highlands, 15% in the Southern zone and 24% in the Lake zone.

In Zanzibar malaria burden has been reduced for consecutive years; 2015/16 TMIS indicated that malaria prevalence in Zanzibar was 0.0% using MRDT and 0.7% using microscope.[7]

USG Commitment to Malaria Vector Control. Malaria prevention and control is a major foreign assistance objective of the U.S. Government (USG). The President's Malaria Initiative (PMI), which was launched in June 2005, represented a major expansion of USG resources for malaria control. Based on the 2008 Lantos Hyde United States Leadership against HIV/AIDS, Tuberculosis, and Malaria Act, PMI's goal was broadened to achieve Africa-wide impact by halving the burden of malaria in 70 percent of at-risk populations in sub-Saharan Africa. Under the PMI Strategy for 2015-2020, the USG's goal is to work with PMI-supported countries and partners to further reduce malaria deaths and substantially decrease malaria morbidity, towards the long-term goal of elimination. Preventive methods (indoor residual spraying, long-lasting insecticide treated nets and larval source management) are three main interventions supported by PMI and are a critical component of PMI's strategy.

PMI's strategy fully aligns with the USG's vision of ending preventable child and maternal deaths and ending extreme poverty. PMI currently includes 25 focus countries in Africa and two focus countries and a regional program in the Greater Mekong Sub-region of Southeast Asia. PMI is an interagency initiative led by the U.S. Agency for International Development (USAID) and implemented together with the U.S. Centers for Disease Control and Prevention (CDC) of the U.S. Department of Health and Human Services (HHS)[8].

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[6]Tanzania Malaria Operational Plan FY2019

https://www.pmi.gov/docs/default-source/default-document-library/malaria-operational-plans/fy19/fy-2019-tanzania-malaria-op ,5/21/2020

[7]Tanzania Malaria Indicator Survey – 2017 https://dhsprogram.com/pubs/pdf/MIS31/MIS31.pdf, 5/21/2020

[8] www.pmi.gov

1.3 SUMMARY OF 22 CFR 216 REQUIREMENTS

Procurement or use of pesticides in USAID-funded activities is subject to USAID's pesticides procedures (22 CFR 216.3(b). In 2007 a PEA was developed for USAID-funded IRS "to serve as an umbrella evaluation of the environmental and human health issues related to malaria vector control and to assist with the preparation of country and activity specific SEA and PERSUAP for malaria vector control programs. (It) provides USAID project managers with the policy, procedural and technical guideline to choose appropriate interventions and insecticides and develop and implement mitigation and monitoring and evaluation activities." The PEA requires the preparation of a SEA for each country in which support will be provided for the use of IRS. This SEA represents fulfillment of that requirement in the PEA for Tanzania. The PEA was updated in 2012 and 2017.

Prior to the award of the VectorLink project, an IEE was written and approved in August 2016 which reflected the broader scope of vector control efforts, to include ITNs, larvicides, and personal repellents. The IEE was amended in 2019 to include small-scale construction.

The use of insecticides for IRS has resulted in a Positive Determination from the Initial Environmental Examination. US regulation 22 CFR 216.3(b) requires that when "a project includes assistance for procurement or use, or both, of pesticides, "that the Initial Environmental Examination or subsequent Environmental Assessment address the following 12 factors:

a. The EPA registration status of the requested pesticide

b. The basis for selection of the requested pesticide

c. The extent to which the proposed pesticide use is part of an IVM program

d. The proposed method or methods of application, including availability of appropriate application and safety equipment

e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use and measures available to minimize such hazards

f. The effectiveness of the requested pesticide for the proposed use

g. Compatibility of the proposed pesticide with target and non-target ecosystems

h. The conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils

i. The availability and effectiveness of other pesticides or nonchemical control methods

j. The requesting country's ability to regulate or control the distribution, storage, use and disposal of the requested pesticide

k. The provisions made for training of users and applicators

l. The provisions made for monitoring the use and effectiveness of the pesticide

This SEA addresses these twelve factors in the Pesticide Evaluation Report (Section 6).

1.4 MAJOR CONCLUSIONS OF SCOPING PROCESS

- IRS has been demonstrated to be a safe and effective malaria prevention method.
- The Ministry of Health, Community Development, Gender, Elderly and Children (MOHCDGEC) and in particular the National Malaria Control Programs, President's Office, Regional Administration and Local Government, regional and district health offices are

essential partners in the planning, execution, and performance of IRS.

- IRS can be performed safely if established mitigation measures are incorporated, and if there is a strict supervisory regime instituted.
- Local populations in general recognize the value of IRS, and are willing participants in the process.
- Sensitive activities and areas such as organic farming, endangered species habitat, bee-keeping and susceptible water resources must be identified and protected from potential negative impacts through the use of mitigation methods, strong supervisory oversight, and responsible waste management.

1.5 AREAS OF CONTROVERSY (IF ANY)

One area of limited controversy concerns IRS in areas where organic agriculture is practiced. Organic farmers are concerned that IRS insecticides could reach and contaminate their fields, invalidating their organic status and resulting in economic loss. To prevent this occurrence, the project has instituted a minimum buffer zone of 100 meters from organic fields, within which IRS will not be performed. This distance may increase in accordance with national or local legislation, but will not decrease.

Another frequently noted area of controversy is the mistaken belief on the part of beneficiaries that IRS attracts household pests, especially bedbugs. This belief is based on the increased appearance of the pests after IRS is performed, but it is more likely that IRS drives the pests out of their hiding places, according to several health officials interviewed.

1.6 ISSUES TO BE RESOLVED

Areas employing organic agriculture need to carefully investigated on a case by case basis, bringing in stakeholders and regulatory officials to discuss and decide where IRS is appropriate, what size of buffer zone is required, and what other mitigation measures might be required. Information, education, and communication programs that precede IRS must include information relating to household hygiene to avoid the appearance of bedbugs.

2.0 PURPOSE

The goal of the PMI project is to reduce the burden of malaria in project countries. The USAID Global Health Bureau has determined that the proposed IRS effort, as described in this SEA, responds to the needs of the community with respect to managing malaria in project countries, and also conforms to the requirements established in 22 CFR 216.

2.1 PROJECT DESCRIPTION

The VectorLink project organizes IRS campaigns, coordinating with national and sub-national MOH personnel to recruit, train, and supervise spray operators to apply long-lasting insecticides to the inner surfaces of homes in order to kill the mosquito vector that carries malaria. The project also carries out supportive activities such as entomological monitoring and consolidation of epidemiological, entomological and spray data to inform operations. The expected duration of the project is August 2017 – August 2022 and the approximate project funding amount is $471 million. This SEA is a critical element of a mandatory environmental review and compliance process meant to achieve environmentally sound activity design and implementation.

2.2 PURPOSE AND NEED FOR THE PROPOSED ACTION

The focus of this project is to reduce the morbidity and mortality of malaria and other vector borne diseases, by implementing IRS and integrated vector control activities (inclusive of ITNs), and larval source management. The need for the project is evident from the health data indicating malaria incidence and prevalence, and the negative consequences to health, well-being, and the economy of Tanzania.

2.3 HOST COUNTRY CONTEXT

The united republic of Tanzania operates under the two governments (The Union and The Revolutionary Government of Zanzibar). Both governments operate under a decentralized system. The country is divided into regions, districts, wards/shehia and villages. The health being a non-union matter, Zanzibar and Mainland Tanzania operate health services independent of each other.

National Health Policy 2017

The overall objective of the National Health Policy (2017) is to reach all households with essential health services, attaining the needs of the population, adhering to objective quality standards and applying evidence informed interventions through resilient systems for health.

The vision of the National Health Policy is a healthy community that contributes to individual as well as to the nation's development towards becoming a middle-income country, while the mission is to facilitate the provision of basic health services that are of good quality, equitable, accessible, affordable, sustainable and gender sensitive.

The Tanzania Development Vision 2025 (TDV 2025)[9] provides direction and a philosophy for long term development. By 2025, the country desires to achieve a high quality of livelihood for its

[9] United Republic of Tanzania, Ministry of Health, Community Development, Gender, Elderly and Children. 2017. National health policy – 2017. Dar-es-Salaam. United Republic of Tanzania

citizens, peace, stability, unity, good governance, a well-educated society and a competitive economy capable of producing sustainable growth and shared benefits by 2025. The TDV 2025 recognizes health as one of the priority sectors contributing to a high- quality livelihood for all Tanzanians.

The goal of the National Malaria Strategic Plan 2015–2020 was to reduce the average country malaria prevalence from 10% in 2012 to 5% in 2016 and further in 2020 to less than 1%. partnerships, with adequate funding. During Mid-Term Review (MTR 2017) it was realized the set national target will never be achieved

The major change that happened during the MTR at mid-point Strategic Plan implementation was the re-orientation of strategic direction by developing the Supplementary Malaria Midterm Strategic Plan 2018 – 2020. The main recommendation was to develop an appropriate strategic approaches that will help to achieve the set targets and eventually realize greater impact and reduce malaria to very low levels. The SMMSP stratified malaria burden according to the observed epidemiological diversity of four major epidemiological strata, and set up for implementation of intervention packages to match with the heterogeneity. Malaria stratification, provides guidance to the transition towards elimination in phases. It is an approach that facilitates strategic adjustments to invest for impact and burden reduction in moderate to high transmission areas and disadvantaged population. Also to further decrease low transmission areas and to advance towards malaria elimination in very low transmission settings. The stratified interventions in the country produced four epidemiological classes; 'very low, 'low', 'moderate' and 'high' burden strata and one operational strata; 'urban'. Stratification maps are the outputs of classified malaria burden in different areas of the country.

The purpose of the National Malaria Strategic Plan is to provide a comprehensive technical guidance to stakeholders and development partners for the period of 5 years (2020-2025), focusing on transitioning to malaria elimination in phases in Tanzania by 2030.[10]

The plan stratifies country malaria burden with a matching package of interventions to enable strategic adjustments to invest for impact burden reduction in high transmission settings and to advance towards malaria elimination in very low transmission areas.

The national goal is to reduce the average malaria prevalence in children aged less than 5 years ($pfpr_{6\text{-}59}$) from 7% in 2017 to less than 3.5% in 2025. The targets for strata are: a) reduce malaria burden in moderate to high risk strata, from 15% *pfpr* in 2017 to less than 7.5% *pfpr* in 2025; and b) maintain and further reduce transmission in low and very low prevalence in areas targeting elimination from of 1% *pfpr* in 2017 to less than 0.5% *pfpr* in 2025.

The reduced transmission is expected to decrease the annual parasite incidence (API) from an average of 122 per 1000 in 2019, to less than 30 per 1000 in 2025. The targets for strata are formulated to a) reduce malaria burden in moderate to high risk strata, from 259 API per 1000 in 2019 to less than 60 API per 1000 in 2025 and b) maintain and further reduce transmission in low and very low prevalence in areas targeting elimination from 24 API per 1000 in 2019 to an average of less than 6 API per 1000 in 2025.

[10] Ministry of Health, Community Development, Gender, Elderly, and Children, National Malaria Strategic Plan 2020–2025 (2020)

2.4 SUMMARY OF ENVIRONMENTAL SCOPING PROCESS

The scoping process for this SEA included a desk review of available country data, including data generated from past campaigns, as well as HMIS/DHIS-2 data from country sources. In addition, a short-term technical assistance visit was made to Tanzania by the Home Office Environmental Compliance Manager to visit with and solicit input from relevant country entities such as the Ministries of Health, President's Office, Regional Administration and Local Government, Environment, and Agriculture. Relevant laws and regulations were researched and documented, to ensure knowledge of and compliance with host country requirements. Visits were made to representative ecosystems in Tanzania, in order to understand the physical environment where IRS will take place. Potential physical facilities for hosting IRS operations were inspected to ensure that safety, security, and environmental requirements could be met. Finally, regional, district, and local officials were interviewed in order to gather information about the success or shortcomings of previous interventions so that plans could be made to simulate that success or to overcome any shortcomings.

2.5 STAKEHOLDER ENGAGEMENT AND HOST GOVERNMENT CONSULTATIONS

Representatives from the MOH, Ministry of Environment, and local government were interviewed at both the national and local levels. Local officials were interviewed and queried to determine what has worked and what has not been as successful in the past IRS and LLIN interventions, in order to design a more successful and efficient project. Waste management facilities were visited and evaluated for their capabilities and determine their usefulness. All major entities involved in complementary activities were contacted in order to establish cooperation and partnerships. Going forward, NEMC, the government body that oversees environmental protection issues suggested that Abt carry out an evaluation of the soak pit and triple rinsing procedures in preventing contamination of the soil strata. Out of this discussion five soak pits in Kakonko District will be investigated for efficiency by taking soil samples from the immediate vicinity of the evaluated soak pits. A protocol will be developed in collaboration between PMI/ VectorLink, NEMC, ZEMA and TPRI to sample and analyze these samples for the presence of IRS insecticide residues.

3.0 AFFECTED ENVIRONMENT (SOCIAL, PHYSICAL, BIOLOGICAL)

3.1 POPULATION CHARACTERISTICS

3.1.1 SIZE

According to Worldodometer, by 2020, the population in Tanzania is estimated at over 59.73 million. The country has the highest birth rates in the world (5.01) and more than 44% of the population is under the age of 15. The population is accommodated on an estimated 947,300 square kilometers of land, making the population density estimated at 67 people per square kilometer.[11]

3.1.2 ETHNICITY

The country also has an incredibly diverse population with more than 120 ethnic groups. The Sukuma is the largest ethnic group in the country and represents around 16% of Tanzania's total population. The vast majority of citizens, including many of the Sukuma, Hehe and Nyakyusa peoples, speak Bantu. There are groups of Nilotic and nomadic Maasai and Luo populations in the country as well, along with two small groups who speak languages in the Khoisan family specific to the Khoikhoi and Bushman people.[12]

3.1.3 GENDER

Tanzania is one of the countries that from grassroots to national level is still facing gender- related challenges. Recently, the country has seen progress on issues such as girl's access to primary and secondary education and women's representation in decision-making spaces. For example, from 2010/11 to 2014/15, the proportion of women in senior leadership positions increased from 33% to 41%. Women have also seen an improvement in access to employment in "sectors such as manufacturing, trade, hotels and food services". However, earnings from agriculture, which is one of Tanzania's most important economic drivers (20% of the country's GDP in 2014), are still lower for women than for men.[13]

3.1.4 AGE DISTRIBUTION

The country has very low median age with more than 44% of the population under the age of 15, about 52% is between 15 and 64 years of age while about 3% is beyond 64 years of age. The median age of the Tanzanian population is only 17.7 years of age, with a life expectancy of 66.6 years of age. [11]

3.1.5 SOCIOECONOMIC STATUS AND CHARACTERISTICS

The Tanzania Development Vision 2025, which is a roadmap to drive Tanzania from the scourge of poverty, states that Tanzania of 2025 should be a nation with six main attributes:

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[11] Worldometer https://www.worldometers.info/world-population/tanzania-population/ , 5/21/2020

[12] WorldAtlas https://www.worldatlas.com/articles/ethnic-groups-of-tanzania.html, 5/21/2020

[13] 2019 Sustainable Development Goal Gender Index https://data.em2030.org/countries/tanzania/ , 5/21/2020

1. High quality livelihoods by all Tanzanians; peace, stability and unity; good governance;
2. A well-educated and learning society; and a competitive economy capable of producing:
3. Sustainable growth and shared benefits. The general targets to be achieved by the year 2010 (according to the Programme of Action for Tanzania), are as follows: Economic Indicators:
4. Real growth rate of the economy at between 8 percent and 10 percent.
5. Increased income per capita to between US$ 300 and US$ 500.
6. Increasing the share of the manufacturing sector from the current 8.4 percent to 10 percent[14]

Despite the 2025 development vision, the social and economic status to date can be reflected by some data on the social economic characteristics of the majority of Tanzanians. The World Factbook has provided numerous points mentioned here that will give a clear view of the problems that the Tanzanian population currently faces. Malaria and HIV are primary causes of death for children and adults respectively in Tanzania. The HIV prevalence rate here is at 4.5% - the 13th highest in the world.

In terms of healthcare, there are only .02 physicians per 1,000 residents and .7 hospital beds per 1,000 residents. Clean drinking water is accessible for only 55% of the population and improved sanitation is available for only 15% of the population. 77.9% of the population over the age of 15 can read and write in any of the official languages used in Tanzania.

3.1.6 Description of Project Beneficiaries

The project benefits the entire population in which it works. There is a focus on children under five and expectant mothers who are particularly vulnerable to illness and death caused by malaria. A total of 1,900,326 persons were protected during the 2019/20 Tanzanian spray campaign; 373,976 were children under five year's old and 56,964 were pregnant women.[15]

3.2 PUBLIC HEALTH STATUS

According to WHO, Tanzania has been improving but more efforts are still required to reach yet unattained various targets. The country's burden of tuberculosis is the sixth highest rate in Africa. HIV has been decreasing from 7% to 5.1% yet the burden of it is still high. TB/HIV co infection is estimated at 37 – 39%. HIV cases are estimated at 1.4 million in the country, of whom 11% are

[14] Tanzania Development Vision 2025 https://www.mof.go.tz/mofdocs/overarch/Vision2025.pdf (5/21/2020)

[15] PMI VectorLink Tanzania End of Spray Report 2018 – 2019 https://www.pmi.gov/docs/default-source/default-document-library/implementing-partner-reports/tanzania-end-of-spray-report-2018-2019-pmi-vectorlink.pdf , 5/21/2020

in the age group of 15 -24 years. The most affected group is women, who account for 58% of all cases.[16]

For the past decade, Tanzania has experienced decline of malaria burden. Cases have reduced from 18.1% in 2008 to 9.5% in 2015. Zanzibar has recorded less than 1% infectivity. These achievements have been possible due to scaled distribution of long lasting insecticide treated nets and indoor residual spraying. In addition, proper malaria case management has been supported by availability of rapid malaria diagnostic tests and treatment with artemisinin combinations. The challenges that lie ahead of these achievements are how to maintain the gains and prevent resurgence of malaria, and how to move towards malaria elimination.

While Tanzania has made gains in reducing under-five mortality, progress has been slower for reducing maternal and neonatal deaths. Maternal mortality rates remain high at 556 deaths per 100,000 live births due to challenges such as inadequate quality of services, lack of access to emergency obstetric care, limited ability of women to independently access health services, and direct causes such as postpartum hemorrhage. Neonatal deaths, which continue to comprise a significant proportion of under-five deaths, highlight the importance of responding to major causes such as infection, asphyxia, HIV, malaria, and congenital syphilis.

Table 1: Status of Infant Mortality Rate 2016-2020

SN	INDICATOR	% DECREASE
1	2019 - 2020	3.54
2	2018 - 2019	3.42
3	2017 - 2018	2.67
4	2016 -2017	2.60

Tanzania is ranked 27th highest in the world with an under 5 mortality rate of approximately between 130 and 150 per 1000 live births. Recent figures show that under-5 mortality rates have been substantially reduced but unsatisfactory to reach Millennium Development Goal 4 target which was to reduce by two thirds the under-five mortality between 1990 and 2015.[17]

Undernutrition remains one of Tanzania's greatest human development challenges. Despite achieving seemingly 'low' and 'acceptable' rates of acute malnutrition, the burden of undernourished children is one of the highest in the East African region. An estimated 450,000 children in Tanzania are acutely malnourished or wasted, with over 100,000 suffering from the most severe form of acute malnutrition. Tanzania has one of the highest undernutrition burdens in East and Southern Africa, threatening not only individual lives but the next generation's economic advancement in lost educational achievement, lost income, and lost opportunities.

[16] United Republic of Tanzania WHO Country Cooperation Strategy 2016 – 2020

https://apps.who.int/iris/bitstream/handle/10665/254890/ccs_tza-2016_2020_en.pdf;jsessionid=72698DEB7273274A3C15997139EFA4D2?sequence=1 , 5/21/2020

[17] https://www.indexmundi.com/tanzania/millennium-development-goals.html

Table 2: Health Indicators in Tanzania Mainland[18]

Description	Figure	Sources
Total Population:	**47.8 million (mainland)**	**NBS 2015 projection**
Under 15 years old	44.2% (mainland)	NBS 2015 projection
15-64 years old	52.2% (mainland)	NBS Census 2012
65 years& above	3.9% (mainland)	NBS Census 2012
Women of reproductive age (15-49)	24.3% (mainland)	NBS 2015 projection
Annual Population Growth rate	2.7%	NBS Census 2012
Life expectancy at birth (years)	61 (63 F, 60 M)	NBS Census 2012
Total Fertility Rate (TFR)	5.2	NBS Census 2012
Under 5 Mortality Rate /1,000 live births	81	TDHS 2010
Infant Mortality Rate / 1,000 live births	45	NBS Census 2012
Neonatal Mortality/1,000 live births	26	TDHS 2010
Maternal Mortality Ratio/per 100,000 live birth	432	NBS Census 2012
Births in health facilities	77%	HMIS 2014
Skilled Birth Attendance	69%	HMIS 2014
Leading Cause Admission/Death in Hospitals	Malaria	SPD 2013
Prevalence of Malaria Parasitemia (6-59 months)	9.2% (MRDT), 4.1% (micro)	THMIS 2012
HIV Prevalence, 15-49 years	5.3% (6.2% F, 3.9% M)	THMIS 2012
ART Coverage persons with advanced HIV	67%	AHSPPR HMIS 2013
Hospital admission per 100 persons per year	2.4	HMIS 2014
OPD visits for new cases per person per year	0.64	HMIS 2014

3.3 GEOGRAPHIC CHARACTERISTICS

Tanzania lies between geographic coordinates 1˚00'S - 12˚00'S and 30˚00'E - 41˚00'E, and is bordered on the south by Mozambique, Malawi, and Zambia; on the west by Zaire, Burundi, and Rwanda; on the north by Uganda and Kenya; and on the east by the Indian Ocean. Tanzania is the largest of the East African nations with a total area of 947,300 km^2 of which 885,800 km^2 island and 61,500 km^2 constitute water bodies.

The country is divided into three physiographic regions, namely, the coastal plains and the Zanzibar, Mafia and Pemba islands; the North and southern islands; and the central saucer shaped plateau. Main features are the Indian Ocean, many lakes and rivers, mountains and multiple wild life conservation areas.

The Great Rift Valley that runs from north east of Africa through central Tanzania is another landmark that adds to the scenic value of the country. The Rift Valley runs to south of Tanzania splitting at Lake Nyasa; one branch runs down beyond Lake Nyasa to Mozambique; and another branch to north-west alongside Burundi, Rwanda, Tanzania and western part of Uganda. The

[18] Tanzania Health Sector Strategic Plan 2015 – 2020 https://www.childrenandaids.org/Tanzania_Health-Sector-Strategic-Plan_2015 , 5/21/20200

valley is dotted with unique lakes, including Lakes Rukwa, Tanganyika, Nyasa, Kitangiri, Eyasi and Manyara. The uplands include the famous Kipengere, Udzungwa, Matogoro, Livingstone, and the Fipa plateaus forming the southern highlands. The Usambara, Pare, Meru, Kilimanjaro, the Ngorongoro Crater and the Oldonyo Lengai, all form the northern highlands. (Kilimanjaro contains Africa's highest point at 19341 ft. / 5,895 m. From these highlands and the central saucer plateau flows the drainage system to the Indian Ocean, Atlantic Ocean, Mediterranean Sea and the inland drainage system.[19]

To the north and west are the Great Lakes of, respectively, Lake Victoria (Africa's largest lake) and Lake Tanganyika (the continent's deepest lake, known for its unique species of fish); to the southwest lies Lake Nyasa.[20]

3.4 LAND USE CHARACTERISTICS

Land use in Tanzania is largely devoted to agriculture, livestock management, forestry, urbanization and wildlife management.[21]

Tanzania is a country of varying agricultural potential, ranging from semi-desert to fertile and highly productive land under rain-fed agriculture. There is potential to grow a range of temperate and tropical crops. The main crops cultivated include coffee, cotton, tea, sisal, wheat, maize, rice, beans, and cashew. But there are growing conflicts between agriculture and other land uses. Much of the productive land is already densely settled and, as population pressure continues to rise, more and more people are settling and cultivating in the marginal areas and encroaching into forest reserves and/or wildlife and livestock grazing areas. Only 10-20% of the land area in the country is currently under cultivation. About 80% is not well suited to agriculture because of unreliable rainfall, infertile soils and pest problems. [22]

Tanzania has the third largest livestock population on the African continent comprising 25 million cattle, 98% of which are indigenous breeds, complemented by 16.7 million goats, 8 million sheep, 2.4 million pigs, and 36 million chickens. Despite the good number of livestock population, the contribution to country GDP remains below from its potential.[23] Other potential related to livestock rearing include, 60 million ha of mainland available for grazing and it is estimated conservatively, that the carrying capacity of this area is about 20 million stock units. A number of factors limit the distribution of livestock: diseases, disparities in the distribution of infrastructure, failure in destocking policies, and the nomadic behavior of pastoralists. Over-stocking in some areas has

[19] World Atlas https://www.worldatlas.com/webimage/countrys/africa/tanzania/tzland.htm , 5/22/2020

[20] The Embassy of the United Republic of Tanzania Washington D.C, United States of America https://tanzaniaembassy-us.org/?page_id=97 , 5/22/2020

[21] Ministry of Lands Housing and Human Settlements Development Tanzania National Land Policy 2016 http://www.tfcg.org/wp-content/uploads/2018/06/TTCS-2016-Presentation-4-Policy-Development-in-the-La , 5/22/2020

[22] Gelas Rubakula, Zhanqi Wang * and Chao Wei Land Conflict Management through the Implementation of the National Land Policy in Tanzania: Evidence from Kigoma Region, 2019. https://www.google.com/search?q=land+policy+in+tanzania&rlz=1C1GCEB_enTZ846TZ846&oq=Land+policy&aqs=chrome.1. 5/22/2020

[23]https://livestocklivelihoodsandhealth.org/wp-content/uploads/2015/07/Tanzania_Livestock_Modernization_Initiative_July_2015.pdf

resulted in severe land degradation. The pursuance of uncoordinated and conflicting objectives on the use of land also limit the more even distribution of livestock, e.g. the establishment of forest reserves has resulted in a loss of dry season grazing.

Tanzania is one of the world's great wildlife strongholds. At present, there are 12 national parks and 18 game reserves, all uninhabited, which constitute 12% of Tanzania's land area, and 49 inhabited game controlled areas which cover 13% of the land. In Arusha Region, wildlife conservation takes about 48% of all land. Wildlife conservation laws and rules are very strict in National Parks and Game Reserves, but are less strict in Game Controlled Areas.[24]

There have been a number of reviews of the extent of Tanzania's forests, but they have tended to rely on old data and are unreliable. The latest study, based on satellite imagery, estimates natural forest cover (defined as all vegetation types with a closed canopy of woody plants exceeding 8m height) as 16,185 km2 (1.85%) of the total forest cover. A recent environmental study of Tanzania estimates that forests and woodlands, including those within other land use types such as game conservation areas and national parks, extend over 45% of the country. Upland evergreen forests occur in the highlands of Kilimanjaro, Meru, Ngorongoro, and the Pare, Usambara and Uluguru mountains and the Southern Highlands. Lowland evergreen forests occur in isolated patches on the coastal plain. These areas all receive over 1000mm rainfall annually. The challenge facing forest potential in Tanzania has been rapid depletion due to anthropogenic activities, mostly agriculture, animal husbandry and new human settlements to accommodate a fast growing population[25]

3.5 CULTURAL OR HISTORIC RESOURCES

Tanzania is a country of remarkable variety in physical and cultural geography that includes a vast array of natural and cultural heritage resources. To safeguard its rich and diversified natural heritage, Tanzania has set aside a protected area network covering about 28 percent of the total land area. Protected areas include; Kondoa – Rock art site, Ruins of Kilwa Kisiwani and Ruins of Songo Mnara and Stone town in Zanzibar. The country has several recognized by United Nations Educational, Scientific and Cultural Organization (UNESCO). These include Ngorongoro Conservation Area, Serengeti National Park, Mount Kilimanjaro, Kondodoa Rock Art Site, Stone Town in Zanzibar, Selous Game Reserve, Ruins of Kirwa and Songo Mnara[26]

ENVIRONMENTAL BASELINE INFORMATION

3.5.1 CLIMATE AND CLIMATIC PATTERNS (HISTORIC, CURRENT, AND PREDICTED)

i. Rainfall:

The mean annual rainfall in Tanzania varies from below 500 mm to over 2500 mm p.a., depending on altitude and latitude. The rain falls mainly during December-May, although a bimodal pattern is found in the North. Rainfall is erratic, only 21% of the country can expect, with 90% probability,

[24] https://www.tawa.go.tz/conservation/protected-areas , 5/22/2020

[25] Isabel M.M . Rosa, Dennis Rentsch, J Grant. C. Hopcraft Evaluating Forest Protection Strategies: A Comparison of Land-Use Systems to Preventing Forest Loss in Tanzania https://www.mdpi.com/2071-1050/10/12/4476/htm , 5/22/2020.

[26] WIKIPEDIA https://en.wikipedia.org/wiki/List_of_World_Heritage_Sites_in_Tanzania , 5/22/2020.

annual rainfall of more than 750 mm, and the central third of the country can expect less than 500 mm, with evapo-transpiration rates exceeding precipitation for most of the year.[27]

In regard to the rain pattern, the country can be divided into four zones. In the North and the East, except in the region of Lake Victoria, there are two rainy seasons: one less intense, known as short rains season (vuli), between October and December, and the other more intense, known as long rains season (masika), from March to May, with a peak in April. In January and February, in the period between the two rainy seasons (kiangazi), the weather is hot and sultry, at least below a thousand meters (3,300 feet). In the far north-west, the two rainy seasons are practically connected, in fact, it rains even in January and February, when rainfall amounts to 100/150 millimeters (4/6 inches) per month depending on the area; therefore, in this region, there is practically a single rainy season from October to May. Such a situation is also found in a few areas of the North-east, in particular, along the Southern slopes of Mount Kilimanjaro[28]

ii. Temperature:

The temperature pattern in Tanzania varies among diverse geographical patterns in the country, they are influenced by altitude from sea level, vicinity to water bodies and distance from equator. The mean maximum temperatures are observed in September to March, ranging from 26.6°C in southern western to 33.1°C in northern Eastern. The mean minimum temperatures occur in July, ranging from 5.3°C in southern western regions of the country to 18.3°C in coastal areas. Recent global climatic changes have influenced a pattern of increased temperature pattern in the country. A recent report on climate indicated that, for the period of 2012 - 2016, the observed annual mean maximum temperature was 28.5 °C while the annual mean minimum temperature was 18.0°C. The results further indicate an increasing trend of monthly mean maximum temperatures with an average of 30.0°C for the period of 2012 to 2016 compared to 29.4°C for the long – term period from 1981 - 2010[29]

3.5.2 AIR

The status of air in Tanzania vary from place to place depending on human activities prevailing in the area. Air pollution concerns are higher in towns and cities where most economic activities concentrate (More than 80% of industries are located in urban areas). Most outstanding sources of air pollution are transport activities, burning of agricultural wastes, manufacturing activities, residential burning of fossil fuels and wood, open field solid waste burning and escalating mining activities. Previously air pollution was considered of less magnitude, but with time the situation is aggravating as the manufacturing sector is growing. The main challenge is the lack of quantitative data available in the country to determine the extent of the problem.

Unquantified evidence of air pollution would be identified by offensive odors, mostly emitted from food industries, chemical and allied industries, sewage treatment plants, solid waste disposal sites, malfunctioning sea outfalls, sea shores and even public sanitation facilities. Broken down

[27] Ladislaus B. Chang'a*, Agnes L. Kijazi, Philbert M. Luhunga, Hashim K. Ng'ongolo, Habiba I. Mtongori 2017. Spatial and Temporal Analysis of Rainfall and Temperature Extreme Indices in Tanzania https://www.researchgate.net/publication/320348219_Spatial_and_Temporal_Analysis_of_Rainfall_and_Temperature_Extrem, 5/22/2020.

[28] World Climate Guide https://www.climatestotravel.com/climate/tanzania, 5/22/2020.

[29] Global Security Tanzania – Climate https://www.globalsecurity.org/military/world/tanzania/climate.htm , 5/22/2020

and leaking sewers as well as sea outfalls and solid waste disposal sites which are inadequately managed also contribute to the air pollution. [30]

3.5.3 Water Resources

Considerable water resources exist in Tanzania, including the Indian ocean, and Lakes Victoria, Nyasa, Rukwa, Tanganyika and Natron. Other resources include diverse of rivers, with about half of the country's surface runoff coming from rivers flowing into the Indian Ocean (including the Pangani, Rufiji, Wami, Ruvu and Ruaha rivers). Part of the rest drains into Lakes Victoria (Meri, Maru and Kagera rivers), Tanganyika (Malagarasi), Rukwa, Bubu, Eyasi and Manyara as well as the Lake Nyasa/Zambezi River system (Songwe and Ruhuhu rivers).[31] Other resources include wetlands, springs and reservoirs. Tanzania is considered as a country of water abundance, however, the fast growing population is expected to hit 130 million by 2050, and already inadequacy in water resources management causes water scarcity in some parts of the country. In addition, water scarcity is experienced in some places due to natural uneven distribution of the resource in spatial temporal circumstances, and the technology to harvest and distribute water is limited[32]

3.5.4 Ground Water

Though no adequate research to quantify ground water in Tanzania exists, it is estimated that the potential of ground water is about 12% to 88% of surface water. The occurrence of groundwater is largely influenced by geological conditions. Hydrogeologically about 75% of Tanzania is underlain by crystalline basement complex rocks of variable composition and ages, but predominantly Precambrian, which form the basement aquifers (for example the Pangani and Makutopora basins). Other aquifer types include karroo (found in Tanga), coastal sedimentary formation of limestone and sandstone (e.g. Dar es Salaam), and the alluvial sedimentary sequence, which mostly includes clay, silt, sand and gravel, and volcanic materials (e.g. Kahe - Pangani basin). The groundwater potential of every type of aquifer differs significantly at the local scale as well as at the basin scale.

Though the data on ground water availability is inadequate, the underground water use is substantial in Tanzania. It is estimated that a volume of 1,265,000 m³ is consumed per day in various ways like Urban water supply 10%, Rural water supply 50%, Agriculture 10%, Industry and mining 2% of total volume, Other uses including livestock and dry land fishing 28% of total volume.[33]

3.5.5 Surface Water

About 50% of the surface runoff flows directly into the Indian Ocean, from the major river systems of Pangani, Wami, Ruvu, Rufiji, Mbwemkuru, Matandu and Ruvuma. The Rufiji contributes 50% of this. The remaining 50% is divided into surface water draining northward into Lake Victoria,

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[30]Environmental Networking Platform for Children and Youth by Samsung Engineering and UNEP Air pollution in Tanzania https://tunza.eco-generation.org/ambassadorReportView.jsp?viewID=13303 , 5/22/2020

[31] Tanzania Water Policy http://www.tawasanet.or.tz/files/Tanzania%20water%20policy%20-%202002.pdf ,5/22/2020

[32] World Bank Group 2030 Water Resource Group https://www.2030wrg.org/tanzania/background/ , 5/22/2020.

33 British Geological Survey Hydrogeology of Tanzania http://earthwise.bgs.ac.uk/index.php/Hydrogeology_of_Tanzania#Groundwater_Status , 5/23/2020.

westward into Lake Tanganyika, southward into Lake Nyasa and finally into the Zambezi and then into a number of drainage basins which have no outlet to the sea. The principal of these are the Lake Rukwa drainage basin, the Bubu complex, Lake Eyasi and Lake Manyara. The Lake Nyasa, Lake Victoria and Lake Tanganyika basins drain into international water bodies.

3.5.6 Land Resources

The land forms a major resource in Tanzania, apart from its contribution on agriculture, forestry, wildlife and inland water resources, is also very rich in minerals The available data base indicates that the minerals found in Tanzania are grouped into the following major categories;[34]

- Metallic Minerals, which include gold, iron ore, nickel, copper, cobalt and silver.
- Gemstones, which include diamonds, tanzanite, ruby, garnets, pearl, theodolite, sapphire, emerald, amethyst, chrysoprase, peridot and tormaline. Recently, a major alluvial occurrence was discovered in the southern region of Ruvuma, Mtwara and Lindi. Varieties include chrysoberyl, spinels, sapphire, garnets, zircons and diamonds.
- Industrial Minerals, which include limestone, soda ash, gypsum, salt and phosphates. Recently graphite of high-grade gneisses found mainly in the Usagaran system. Sufficient reserves have been identified at Merelani, northern Tanzania, for a 40 year operation at a mining rate of 15,000 tons per year of high grade flake graphite of 97-98% purity.
- Energy source Minerals, such as coal and uranium, Coal, and various industrial minerals such as soda, kaolin, tin, gypsum, phosphate and dimension stones are plentiful. Coal resources similar in quality to the Gondwana coals of southern Africa occur in the Ruhuhu and Songwe-Kiwira basins in Limestone and dolomite-good resources of high purity occur in the white marble deposit
- Construction minerals, such as aggregates, gravel, sand and dimension stones.

In economic terms, mining contributes significantly in the National GDP. In 2011 the value of mineral exports reached $2.1 billion, more than 95 percent of which came from six gold mines. The mining sector contributes approximately 3.0% to annual GDP. Tanzania has the ambition to make the mining industry account for 10% or more of GDP by 2025. [35]

[34] https://ke.tzembassy.go.tz/tanzania/natural-resources-and-mining-in-ta

[35] https://opentoexport.com/article/mining-sector-in-tanzania-1/

3.5.7 Protected Areas and National Parks

As part of Tanzania's wildlife conservation strategy, certain areas of land or sea have been declared as protected areas by the President of Tanzania after consultation with the relevant authorities. These areas are specifically protected for maintenance of biological diversity, natural or associated cultural resources and managed through legal or other effective means. Special rules and regulations apply for these areas, e.g. related to settlement, tourism, hunting and other activities. Depending on their status, the areas are divided into four categories of game reserves, game controlled areas, wildlife management areas, wetlands, Forest nature reserves, Marine Park and reserves and Ramsar sites[36]

Game controlled areas

A Game Controlled Area is an area declared for conservation of wildlife outside village land where activities detrimental to wildlife prevails. In Tanzania two areas are under game controlled areas. Mount Ol Doinyo Lengai which is a strato volcano with a summit of 2962m above sea level, it is the only certified active volcano in Tanzania and the only world's carbonatite volcano. The other game controlled area is Lake Natron which is the world's most important breeding site for Lesser Flamingos classified as near threatened species.[37]

Wildlife management areas

A Wildlife Management Area is an area set aside for purpose effecting community based wildlife conservation in village land outside protected areas which are used by local community members, TAWA 2016.[34]

Tanzania has very diverse areas for wildlife management, as the chart below indicates;

[36] WIKIPEDIA List of protected areas of Tanzania https://en.wikipedia.org/wiki/List_of_protected_areas_of_Tanzania , 5/23/2020.

[37] Wild Life Management Authority https://www.tawa.go.tz/conservation/protected-areas/game-controlled ,5/23/2020.

Table 3: Wildlife management areas and reason for the qualification[34]

SN	NAME OF WILDLIFE MANAGEMENT AREA	REASONS FOR THE QUALIFICATION
1	Buruge	The home of large buffalo population and migratory birds
2	Ikona	High abundance of large wild mammals
3	Ipole	The calm wildlife sanctuary
4	Magingo	Undiscovered wealth potential for wildlife researches
5	Makame	The largest wildlife management area in Tanzania with diverse opportunity
6	Makao	For hunting tourism
7	Mbarang'andu	The wildlife and uranium hotspot
8	Mbomipa	The home of flagship species, untrammeled, and highly exclusive scenery
9	Nalika	One of the important elephant transboundary migration trails
10	Ngarambe - Tapika	Selous wildlife refuge during dry season
11	Ukutu	Wildlife at a glance
12	Uyumbu	Wildlife and history at crossroad
13	Wami - Mbiki	Potential for photographic tourism and walking safaris

Ramsar sites

Ramsar Sites are wetlands of international importance which advocate wise use principles[38]. Areas under this category are Lake Natron and Kirombelo valley[34]

3.5.8 Environmental Data

This chapter summarizes data from various subject areas of environment that are relevant for measuring, monitoring and decision making on environmental matters. Such areas include physical, biological, chemical, meteorology, hydrography, soil characteristics, land cover, ecosystems, biodiversity, forests and fresh water quality.

Some of the aspects have been covered in the previous chapters as follows, climate part of the data has been covered in chapter 3.6.1 of this report. Other chapters covered include; air 3.6.2, water source 3.6.3, ground water 3.6.4, surface water 3.6.5, land resource 3.6.6 and wildlife 3.6.7.

[38] Tanzania Wildlife Management Authority 2016 https://www.tawa.go.tz/conservation/protected-areas/ramsar-sites/

The below table provides the summary of these chapters and additions of other subject areas that were not discussed in the previous chapters. See baseline environmental data in sections 3.6.1-3.6.9 above.

Table 4: Summary Of Current Environmental Related Data in Tanzania[39]

SN	INDICATOR	VALUE
1	**TEMPERATURE, 2012 - 2016**	
	Range of Mean Minimum Temperature (°C)	5.3 °C – 18.3°C
2	**RAINFALL, 2012 - 2016**	
	Range of annual rainfall	550mm – 2500mm
	Minimum Rainfall	411.8mm
	Maximum Rainfall	2,280.0mm
3	**HYDROLOGICAL CHARACTERISTICS**	**VALUE**
	Largest water basis (Rufiji basin)	182,708 Km^2
	Smallest water basin (Nyasa basin)	34,266.09Km^2
	Lakes and swamps country area coverage	5.4 million hectares
	Annual average available renewable water resources per capita 2015/16	1,952 M^2/year
	External renewable water resources - 2016	12.27 million M^2
	Estimated water leaving the country - 2016	15,640 million M^2/year
	Number of dams - 2009	633
	Total capacity of large dams - 2009	104,200 million M^2
4	**WATER USE**	
	Total water withdrawn in year 2012	5,142 million M^2
	Proportions of Dominant Sectors in use of the Withdrawn Water Resources	
	Agricultural sector	90%
	Municipal sector - 2002	10%
	Rural population in Tanzania mainland (2012)	31,623,999
	Cumulative water points constructed (2007 -2016)	22,792,322
5	**URBAN WATER SUPPLY AND SANITATION**	
	Ground water withdrawal - 2012	462 million M^2
	Urban population served with clean and safe water (23 Regional headquarters) - 2016	86%
	Number of people with access to water supply - 2016	4,260,820
	Domestic connections - 2016	375,757
	Kiosk - 2016	2,013
6	**DOMINANT SOIL TYPES IN TANZANIA**	
	Cambisols – soils characterized by a slight or moderate weathering of parent material and by absence of appreciable quantities of alleviated clay, organic matter, aluminium and/ or iron compounds	37%
	i. Luvisols – are fertile soils and suitable for a wide range of agricultural use	7.6%

[39] National Environment Statistics Report, 2017 Tanzania Mainland https://unstats.un.org/unsd/environment/Compendia/United%20Republic%20of%20Tanzania,%20National%20E , 5/23/2020.

	ii. Lixisols – suitable for perennial crops	6.7%
	iii. Ferrasols, less susceptible to erosion and easy to work	5.7%
7	**Land cover - 2015**	
	Forest/woodland/bushland cover	60%
	Cultivated land (Around)	20%
8	**Total Number of Game Reserves**	
	Game Reserves Coverage Area	114,782.97 Km^2
9	**EXPORTATION OF SELECTED MINERALS, (000) 2016**	
	Gold – 45.15kg	USD 1,824.81
	Diamond 239.89 Carats	USD 90.39
	Tanzanite 13.94kg	USD 29.05
10	**NATURAL GAS PRODUCTION (MCFT), 2013, 2017**	
	2013	20,633.43
	2014	33,184.69
	2015	37,182.41
	2016	48,247.27
	2017	51,041,21
11	**ELECTRICITY GENERATION (GWh) BY TYPE OF FUELS 2011 - 2017**	
	Gas	21,817.4
	Hydro	14,972.9
	Diesel/HFO/GO	5,649.4
	Biomass	116.9
12	**GENERATION OF WASTE WATER IN DARE ES SALAAM CIY, 2017**	1000,078,972M^2
	Volume of water generated	62,329,545M^2
	Total volume of waste water discharged to the environment without treatment	83,749,428
13	**GENERATION OF SOLID WASTE (TONNES) PER ANNUM IN DAR ES SALAAM CITY 2013 - 2016**	
	Residential sources	594,000
	Industrial sources	46,000
	Non industrial sources	1,476,000
14	**RECENT NATURAL DISASTERS**	
	Earthquake occurred on 10th September, 2016 in Kagera Region	17 people died and 440 people were injured
15	**RECENT TECHNOLOGICAL DISASTERS AND CASUALITIES**	
	Collapse of a Building in Dar es salaam on 29th , 03, 2013	39 people died

3.5.9 Environmental Studies of Affected Area

There are limited data generated from research studies to inform about the state of environment in Tanzania. There are limited resources and expertise available, and the high diversity of

environment result in some areas that remain untouched by research. While composing this report, few research reports on environment in Tanzania were perused as indicated below, further the search looked into areas of gaps that require researches.

Tanzania: Country Environmental Assessment; Managing Natural Resources More Effectively Can Get the Country Rivers Flow again. This research was supported by World Bank to look into factors that degrades water resources and the possible mitigation measures. [40]

Tanzania: Country Environmental Analysis – Environmental Trends and Threats and Pathways to Improve Sustainability. Again the study was supported by World Bank to research on how to mitigate development while sustaining the environment potentials to support livelihood in the country. [41]

Tanzania – Environmental – Threats and Opportunities – Assessment, 2012[42]

The United Republic of Tanzania, National Environmental Statistics Report, 2017. This report was established by Tanzania Bureau of Statistics to assemble most of the data that reflect the state of environment in Tanzania. It covers physical, Biological, chemical, climatological, hydrogeological, air and natural resources.[36]

Dealing with Scarce Resources, this report elucidates on how environmental resources are being depleted over, time with increasing population and technology. Further it tells on how to manage the scarce resources to bring about sustainable environment.[43]

Further, this part of this report has identified areas of research that need exploration to bridge the gaps of environmental data required to guide development in view of environmental protection and conservation.

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[40] The World Banks 2019, Tanzania Country Environmental Assessment: Managing Natural Resources More Effectively Can Get the Country's Rivers Flowing Again https://www.worldbank.org/en/country/tanzania/publication/tanzania-country-environmental-assessment-ma , 5/23/2020.

[41]World Bank Group. 2019. Tanzania 2019 Country Environmental Analysis: Environmental Trends and Threats, and Pathways to Improved Sustainability. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/31643 License: CC BY 3.0 IGO." https://openknowledge.worldbank.org/handle/10986/31643 , 5/23/2020.

[42] USA Tanzania Environmental Threats and Opportunities Assessment http://www.brucebyersconsulting.com/wp-content/uploads/2013/01/Tanzania-Environmental-Threats-and-O

[43] https://wwf.panda.org/wwf_offices/tanzania/environmental_problems__in_tanzania/

Table 5: Required Environmental Studies Of Affected Areas

SN	AFFECTED AREA	POSSIBLE CAUSES	AREAS OF RESEARCH
1	Deforestation and forest degradation	• Fast population growth • Agricultural expansion • Fuel wood and charcoal	• Agricultural technology for land conservation • Alternative sources of energy to conserve forests
2	Land degradation	• Deforestation • Overgrazing • Poor agriculture practice	• Innovations in animal husbandry for reduced numbers but increased output
3	Degradation of water resources	• Land degradation • Encroaching water sources for settlement and agriculture	• How to mitigate multi-sectoral approaches in water resource conservation
4	Loss of biodiversity	• Habitat degradation • Poaching • Overexploiting	• Protection and restoration of habitats for biodiversity • Multisector approaches for biodiversity conservation
5	Fresh water and marine fisheries depletion	• Water resource degradation • Overfishing • Use of inappropriate fishing gear, such as LLINs	Refer No 3
6	Climate change	• Worldwide increase of greenhouse gases • Reduction of carbon sink (forests)	• Afforestation, and forest conservation for expansion of carbon sink • Reduction of greenhouse gases in Tanzania

3.6 POLICY, LEGAL, REGULATORY AND PERMITTING REQUIREMENTS

3.6.1 RELEVANT AND APPLICABLE HOST GOVERNMENT POLICY, LEGAL, AND REGULATORY REQUIREMENTS

Policies relevant to IRS

The following policies have resulted in laws and regulations that affect the performance of IRS

- National Health Policy (2017)[44]
- National Bee Keeping Policy (1998)[45]
- National Land Policy[46]
- Fisheries Sector Policy and Strategy[47]
- Tanzania Agricultural Policy[48]
- National Water Policy[49]

Legal and Regulatory Requirements

The Plant Protection Act

The Plant Protection Act, (1997) prohibits the registration of any plant protection substance (insecticides/pesticides) that in the course of the use or application may cause harmful effects on human and animal health, ground water and/or the general natural environment (Section 18 (1) (c). Further, the Act requires that, the pesticide and equipment used in application undergo registration process. To comply with the requirements of this act, PMI VectorLink in collaboration with the MOH procures compression pumps and insecticides only after they have obtained in country registration by TPRI.

Section 19 of the Act, prohibits usage, importation, distribution and sale of pesticides other than those registered in the country. Also, section 18 of the same Act emphasizes the protection of human health, other organisms and the environment in general during application of insecticides.

VectorLink BMPs require the use of PPE for human protection, and training and supervision on human safety targeting workers and beneficiary communities. For the environment the best management practices including recycling of contaminated effluent, and treating less contaminated effluent using special soak pits with wood charcoal or activated charcoal. [50]

The Environmental Management Act (EMA)

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[44]The National Health Policy 2017 http://www.tzdpg.or.tz/fileadmin/documents/dpg_internal/dpg_working_groups_clusters/cluster_2/health/JA , 5/23/2020.

[45] Tanzania National Bee Keeping Policy 1998 http://www.tzonline.org/pdf/nationalbeekeepingpolicy.pdf , 5/23/2020.

[46] Tanzania National Land Policy of 2016

[47] Tanzania National Fisheries Policy of 2015

[48] Tanzania Agriculture Policy of 2013

[49] Tanzania National Water Policy 2002

[50] The Plant Protection Act 1997 - Tanzania

Through this act, the government of Tanzania Mainland has put in place the Environmental and Social impact assessment (ESIA) mechanism that contains principal laws, regulations and policies that provide human and environmental protection in case of insecticide use. VectorLink is required to develop an ESIA prior to implementation of IRS.

Among other things, EMA established the Environmental Management Council (NEMC) under the office of the Vice President, division of environment. NEMC is tasked with advisory roles to the government of Tanzania Mainland on matters of environmental conservation and management.[51]

Environmental Management (Hazardous waste Control and Management) Regulations

These regulations require a project proponent who is handling hazardous substances:

- To comply with principles of environment and sustainable development relevant to hazardous waste management i.e. the precautionary principle; polluter pays principle; and producer extended responsibility (Part II, regulation 4);
- To minimize waste generated by adopting cleaner production principles (Part II, Regulation 5)
- To safeguard the environment from the adverse effects of hazardous waste and to inform the relevant authority on any activity and phenomenon resulting from hazardous waste that is likely to have adverse effects to the public health and environment (Part II regulation 6)
- To abstain from packing or storing wastes in a container or package, unless the container or package in which that waste is to be contained, packed or stored is UN approved container that is capable of containing or storing the waste in an environmentally sound manner without any risks to human health and the environment (part III regulation 9)
- To ensure that the hazardous wastes are labelled in accordance with sub-regulation (1) (f) (Part III regulation 10)
- To ensure hazardous materials, chemicals, waste are handled and stored in a manner that ensures safety to the environment and human health (Part III, regulation 11)
- To ensure that people transporting hazardous chemicals, materials and waste into and outside Tanzania have a valid Prior Informed Consent for such movement issued by the Director of Environment (Part III, regulation 16)
- Abstain from transporting biomedical waste without a valid permit issued by the relevant department or unit in the Ministry responsible for Health in consultation with the Director of Environment (Part V, regulation 34)
- To abstain from disposing of any pesticide or toxic substance other than at designated site or plant approved by the Tanzania Atomic Energy Agency (Part VII, regulation 43)[52]

[51] Tanzania Environmental Management Act (EMA) 2004

[52] Tanzania Environmental Management (Hazardous waste Control and Management) Regulations 2019

The project shall ensure all hazardous wastes emanating from the project operations are managed according to the requirements of this legislation.

Environmental (Solid Waste Management) Regulations, (2009)

These regulations require the proponent who is handling wastes:

- To comply with principles of environment and sustainable development relevant to waste management i.e. the precautionary principle; polluter pays principle; and producer extended responsibility (Part I, regulation 4);
- To minimize waste generated by adopting cleaner production principles (Part I, Regulation 5)
- To safeguard the environment from the adverse effects of waste and to inform the relevant authority on any activity and phenomenon resulting from waste that is likely to have adverse effects to the public health and environment (Part I Regulation 6)
- To obtain relevant permit to transport waste (Part III regulation 9)
- To provide approved waste receptacle by council or local Government Authority (Part IV, regulation 15)
- To respect waste collection times (Part IV, Regulation 16)
- To abstain from disposing hazardous waste, chemicals and materials into municipal waste receptacles (Part IV, Regulation 17)
- To ensure plastic wastes are separated from non-plastic waste (Part Vi Regulation 35)
- To control litter in public places (Part VII, Regulation 45)

The project shall ensure all solid wastes emanating from the project operations are managed according to the requirements of this legislation.

The Beekeeping Act

The Act, prohibits the taking, removal, damaging or destroying of any bee colony or apiary products (section 17 (1) (a). The IRS requires that storage of insecticide especially Sumishield 50WG which is very toxic to bees to be stored away from bee hives and the store has to be installed with windows and other vent routes covered with wire mesh that can prohibit bees entrance. Spraying of insecticide is prohibited in houses where bee colonies cohabitate.[53]

The Occupational Health and Safety Act

The Act provides for safety and health of workers at work places (Section 44 – 45). The provide standards for operating procedures and required protective gears. The Act, require the mandated organ, Occupational Safety and Health Administration (OSHA), to train and inspect

[53] Tanzania Bee Keeping Act 2002

working places. Where noncompliance is encountered legal measures including penalties are instituted. For IRS requirements we ensure PPE sourced and used are of OSHA acceptable standards.[54]

The Public Health Act [55]

Section 25 of the Act, provides for the control of epidemic, endemic and pandemic diseases of which malaria is among. Section 37 of the Act prohibits discharge of wastes into water bodies which may result into various health and environmental dire consequences.

The Water Utilization (Control and Regulation) Act (1974

Section 36 (4) of the Act and its amendment of 1997 prohibits any act of adulteration by additions or omissions that would lead into water pollution of the water river, stream, or any other water body that would cause injury directly or indirectly to public health, livestock, aquatic organisms or plants. As stated under Agriculture Act, IRS is designed and implemented to ensure maximum protection of water bodies.

The Industrial & Consumer Chemicals (Management & Control) Act

Although insecticides used in IRS falls under the category of pesticides that require a different mechanism and process for its registration, drugs and medicines used to treat cases of accidental poisoning fall under the jurisdiction of the this Act, which prescribes measures to be ensured in order to minimize harmful effects to human health or the environment as a result of such chemicals and to recommends the use of safer alternatives (Section 42 (1-b)). Arrangements are in place to ensure that all project staff have access to medical treatment in case of accidental exposure or poisoning in the course of implementing IRS.[56]

The Wildlife Conservation Act [57]

Section 74 of the Wildlife Conservation Act, (2009), puts restrictions on human activities in wildlife protected areas and borderline areas. Since IRS beneficiary regions (Kagera, Kigoma, Zanzibar, Geita and Mwanza have some National Parks within and in its vicinity, this Act is of great relevance because of the potential use of various classes of insecticides as a poison against protected species within the park or game reserves. Therefore, the proposed IRS project will ensure that none of the consignment of the insecticide falls into wrong hands that may use it unscrupulously and in contravention of this Act. The program has put in place robust stock control of insecticides.

The Fisheries Act

[54] Tanzania Occupational Health and Safety Act 2003

[55] Tanzania Public Health Act

[56] The Industrial & Consumer Chemicals (Management & Control) Act 2003 - Tanzania

[57] The Tanzania Wild Life Conservation Act 2013

The Fisheries Act, (2003), has provisions on sustainable development, protection, conservation, aquaculture development, regulation and control of fish, fish products, aquatic flora, and its products and for related matters. Indoor-residual spraying implementation in Mwanza (Ukerewe Island), Zanzibar, Pemba and other small islands will have to observe these provisions and to institute necessary safeguards to ensure aquaculture is not impacted negatively as a result of IRS activities. The IRS planning and implementation in these fragile areas include strict safety transportation of insecticides across water bodies.[58]

Forest Act

The Act, is meant to protect National forest reserves to preserve, maintain and enhance biodiversity and genetic resources. Outside the reserves, conservation of trees include both protection of natural water supplies and biodiversity. Provisions are made for protection of wild plants and animals listed in the government gazette. Sovereignty over "biological resources, their derivative products and intangible components" is also affirmed. There will be no IRS activities undertaken in forest areas protected under this Act.59

Environmental and Social Impact Assessment Regulations

The National Environmental and Social Impact Assessment and Audit Regulations are prescribed by NEMC, which falls under the Office of the Vice President. Both the Act and its regulations emphasize the need conduct ESIA for all projects that are eligible and to follow the right procedures while carrying out ESIA or Environmental Audit. Projects are divided into categories A and B of which the former require EIA as a mandatory. The use and application of insecticides as it happens in IRS falls in category A. Currently all six districts (Biharamulo, Kakonko, Kibondo, Kasulu, Bukombe and Ukerewe) were subjected to ESIA prior commencement of IRS and ASIA certificates have been issued for every district. In the event that a new district will be recruited for IRS[60]

The Surface and Marine Transport Authority Act (2001)

The Act requires that, whoever is using marine transport to use only the approved surface and marine service providers. IRS program is bound to ensure sourcing of vessels for marine transportation is in compliance with the law.

3.6.2 International Conventions relevant to IRS

The Basel Convention

The 1989 Basel Convention on the Control of Trans-boundary Movements of Hazardous

[58] Tanzania Fisheries Act 2003

[59] Tanzania Forest Act 2002

[60] The Tanzania Environmental Impact Assessment Regulations, 2014

Wastes and Their Disposal was designed to eliminate the risks arising from the trans-boundary movements of hazardous and other wastes. These risks include those arising from the transportation, handling, disposal and recycling of waste. Central to this process were movements from industrial to developing countries. The VectorLink project uses various classes of insecticides which are sourced from outside the country. Therefore, it is important to observe and abide by the requirements of the Convention.61

Convention on Biodiversity

The Convention on Biodiversity (1992), ratified by 179 countries (known as Parties) including Tanzania. Signatories are required to develop national strategies for the conservation and sustainable use of biological diversity, and to integrate biodiversity considerations into all activities. It is implicit in the Convention that, there is need to protect biodiversity, and therefore, IRS in Tanzania will ensure that non-target species are not harmed deliberately through implementation of project activities.[62]

The Convention on Prevention of Marine Pollution

The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Convention) binds its 78 contracting parties (Art. I) to 'individually and collectively promote the effective control of all sources of pollution of the marine environment' and 'to take all practicable steps to prevent the pollution of the sea by the dumping of wastes and other matter that is likely to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea'. Although remotely related to the proposed project, the program will ensure that this Convention is not violated as a result of the importation process or disposal of wastes arising from the IRS project.

The Rotterdam Convention

The objectives of the Convention are:

- to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm;
- to contribute to the environmentally sound use of those hazardous chemicals, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export and by disseminating these decisions to Parties.

In line with IRS, the project ensures that manufacturer and suppliers of used insecticides provide the information required to enable safe handling and use of supplied insecticides. Such information is contained in the Material Safety Data Sheets, environmental profile

[61] http://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx , 5/25/2020.

[62] https://www.cbd.int/doc/legal/cbd-en.pdf , 5/25/2020.

and packaging labels.[63]

Table 6: Relevant and Applicable International Standards and Best Practices

No	Convention / accord	Ratification Date (or signature)
1	African Convention on the Conservation of Nature and Natural Resources	14 September 1968
2	UNESCO World Heritage Convention	14 September 1982
3	Bonn Convention-Conservation of Migratory Species	5 April 1989
4	International Plant Protection Convention	4 April 1991
5	United Nations Framework Convention on Desertification	30 June 1994
6	Montreal Protocol on Substances that Deplete the Ozone Layer	11 October 1994
7	UN Convention to support desertification	27 June 1997
8	Basel Convention	12 April 2000
9	Convention on Persistent Organic Pollutants	17 May 2002
10	Kyoto Protocol	25 February 2002
11	Cartagena Protocol on Biosafety to the Convention on Biological Diversity	7 January 2004
12	United Nations Framework Convention on Climate Change	14 May 2005
13	Convention on African Energy Commission	25 November 2008
14	Paris agreement under the United Nations Framework Convention on Climate Change	9 March 2017

3.6.3 Relevant and Applicable Permitting Requirements

According to Government of Tanzania Regulations, there a number of permits that IRS project should acquire prior to staging various IRS processes, these include;

i. Environmental and Social Impact Assessment issued by the minister of Environment, this is required wherever IRS is to be implemented for the first time, and in case there is change of insecticide the project will have to pursue Variation certificate.
ii. Certificate to handle hazardous wastes issued by the Vice President Office, prior issuance of the certificate the proponent has to narrate the type of waste and mode of disposal. Upon inspection and satisfaction of the authority the certificate is issued
iii. Working place registration by offered by Occupational Safety and Health Authority
iv. Insecticide import permit required every time you have to import insecticide issued by Tropical Pesticide Research Institute

[63]https://www.nicnas.gov.au/about-us/international-obligations/rotterdam-convention (5/25/2020)

4.0 ALTERNATIVES, INCLUDING THE PROPOSED ACTION AND CONNECTED ACTIONS

4.1 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.

4.2 DISCUSSION OF ALTERNATIVES

4.2.1 ALTERNATIVE 1 (PREFERRED)

The preferred action is to implement an IRS and ITN distribution 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. PMI has developed a comprehensive set of mitigation measures (EMMP) to avoid negative environmental and health impacts, and has performed IRS in a multitude of countries with minimal impacts. All insecticides are managed in accordance with both host country regulations and US 22 CFR 216.

Storerooms for keeping IRS insecticides and materials are selected based on PMI BMP guidelines on siting and other building requirements. Requirements for insectary location and structure (for example, internal environment control) may result in the unavailability of appropriate existing structures for an insectary. Under the proposed action, when such situations arise, PMI may approve small scale construction or refurbishment for IRS storerooms or insectaries and other supporting structures to meet the WHO and PMI BMP and in compliance with the EMMP in Annex A of this document.

4.2.2 ALTERNATIVE 2: 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 Tanzania NMCP and the PMI program.

4.2.3 ALTERNATIVE 3: USE OF ALTERNATIVE INSECTICIDE(S)

For PMI-supported IRS, a pesticide listed by the WHO PQ, must be selected for use. The WHO 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 classes: pyrethroids, carbamates, organophosphates, neonicotinoids and clothianidin/deltamethrin combination. The proposed action for Tanzania includes the potential to use all of the WHO PQ listed formulations, including chlorfenapyr when recommended by the WHO PQ. Use of alternative pesticides is not permitted.

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-listed insecticides, other than chlorfenapyr.

4.2.4 Alternative 4: Alternative Technologies

A full range of known, available technologies are continually considered for use by the stakeholders in malaria prevention and control. For example, the application of larvicides and environmental control are two other methods that may be considered for malaria control. Larvicides are applied to waterbodies that serve as breeding places for mosquitoes to eliminate mosquito eggs and larvae before they develop into adult mosquitoes. It is unknown but doubtful that larvicides could serve as a stand-alone replacement for IRS, with the same cost/benefits, if at all. An additional factor weighing against larvicides would be the hazards of increasing the load of chemical or biological substances to the environment, such as damage to non-targeted species, and water pollution.

Environmental management for malaria control is limited to some-common sense safeguards, such as limiting standing water around residences, 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.

It has been determined that IRS plays a significant part in malaria prevention, in concert with other technologies.[64] The specific focus of this PMI project is performance of IRS and facilitating the distribution of ITNs, and the role that PMI plays in Tanzania includes IRS and ITNs. 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.

4.2.5 Alternative 5 (No Action) No-Project Alternative

IRS and ITN distribution are two of the critical vector control 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 Tanzania's NMCP National Malaria Strategic Plan 2014 – 2020, the Global Fund's Technical Strategy, or PMI's Strategy for 2015–2020. [65]

4.3 COMPARISON OF ENVIRONMENTAL IMPACTS

As required by 22 CFR 216.6(c)(3), the following provides in comparative form, impacts of the proposed intervention, reasonable alternatives, and the no action scenario.

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[64] PRESIDENT'S MALARIA INITIATIVE Malaria Operational Plan (MOP) Tanzania FY 2019 https://www.pmi.gov/docs/default-source/default-document-library/malaria-operational-plans/fy19/fy-2019-tanzania-mala , 5/25/2020.

[65] National Malaria Strategic Plan 2014–2020 Abridged Version https://www.out.ac.tz/wp-content/uploads/2019/10/Malaria-Strategic-Plan-2015-2020-1.pdf , 5/25/2020.

Table 7: Alternative Evaluation

	Alternative 1 (Preferred)		Alternative 2 (Alternative Geographical Sites)		Alternative 3 (No Action Scenario)	
	Construction	Operation	Construction	Operation	Construction	Operation
Water Resources	**0**	**-1**	**0**	**-1**	**0**	**0**
Water usage for insecticide dilution and cleaning	0	-1	0	-1	0	0
Land Use	**-2**	**-1**	**-2**	**-1**	**0**	**0**
Building storerooms and insectaries	-1	0	-1	0	0	0
Building fixed soak pits	-1	-1	-1	-1	0	0
Socioeconomic	**+2**	**+4**	**+2**	**+3**	**0**	**-3**
Social	+1	+2	+1	+1	0	-2
Economic	+1	+2	+1	+2	0	-1
Public Health	**+2**	**+6**	**+2**	**+3**	**0**	**-2**
Reduction in mortality and morbidity	0	+2	0	+1	0	-2
Increased knowledge and capacity	+1	+2	+1	+1	0	0
Efficient waste management system	+1	+2	+1	+1	0	0
Air Quality	**0**	**-1**	**0**	**0**	**0**	**0**
Waste management system	0	-1	0	0	0	0
Habitat Alteration	**+1**	**+2**	**0**	**0**	**-1**	**-1**
Waste management	+1	+2	0	0	-1	-1
Biodiversity	**+1**	**+2**	**+1**	**+1**	**0**	**0**
Waste management	+1	+2	+1	+1	0	0
GHG Emissions	**-2**	**-2**	**-2**	**-2**	**0**	**0**
Transportation of staff, insecticides and spray teams	0	-1	0	-1	0	0
Energy usage for offices and insectaries	-1	-1	-1	-1	0	0
Operating construction machinery	-1	0	-1	0	0	0
Column Totals	**+2**	**+9**	**+1**	**+3**	**-1**	**-6**
Alternative Totals	**+11**		**+4**		**-7**	

Notes: (+2) highly positive effect/beneficial; (+1) positive effect/beneficial; (-2) significant negative effect/highly detrimental; (-1) negative effect/detrimental; (0) remains the same (i.e., no effect or same rate of change versus becoming progressively worse or better).

4.4 EVALUATION OF THE ALTERNATIVES

Based on the above table, Alternative 1, the Preferred Action, has the most highly beneficial effect, with the least amount of overall environmental impact. Although there are some minor potential negative environmental impacts from construction and maintenance of facilities and the use of water resources, the social, economic, and health benefits outweigh these impacts. In addition, the impacts can be eliminated or minimized by following best management practices and utilizing the mitigation strategies in the Safer Use Action Plan and the Environmental Mitigation and Monitoring Plan.

4.5 RATIONALE FOR ELIMINATING ALTERNATIVES NOT INCLUDED FOR FURTHER EVALUATION

Over time, the IRS project has undergone considerable analysis that indicates it is an essential intervention to reduce the morbidity and mortality of malaria, in concert with other interventions such as net distribution, LSM IPTp and case management with ACTs. The available alternatives will not produce the same benefits as the proposed course of action.

4.6 RANKING OF ALTERNATIVES WITH RESPECT TO SIGNIFICANCE OF ENVIRONMENTAL IMPACTS

The preferred alternative is the only one that meets the project purpose and need of reducing the prevalence and spread of malaria. Other alternatives are not as efficient, and will not reduce the malaria burden to the same degree. Please reference the numerical rankings in Table 2 above.

5.0 ENVIRONMENTAL CONSEQUENCES

Per 22CFR216.6(c), this section forms the analytic basis for the comparisons of the identified alternatives.

5.1 ENVIRONMENTAL IMPACTS OF THE PREFERRED ACTION AND ALTERNATIVES

5.1.1 DIRECT EFFECTS AND THEIR SIGNIFICANCE

i. Positive Impacts[66]

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.

ii. Potential Negative Impacts

Contamination of Surface Watercourses and Underground Water

During IRS implementation, it is possible to accidently release insecticides into water bodies during the transportation and storage of pesticides, application of insecticides to walls, and clean-up of IRS equipment and PPE. It is also possible to have a 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 affected.

Contamination of underground water resources is also 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. Secondarily, 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.

Potential Impacts to Non-Target Organisms from Insecticides

The potential impacts to non-target organisms from insecticide use is summarized in the Table 1 of Section 6.6. It is apparent that the most significant potential effects would be on fish and other aquatic organisms, as well as bees. However, these potential impacts are mitigated by the use of PMI Best Management Practices (BMPs), and the fact that insecticide spraying is confined to indoor surfaces and eaves, which are only sprayed when winds are low. Also, BMPs regarding liquid and solid waste management are strictly followed, which eliminate or reduce any release to the environment.

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[66] https://www.pmi.gov/how-we-work/technical-areas/indoor-residual-spraying

5.1.2 Indirect Effects and Their Significance

i. Indirect Positive Impacts

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[67], 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[68].

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, as well as per capita income for workers. The most direct economic benefit of IRS is the reduction in household health expenditures associated with reduced malaria prevalence.

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 Tanzania 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 Tanzania 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.

Finally, a reduction in household pests from IRS may result in a reduction in other diseases carried by the pests, therefore by reducing the overall burden on the healthcare system.

ii. 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.

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[67] https://www.worldbank.org/content/dam/Worldbank/Feature%20Story/Africa/afr-marie-anne-valfort.pdf

[68] https://www.path.org/media-center/fighting-malaria-in-the-workplace/

In general, if PMI supports the procurement of insecticide or disposition of unused insecticide to the Government of Tanzania, 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 Tanzania 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 Tanzania, 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 Malaria Focal Person 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 Malaria Focal Person, 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.

5.1.3 Cumulative Effects and Their Significance

A cumulative environmental effect of IRS is the potential for contribution to the development of resistance to insecticides by the vector mosquitoes. Although other activities such as agricultural pesticide use have a potentially greater impact, this is a serious problem for IRS and other mechanisms of malaria control, such as ITNs. Widespread resistance to pyrethroids is an established fact in Africa, and has practically eliminated the usefulness of pyrethroids in IRS.

Tanzania has responded to this threat through the development of an Insecticide Resistance Management Plan, which, among other things, calls for rotation of insecticides on a biannual basis, and incorporation of new insecticides into the rotational scheme upon their PQ-listing by WHO and in country registration by TPRI

Organophosphates are the pesticides with the highest potential for cumulative health 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 to strictly follow the safer use action plan to prevent exposure to insecticides, and 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. [69]

5.1.4 Area of Land Disturbance

In the execution of IRS, there are very small areas of land disturbance, and these occur in already developed areas, mainly within health center grounds. An operations site normally consists of a secure storeroom in which to store insecticides, a wash area and soak pit to conduct end of day cleanup and uniform laundering, and sanitary facilities. Upgrade and maintenance of these facilities provide a positive benefit to the community, both during IRS and in the off-season, where they can be used for similar or other purposes.

5.1.5 Impacts to Endangered, Threatened or Protected Species and Their Habitats

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 its Annex A, Environmental Mitigation and Monitoring Plan 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.

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. Tanzania has a very big potential on beekeeping. It is estimated that Tanzania has about 9.2 million honeybee colonies with production potential of about 138,000 tons of honey and 9,200 tons of wax. The challenge of facing beekeeping is that the country is still depending on traditional approaches of beekeeping (Bee keeping Policy 1998)

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.

[69] Mitchell, David, et al, (2015).

5.1.6 Impacts to Forestry and Biodiversity

No significant impacts to forestry and biodiversity are expected due to the limitations placed upon the choice of locations for operations sites, the use of PMI BMPs in all phases of the project, and the indoor use of insecticides. Waste management and disposal are highly regulated and supervised according to PMI waste management policies, which favor reduction, reuse, and recycling.

5.1.7 Wetland Impacts

No significant impacts to wetlands are expected due to the limitations placed upon the choice of locations for operations sites, the use of PMI BMPs in all phases of the project, and the indoor use of insecticides. Waste management and disposal are highly regulated and supervised according to PMI waste management policies, which favor reduction, reuse, and recycling.

5.1.8 Possible Conflicts Between Preferred Action and Land Use Plans

The practice of IRS has very little impact on land use. Facilities that are used year round are limited to 2-3 medium-sized (1500-10,000 sq. ft.) storage buildings, and are usually pre-existing facilities in major urban areas. Most operations sites for PMI IRS are located within land that is already dedicated to health facilities, and developing them for IRS use involves little modification. IRS insecticides and commodities are stored in districts on a temporary basis (~60 days) in pre-existing buildings that are used for other purposes the rest of the year. Occasionally, the project will renovate or expand damaged, insecure, or otherwise unsuitable buildings to meet PMI BMPs, but these facilities are usually put to beneficial use when not occupied by the IRS project.

5.1.9 Possible Conflicts Between Preferred Action and Policies and Controls for Areas Concerned

No conflicts are expected due to the limitations placed upon the choice of locations for operations sites, the use of PMI BMPs in all phases of the project, and the indoor use of insecticides. During this environmental assessments, the project has identified all protected areas in the vicinity of operations, and will restrict activities to be in compliance with relevant policies and controls. The project has also researched and documented applicable laws and regulations, and will conform activities to be in compliance.

5.1.10 Energy Requirements and Conservation Potential of Various Alternatives and Mitigation Measures

IRS has been determined to be an essential component of PMI's goal to reduce the prevalence, morbidity, and mortality of malaria in targeted areas. Given that determination, PMI works with ministries of health in host countries to execute the project in a manner with the greatest possible impact. Therefore, at the present time, there are no feasible alternatives to IRS.

However, there are inherently low energy requirements for the execution of IRS. The fixed requirements consist of electricity for lights, air conditioning, computers, and other office equipment in the occupied facilities. A more significant energy requirement results from the transportation of people, insecticides and commodities to the remote locations where IRS is performed. For economic and logistical reasons, transportation requirements are carefully planned to minimize the type and number of vehicles used, and trips taken, which therefore minimizes the energy (fuel) requirements. Motorcycles are used extensively for supervisor transport, and modified three-wheeled vehicles transport spray operators as well as insecticides and equipment.

5.1.11 Natural or Depletable Resource Requirements

The major depletable resource usage is the insecticide itself, which is an international import. In Tanzania, natural materials (branches, shrubs, grass) are usually used in the construction of enclosures around operations sites, and for the construction of changing rooms and bathrooms. These are renewable resources, and are used in small quantities that do not have a significant impact on the area where they are harvested. The project also uses stone, concrete, wood chips, and charcoal in small quantities for the construction of soak pits for liquid waste disposal.

5.1.12 Conservation Potential of Various Requirements and Mitigation Measures

Although the resource requirements of the project are small, PMI strives to be as efficient and economical as possible. Through the establishment of BMPs and the extensive training of spray team members, all materials are used as efficiently as possible. Insecticide purchase quantities are carefully calculated using population data and knowledge of typical structure sizes in particular areas. Extensive inventory control measures are in place, with serialization of insecticide packages, and complete chain of custody paperwork. Data systems are in place to compare actual vs. projected usage, and anomalies are investigated immediately. Any insecticide leftover at the end of the day is collected, stored, and reused the following day for make-up water. Most IRS insecticides have a two year shelf life, and any insecticide left over from spray operations in a given year are used up the following year before new material is introduced.

Soak pits are used for three years before the materials are evacuated and the wood chips and charcoal are replaced, while the stones are replaced and reused. All commodities are reused from year to year, as practical, and are recycled at end of life, particularly plastic bottles, buckets and basins. Throughout the life of the AIRS and VectorLink projects, over 4,000,000 plastic insecticide bottles have been recycled to produce useful products, such as electrical conduit, paving stones, and oil tanks. Cardboard containers formerly containing insecticide are also recycled wherever the facilities are available in the host country.

5.1.13 Urban Quality

PMI does not perform IRS in urban areas in Tanzania, so the potential for impact on environmental and social quality are minimal. The project has an office in Mwanza and Zanzibar and storerooms in the outskirt of Mwanza and in a fenced area in Zanzibar town with a small effect on traffic.

5.1.14 Historic and Cultural Resources

Through this environmental assessment, historic and cultural resources in Tanzania have been identified, and measures will be taken to avoid negative impacts. The project will decline to conduct activities in the vicinity of these resources if any impacts that cannot be mitigated are suspected.

5.1.15 Design of the Built Environment, Including Reuse and Conservation Potential of Various Alternatives and Mitigation Measures

Please see descriptions above. The built environment for IRS is minimal, operations are designed to be efficient, and recycling is an established practice wherever suitable facilities are available.

5.1.16 Means to Mitigate Adverse Environmental Impacts

PMI has developed a project-wide Environmental Mitigation and Monitoring Plan that considers all potential impacts of the IRS project and lays out the mitigation measures and monitoring plan for those impacts. The EMMP is included in Annex A of this SEA.

5.2 COMPARISON OF ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES

5.2.1 SUMMARY

Accepting that IRS is a necessary component of PMI's strategy to reduce the morbidity and mortality of malaria, the preferred alternative is the one with the maximum positive benefit and the least negative impact. PMI will consistently monitor the alternatives to IRS, and adjust the project and priorities accordingly.

5.2.2 COMPARISON OF REMEDIES AVAILABLE FOR THE ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES

The remedies to the environmental consequences of the alternatives to the proposed are the same, with the exception of the No Project alternative, which does not meet PMI's objectives, and does not require any environmental mitigation.

5.2.3 OVERALL COMPARISON OF ALTERNATIVES WITH RESPECT TO FEASIBILITY, ABILITY TO MEET PROJECT GOALS, ENVIRONMENTAL IMPACT RANKING, COSTS, AND SCHEDULE FOR COMPLETION

The preferred alternative is the most desirable in terms of the ability to meet project goals, and is more feasible in terms of the needed partnership of the Government of Tanzania. Its environmental impact is virtually the same as other alternatives, with the exception of the No Project alternative, which does not meet the project purpose and need to reduce malaria.

5.3 ADVERSE IMPACTS THAT CANNOT BE AVOIDED

The major adverse impact that cannot be avoided is the increase in the load of insecticide on the environment, although that load is largely confined to the inside of homes. There, it is a potential health, rather than environmental impact, through potential resident contact with treated surfaces. The insecticide is designed to dry on the wall in relatively small concentrations, and to be fairly inaccessible in quantities large enough to be harmful. Through the development of BMPs, the intensive training of spray team members, and multiple layers of supervision, the insecticide should be applied where it is needed, and not pose a threat to the health of the beneficiaries.

Information campaigns and mobilization are critical to ensure the safety of residents and spray operators. Household preparation actions will be completed before spraying begins so that spray operators can use the spray technique taught during training that results in high-quality IRS. These actions also minimize the risk of injury to the spray operator inside the house and will ensure that household items will not be contaminated with insecticide.

Post-spray actions are necessary to ensure resident's safety after IRS and that the insecticide has the longest-lasting effect possible. For more information on household preparation and post-spray actions, refer to BMP 2 of the 2020 PMI BMP Manual.

5.4 RELATIONSHIP BETWEEN SHORT TERM USES OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

The use of the environment for IRS is very limited, and will not affect the long term productivity of natural resources.

5.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

IRS is resource intensive, and especially consumes large quantities of insecticide. In addition, there are large quantities of commodities and consumables required to support the operations. PMI's IP strives for resource efficiency, and through experience has developed systems that minimize resource usage. However, the project continually looks for more efficient methods, and is particularly good at disseminating best practices seen in one country across the entire portfolio, as practicable.

6.0 PESTICIDE EVALUATION REPORT

The PMI document Integrated Vector Management Programs for Malaria Vector Control Programmatic Environmental Assessment updated in 2017 analyzed all WHOPES 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 Tanzania IRS program includes assistance in both of these aspects, it is subject to this regulation. This section addresses each of those twelve factors for the Malaria Control Program in Tanzania.

6.1 USEPA REGISTRATION STATUS OF THE PROPOSED 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 6.1–6.12 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 Tanzanian authority, to use in country 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.

6.2 BASIS FOR SELECTION OF THE PESTICIDE

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

6.2.1 PRIMARY CRITERIA FOR CHOOSING PESTICIDES:

a) **Approval by the WHO:** Only insecticides recommended by WHO PQ team or by USEPA can be used in IRS. Certain pesticides in the organophosphate, carbamate, pyrethroid, neonicotinoid, and the clothianidin/deltamethrin combination are WHO PQ-recommended for use in IRS. Chlorfenapyr (pyrrole class) is not yet recommended by WHO, but

authorization is requested in this SEA to use it for hut trials, and for IRS if and when WHO PQ listed[70].

b) **Registration for use in country:** The Tropical Pesticide Research Institute under the Ministry of Agriculture Plant Protection Directorate is responsible for regulating the registration, importation and use of agricultural and public health pesticides in Tanzania. Currently, classes of pyrethroid (deltamethrin), lambda-cyhalothrin, alpha-cypermethrin, pirimiphos methyl (Actellic®), SumiShield® 50 and Fludora® Fusion are registered in the country. Insecticide import permits are processed annually depending on the insecticide approved by NMCP and ZAMEP in collaboration with PMI and other partners.

c) **Residual effect of selected pesticides:** The residual effect of selected pesticides must be for a period longer than, or at least equal to, the average duration of the malaria transmission season in the area. According to WHO, all WHO PQ-listed pyrethroids, carbamates, organophosphates and neonicotinoids 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. All WHO-recommended larvicides in the: bacterial, benzoylureas, juvenile hormone mimics, organophosphates and spinosyns class are expected to stay active and effective for 7-10 days after application, but can be longer for standing clear water or with treatment at higher dosages.

   In Tanzania, the peak periods of malaria incidence occurs from January to February, following the main rainy seasons (September to-December), and from June to July, during and after the heavy rainy seasons (March to May).

d) **Appropriate for use on the wall surfaces of the selected location:** The majority of structures in the targeted regions are made of thatch/wood covered with a mud plaster and in some cases, walls made of commercial plaster. Ceilings and eaves are constructed with thatch and are sprayed during IRS. Pyrethroids, carbamates, organophosphates, clothianidin/deltamethrin combination and neonicotinoids are known to function well on these surfaces, and are therefore appropriate for use.

e) **Local vector susceptibility to the insecticide:** One of the major concerns when implementing an IRS campaign is to prevent resistance to insecticide among vectors. Resistance to insecticide develops when a hereditary feature is selected in an insect population that reduces the population's sensitivity to a given insecticide.

The major malaria vectors in most areas of Mainland Tanzania are members of the *Anopheles funestus* group *and Anopheles gambiae complex*; *Anopheles funestus* account for the majority (56.3%) followed by *Anopheles arabiensis* (24.9%) and the least is *Anopheles gambiae ss.* (18.8%). *Both An. funestus* and *An. gambiae ss* exhibit endophilic and anthropophagic behaviour and these species are highly affected by the use of indoor interventions such as IRS and LLINs. Another member of the *An. gambiae* complex, *An. arabiensis* is an opportunistic species either feeding on humans or animals and indoor or outdoor depending on factors including geographical location and blood-host availability. Due to its feeding and resting habits, *An. arabiensis* is considered less vulnerable to IRS or LLINs but more vulnerable to larval source management. *An. funestus* is associated with dry season

[70] http://www.who.int/pq-vector-control/prequalified-lists/en/

and prefer breeding in permeant water bodies under direct sunlight while members of the *An. gambiae s.l*. breed in clean temporally water bodies exposed to direct sunlight.[71]

The United States Agency for International Development (USAID)–funded Okoa Maisha Dhibiti Malaria (OMDM)/Save Lives, End Malaria Activity conducted routine entomological surveillance and insecticide residual efficacy testing in Mainland Tanzania's Lake Zone (11 sites) and Zanzibar (10 sites) to assess the efficacy of IRS from September 2018 through October 2019. Similarly, routine monitoring of the susceptibility status of major malaria vectors to insecticides were conducted in 22 sentinel districts of Mainland Tanzania and 8 in Zanzibar. These entomological monitoring activities were implemented in partnership with the National Institute for Medical Research (NIMR) Mwanza Centre, NIMR Amani, and the Zanzibar Malaria Elimination Programme (ZAMEP).

Insecticide resistance monitoring (Mainland Tanzania). An. gambiae s.l. were resistant to permethrin (mortality rate less than 90%) in 14 out of the 22 sentinel sites. The 14 sites are Biharamulo, Geita, Igunga, Kakonko, Kasulu, Kibaha, Kibondo, Kilwa, Misenyi, Newala, Rorya, Tandahimba, Tunduru, and Ukerewe. Malaria vectors were resistant to deltamethrin in all districts that showed resistance to permethrin. Resistance to dichlorodiphenyltrichloroethane (DDT) was recorded in Biharamulo, Kasulu, Kibondo, Misenyi, Tandahimba, and Ukerewe. Resistance to bendiocarb was recorded in Biharamulo, and resistance to pirimiphos-methyl was recorded in Kilosa. Vectors were fully susceptible to clothianidin in all seven sentinel sites where it was tested (i.e., Geita, Ukerewe, Rorya, Kibondo, Kakonko, Kasulu, Biharamulo). The Anopheles mosquitoes showed 100% mortality on Day 6, 24 hours before the recommended post-exposure observation period of 7 days.

The resistance intensity to permethrin was high in Kibondo and Ukerewe. There was also a high resistance intensity to deltamethrin in Misenyi and Rorya. Full restoration of susceptibility after pre-exposure to piperonyl butoxide (PBO) was observed against permethrin and deltamethrin exposure at all sites; the only exceptions were for permethrin in Ukerewe and Misenyi and for deltamethrin in Biharamulo and Misenyi. These responses suggest that insecticide resistance in the An. gambiae population is primarily mediated by an oxidase-based metabolic resistance (cytochrome P450s), with minor contributions from other mechanisms, including knockdown resistance (kdr) gene mutations.

Molecular and biochemical tests revealed the occurrence of both target site mutations (kdreast [L1014S]) and metabolic (cytochrome P450) resistance mechanisms in the resistant sentinel districts, respectively. Also, kdr-east (L1014S) were detected in mosquitoes in more than half (14 out of 22) of the sentinel districts, with allelic frequencies ranging from 2% in Nachingwea and Geita to almost 90% in Kibondo. Likewise, the mean levels of oxidase enzymes were significantly higher in mosquitoes from almost all resistant sentinel districts, demonstrating the existence of oxidase types of metabolic resistance.

Insecticide resistance monitoring (Zanzibar). An. gambiae s.l. was resistant to deltamethrin, permethrin, and alphacypermethrin (mortality less than 90%) but remained susceptible to bendiocarb and pirimiphos-methyl (mortality greater than 98%) across all sites.

[71] Tanzania Ministry of Health, Community Development, Gender, Elderly and Children, 2020

The resistance intensity varied between the two islands, being higher in Pemba than Unguja. Pre-exposing An. gambiae s.l. to PBO restored complete susceptibility to the three pyrethroids tested, indicating the involvement of cytochrome P450 in observed pyrethroid resistance.

To summarize:

- The insecticides found to be widely resistant are the pyrethroids which are not on the insecticide rotation list for the IRS program
- Malaria vectors are susceptible to Sumishield which is in current use, therefore it thus good option for insecticide rotation
- Actellic which is on the list of rotation malaria vectors have developed resistance in Biharamulo but are susceptible in other areas, we may further consult not to use Actellic in Biharamulo
- Fludora Fusion which will be on use for IRS for the first time need to be monitored for future decision making.

f) **Ecological impact:** Tanzania 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. More information on ecological impact of the proposed pesticides is found in Section 5.1 as well as other sections of this document.

Climate impacts of IRS 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**.**

g) **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).

6.2.2 Secondary Selection Criteria:

Once the MOHCDGEC and PMI approve the analysis of these factors, then the criteria is updated to include international procurement language in which the criteria is clearly stipulated and then tendered out in accordance with international open competitive procurement rules. Once there are responses to the call for bids, the resulting proposals are subjected to secondary criteria including:

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

6.3 THE EXTENT TO WHICH THE PROPOSED PESTICIDE USE IS PART OF AN INTEGRATED PEST MANAGEMENT PROGRAM

Integrated Pest Management (IPM) is defined[72] 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 [agricultural products]. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials [pesticides] are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment."

IPM is often used in an agricultural context, but similar in nature is the concept of 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, ITNs 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 and ITN distribution will be implemented as a component of IVM for malaria control in Tanzania. 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.

6.4 PROPOSED METHOD(S) 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

[72] (http://www.ipm.ucdavis.edu/IPMPROJECT/about.html

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.

For effective application of an insecticide, a specific discharge rate must be maintained. The following IRS equipment will be used:

- **Spray Nozzles -**The program in Tanzania will procure 8002E nozzles for the spray pumps, which are the standard size recommended by WHO for mud walls.
- **Spray pumps**- The spray operators who implement IRS using Hudson and Goizper backpack compression sprayers are trained to apply a measured amount of insecticide on the interior walls of houses and structures. Goizper sprayers are designed to automatically shut off when the control flow valve (CFV) cannot maintain the specific flow rate for effective IRS. For Hudson sprayers fitted with a CFV, the flow through the lance will not work when the pressure is too low to maintain appropriate flow. For Hudson sprayer with pressure gauges, spray operators are trained to re-pressurize the sprayer when the pressure falls below 35 psi. 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 to the interior walls of targeted house (structure). After the day's spraying is complete, SOPs must clean the sprayer following the manufacturer's recommendations to ensure their proper operation and calibration.

6.5 ACUTE AND LONG-TERM TOXICOLOGICAL HAZARDS ASSOCIATED WITH PREFERRED 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 8: The Degree of Toxicity of WHO PQ-recommended IRS Insecticides

IRS Insecticide	Mammal	Bird	Fish	Other Aquatic	Bee	Persistence	Bioaccumulate
Alpha-cypermethrin (P)							
Bendiocarb (C)							
Bifenthrin (P)							
Cyfluthrin (P)							
DDT (OC)							
Deltamethrin (P)							
Etofenprox (P)							
Fenitrothion (OP)							
Lambda-cyhalothrin (P)							
Malathion (OP)							
Pirimiphos-methyl (OP)							
Propoxur (C)							
Chlorfenapyr							
Clothianidin (N)							

Source: IVM PEA 2012 and 2017

Key

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

6.5.1 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. 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 7 and Annex A.

6.6 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 6.2 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.

6.6.1 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 MOHCDGEC in collaboration with the PMI-supported VectorLink Tanzania project, and the results from this ongoing program are the primary determinants of the choice of pesticide and other supplementary actions.

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. More information on vector susceptibility is seen in Section 6.2.1.(e).

6.6.2 VECTOR BEHAVIOR

Pesticide efficacy is also affected by vector behavior, insecticide quality, and the residual action of the pesticide. The probability of vector-pesticide contact depends on whether the targeted vector feeds indoors (endophagic) and rests indoors (endophilic), as this increases the likelihood of the vector resting on the sprayed wall. The efficacy of the pesticide to kill may be either compromised if the vector exits after feeding without resting on the wall, or absent if the vector feeds outdoors (exophagic) and rests outdoors (exophilic). For the 2018/19 entomological monitoring report in IRS areas indicated that there was a general decrease in indoor biting rate in all sprayed sentinel sites following IRS operations (from October 2018 to May 2019). However, indoor biting rates increased in Kakonko (the highest so far – reaching up to 15 bites per person per night, from December 2018 to May 2019). The rest of sprayed districts maintained low indoor biting rate during the reporting period. In unsprayed districts, indoor biting rate for both *An. gambiae s.l.* and *An. funestus*. started to increase, from January 2019. *An. gambiae s.l* dominated in most of the unsprayed sites except in Kibondo where An. funestus s.s was highly sampled. However, because people spend more time indoors during the mosquito's preferred biting time (night time), a mosquito more often has to go inside to bite, which means people can still be protected by IRS. This coupled with those districts with high endophagic rate, IRS still remain potential to protect the population in targeted districts against Malaria.

6.6.3 RESIDUAL EFFICACY

The residual efficacy of the pesticide being used for IRS is crucial to evaluating the implication of vector resistance. Generally, a positive correlation between observed vector resistance and a decline in pesticide efficacy is an important criterion in determining the need for a change of the pesticide in a local area. It is important that wall bioassays be carried out at specified intervals after the IRS operation in order to determine the period and level of residual activity in a given locality and the sprayed surface. In 2020/21, the residual efficacy of Actellic 300CS, Fludora Fusion, and SumiShield 50WG will be determined from cone bioassays which will begin two weeks following IRS and continue on a monthly basis until mortality is less than 80% for two consecutive months.

6.6.4 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 Tanzania 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.

6.7 COMPATIBILITY OF THE PROPOSED PESTICIDE WITH TARGET AND NON-TARGET ECOSYSTEMS

The pesticides are compatible with the target environment (walls, ceilings, eaves) in that they dry on these surfaces, and are not released to receptors or the general environment to any great extent. The dried pesticide remains on the sprayed surfaces, and performs as designed, killing

vector mosquitoes that rest on them, and the exposure to non-target organisms and ecosystems is very limited.

The 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 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. 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 (Section 7).

6.8 THE CONDITIONS UNDER WHICH THE PESTICIDE IS TO BE USED

Section 3.6 of this SEA discusses in detail the environmental conditions that exist in Tanzania relative to the implementation of IRS. In Tanzania IRS is implemented in the Lake Zone Regions and in Zanzibar where climatological conditions (Temperature, humidity and rainfall) are very favorable to malaria vector abundance which consequently leads to malaria transmission.

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 Section 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.

6.9 THE AVAILABILITY AND EFFECTIVENESS OF OTHER PESTICIDES OR NON-CHEMICAL CONTROL METHODS

In Tanzania, 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 Tanzania 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[73,74,75]. Each of these agents has been evaluated for effectiveness within the program, and continuing monitoring for resistance and susceptibility will be employed to allow up-to-date decisions prior to each spray campaign. 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 6.3, 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).

6.10 HOST COUNTRY'S ABILITY TO REGULATE OR CONTROL THE DISTRIBUTION, STORAGE, USE, AND DISPOSAL OF THE REQUESTED PESTICIDE

In Tanzania, Tropical Pesticide Research Institute (TPRI) under the Ministry of Agriculture is responsible for regulating the registration, importation and use of agricultural and public health pesticides. The Institute is equipped with laboratory and staff to monitor insecticides quality whether produced in country or imported. The quality of the pesticide used can have a large impact on the effectiveness of the IRS undertaking.

More information on Tanzania's authority, policy, regulations and permitting requirements are detailed in Section 3.7 of this SEA.

6.11 PROVISIONS 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

[73] 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)

[74] 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, 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.

[75] http://www.who.int/pq-vector-control/prequalified-lists/en/

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, 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 Tanzania. 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, storekeepers, and team leaders are trained on all aspects of IRS operations. 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 7, the Safer Use Action Plan.

6.12 PROVISIONS MADE FOR MONITORING THE USE AND EFFECTIVENESS OF THE PESTICIDE

Entomological monitoring is conducted by a PMI IP 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.

7.0 ENVIRONMENTAL MITIGATION AND MONITORING/SAFER USE ACTION PLAN

This section outlines the mitigation plan 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. To mitigate contamination that has been observed during the end of the day clean up at the washing slab, the project has designed a new alignment of the washing area. The fence will have two gates, one for inlet and the other one as an exit to ensure that after cleaning at the slab, SOPs goes directly to changing rooms where they drop off coverall and step into the shower rooms. Further the new design will provide a water delivery point outside the cleaning area to serve the shower rooms and thus eminimizing the chance of SOPs going back to the cleaning area. Other mitigation measures, along with monitoring and reporting information, are compiled in the EMMP found in Annex A.

7.1 IMPLEMENTATION CONDITIONS

During implementation, PMI/Tanzania 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.

7.1.1 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.

7.1.2 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 Tanzania. 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.

7.1.3 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 the Environmental Compliance Officer (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 ECO or a qualified designate, using a smart phone.

Prior to long-distance transport of the insecticide from the customs warehouse or VectorLink Tanzania 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 1: Emergency Response to a Spill

IN CASE OF INSECTICIDE SPILLS

- Control, contain, and clean up the spill.
- Don protective clothing prior to attempting to clean the spills.
- 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.
- Onlookers and bystanders must be kept away from the accident site.
- If the crew has come in contact with the pesticides, they must remove contaminated clothing immediately and wash the pesticide off their skin.
- For major spills send for help immediately; Drivers must have a charged cell phone and an emergency number for use in such cases.
- 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.
- 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.

7.1.4 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
- Temperature controlled as needed
- 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 Ethiopia 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 Tanzania, IRS is implemented in partnership with the MOH/NMCP; therefore, some warehouses are located on District Medical Office property for logistic and security purposes. Where the government owned storage facilities are not in place, the project hires the facilities from private owners.

7.1.5 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.

7.1.6 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 20-60 L carboy 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 technical drawing of the MSP in Figure 6 of Section 9.2 and the PMI BMP manual.[76]

7.1.7 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 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

[76] Chandonait, Peter. February 2020. *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.

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.

1.1.1.1. 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.

7.1.8 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.

7.1.9 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 2020 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.

7.1.10 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, District Medical Officers, 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 Tanzania National Malaria Strategic Plan (2014-2020) and PMI Malaria Operational Plans. The IEC campaign (as well as IRS project leaders and MOH/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.

7.1.11 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.

7.1.12 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.

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 Tanzania, as such solid wastes are incinerated in a PMI-owned incinerator and the IP will incorporate the ash and slag into concrete.

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 Tanzania, the management of contaminated wastes from IRS activities will be handled using various approaches including incineration using project-owned and operated incinerators located in Mainland Tanzania and Zanzibar. Other approaches will include recycling, reuse and disposal at the government landfill.

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.

7.2 ENVIRONMENTAL MONITORING PLAN

Please see the project-wide Environmental Mitigation and Monitoring Plan in Annex A.

8.0 LIST OF PREPARERS

Name	Expertise	Experience	Professional discipline
Peter Chandonait	Environmental compliance, engineering, water treatment	11 years USAID environmental compliance experience	Environmental Engineering, Environmental Policy
Joshua Mutagahywa	Environmental compliance, public health	4 years of PMI IRS environmental Compliance experience	Environmental Science and Management & applied zoology

9.0 APPENDICES

9.1 TERMS OF REFERENCE

The procedure for conducting this SEA is detailed in Section 8.4.

9.2 RELEVANT MAPS

Figure 2: Map of Tanzania indicating IRS targeted districts 2020/21

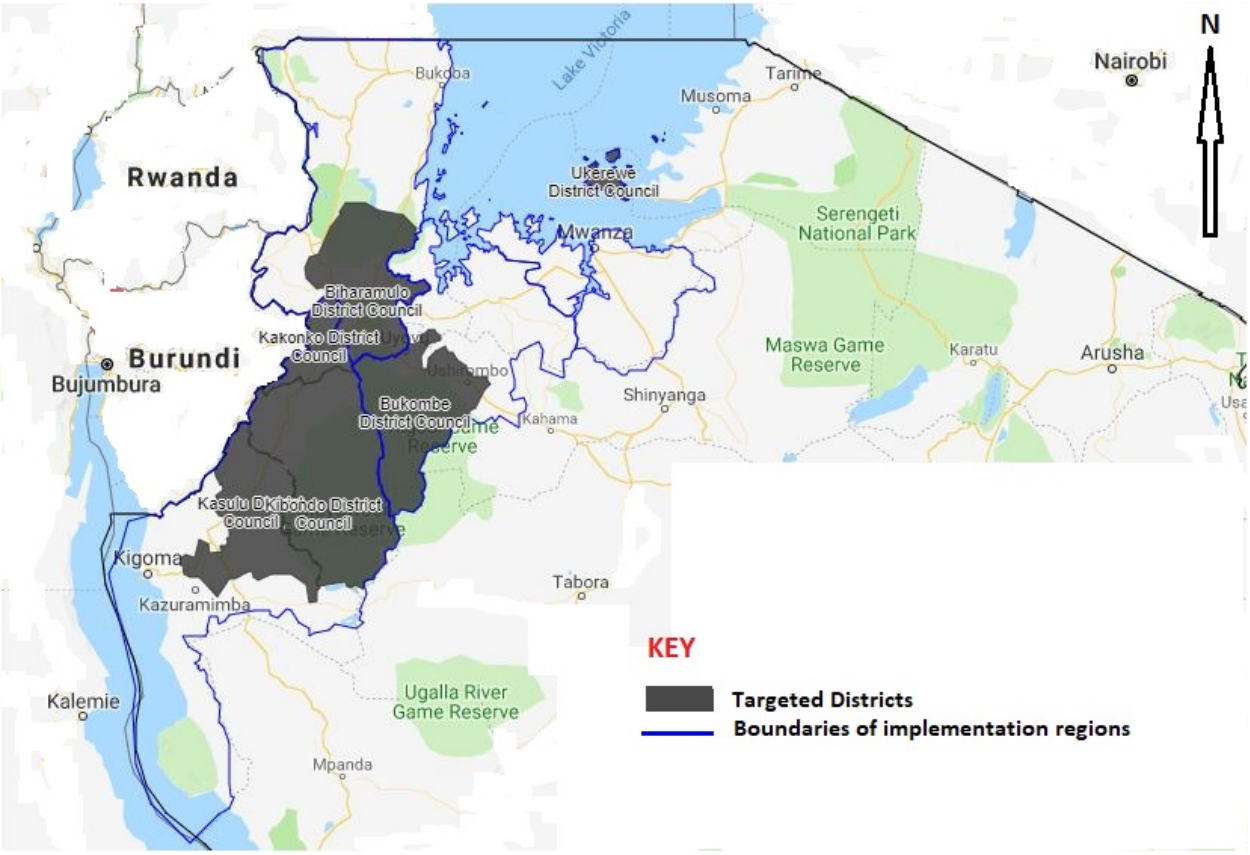


Figure 3: Map of Zanzibar showing targeted IRS zones

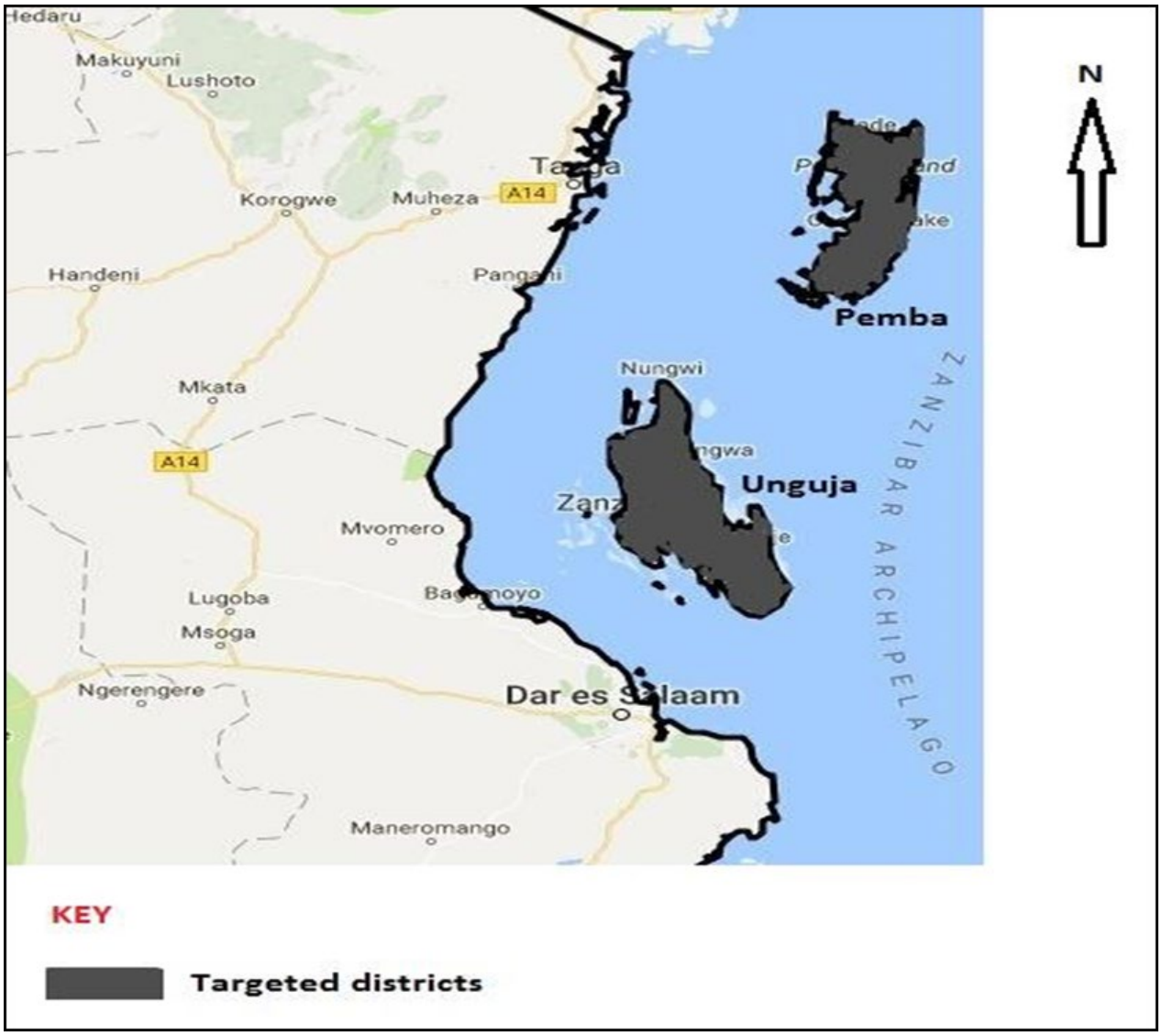


Figure 4: Map of Tanzania regions supported by PMI/VectorLink project for nets

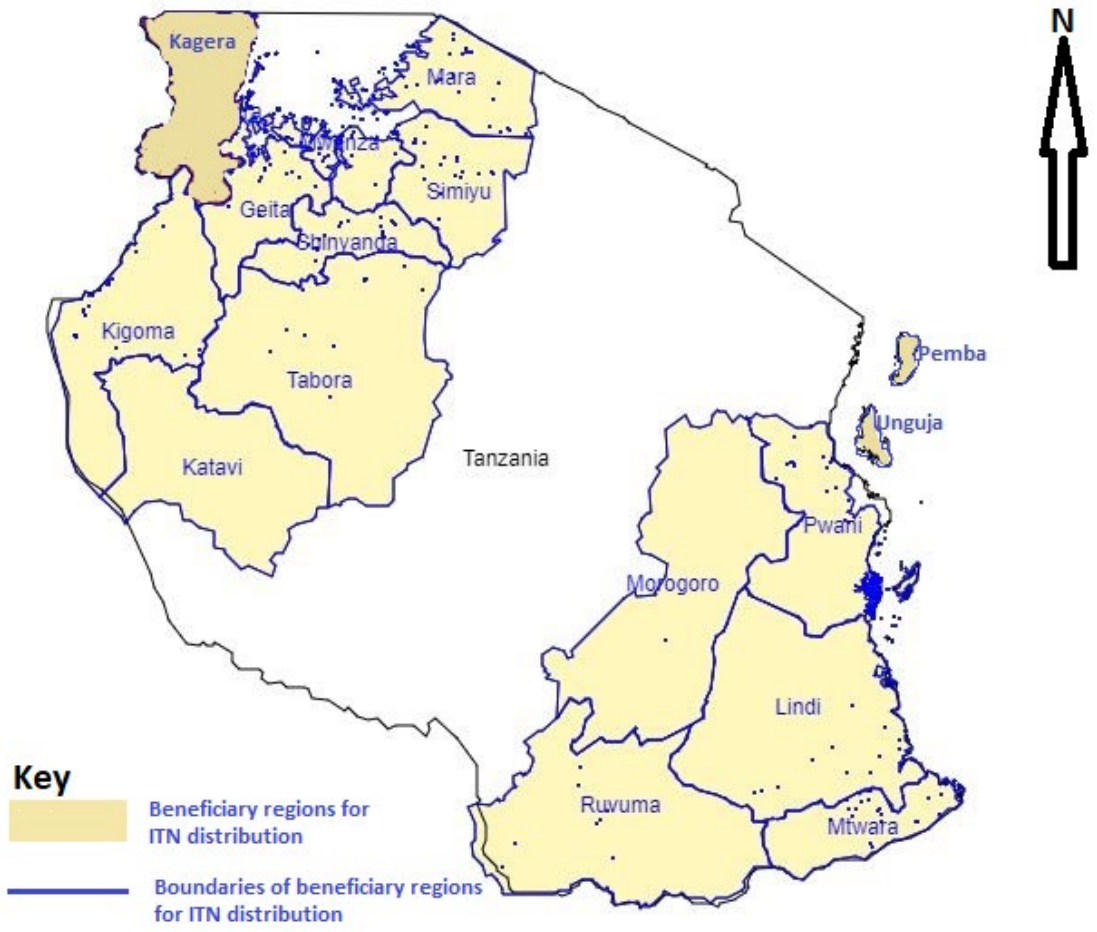


Figure 5: Map of Tanzania's Protected Areas

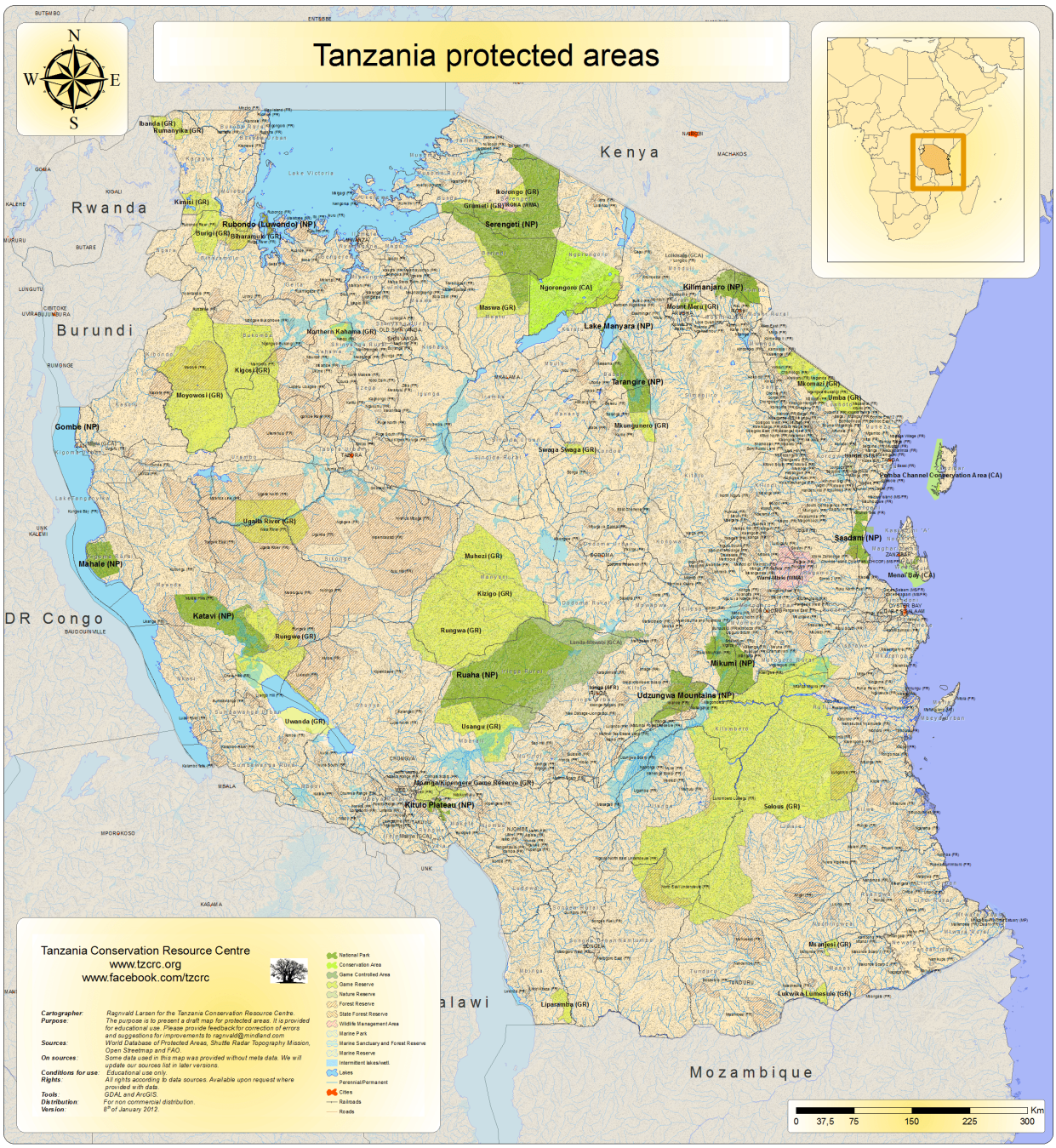


Figure 6: Map of Tanzania Indicating Administrative Regions

9.3 TECHNICAL DESIGNS AND DRAWINGS

Figure 7: Mobile Soak Pit Layers

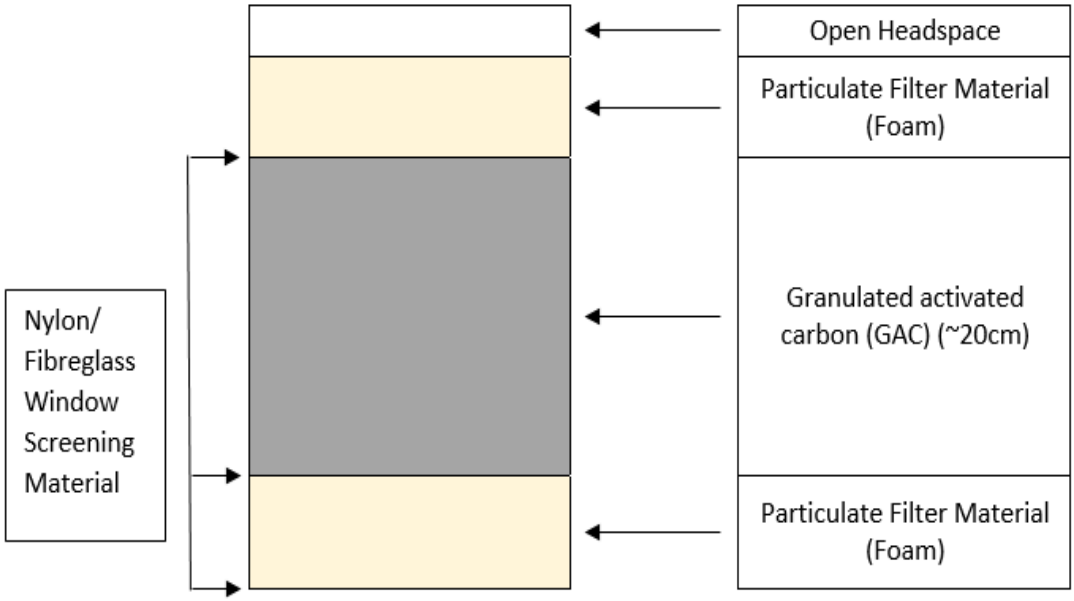


Figure 8: Layout for washing bay and soak pit

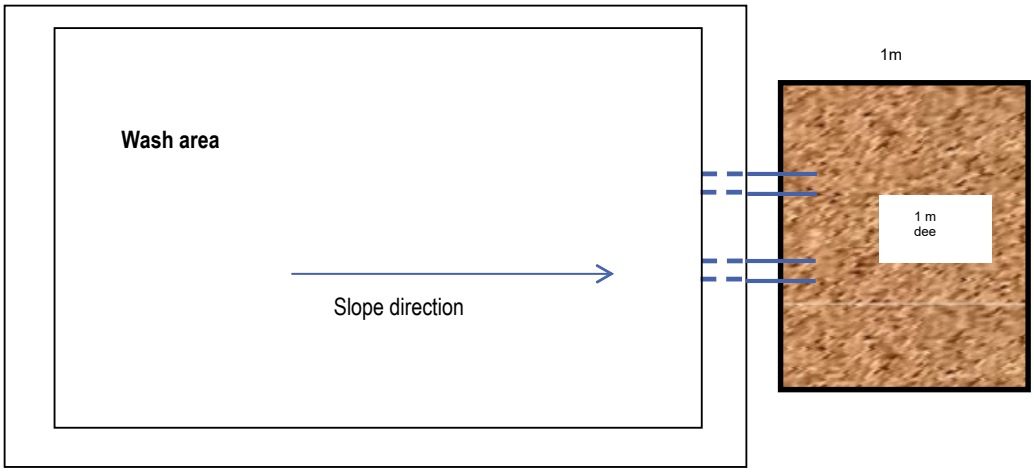
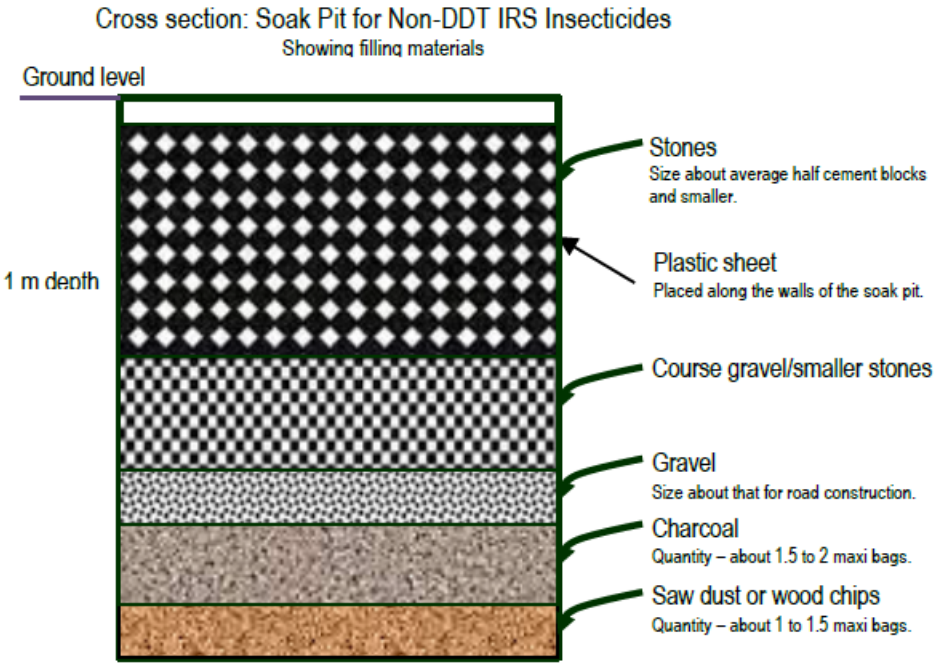


Figure 9: Cross section of IRS soak pit



9.4 DOCUMENTATION OF STAKEHOLDER CONSULTATION

Peter Chandonait, Director of Environmental Compliance and Safety, VectorLink project of Abt Associate served as the lead writer and provided in-country support for the SEA. He travelled to Tanzania to gain a comprehensive understanding of the potential impacts of IRS in Tanzania, and design feasible mitigation strategies and measures. The VectorLink Tanzania in-country team assisted in gathering information and coordinating meetings in-country.

The main purpose of Peter Chandonait trip to Tanzania to update the draft was:

- Meet with relevant stakeholders such as the PMI to identify priorities and concerns.
- Obtain the necessary information to update the Supplemental Environmental Assessment
- Review EC and supervisory tools (mHealth and ODK) utilized by the project to ensure sound oversight of the program.
- Inspect soak pits and store rooms to ensure they are environmentally compliant.
- Participate in the Final PSECA and Greenlighting of operational sites
- Supervise the insecticide supply chain management: transport, storage, empty bottles management, records systems with stock cards, ledger register and spray performance. Physical counts of stock at the storerooms and ensuring all insecticide sachets are tracked in and out daily by the store manager and team leader.
- Supervise morning mobilization, evaluate breakfasts and daily monitoring of operators health.
- Supervise homeowner preparation and the spray operator performance.
- Supervise end of day activities such as the triple rinse, washing of PPE, handling of contaminated items
- Supervise spray operations; propose appropriate mitigating solutions to challenges as necessary. Ensure spray quality measures are implemented in compliance with program policies and standards.
- Check for correct marking on household
- Review waste management practices

Prior to traveling to Tanzania, a discussion and arrangements were conducted between Peter Chandonait and ECO for PMI VectorLink Tanzania to identify key stakeholders and potential areas to be visited to harness the required information to assemble the SEA report, the stakeholders met included;

- The National Environmental Management Council
- Regional Medical Officer for Geita

- Regional Malaria Focal Person for Geita Region
- Council Health Management Team for Ukerewe District
- District Medical Officer and Health Officer for Bukombe District
- Supervisors, store keepers, Team Leaders, Spray Operators and some IRS beneficiaries in the community in the Districts of Ukerewe and Bukombe which were operating IRS at the time of visit.
- Tanzania VectorLink staff which included COP, Operations Manager, ECO, Logistics Manager, Warehouse Managers and Regional Coordinators.

The most outstanding finding was the widespread acceptance of IRS. The leaders went further to request for the wide coverage of IRS in other Districts where malaria burden is high in the country.

Further literature review from various documents relevant to SEA report was conducted. Reviewed documents included national policies, laws, regulations and international treaties and agreements

9.5 ANNEX A: ENVIRONMENTAL MITIGATION AND MONITORING PLAN (EMMP)

PMI VECTORLINK PROJECT (AID-OAA-TO-17-00027)

Category of Activity	Specific environmental threats	Mitigation Measures for these activities	Responsibility for monitoring?	Monitoring Indicator	Monitoring Method	Frequency of Monitoring
1. Education, Technical Assistance, Training	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
2. Research and Development	Entomological surveillance and vector control research use laboratory equipment, chemical reagents, insecticides, and entomological surveillance supplies that have the potential to cause adverse health and environmental impacts if not	• 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. • 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,	Laboratory personnel within the respective country, with oversight provided by Abt Associates technical experts.	• EHS manual/Standard operating procedures (SOPs)implemented per PMI and country-specific requirements • Training of staff in activities related to the laboratory EHS manual/SOPs	• Review of EHS manual/SOPs to ensure it is appropriate, and complies with PMI, WHO and country-specific recommendations for safety, use of personal protective equipment (if needed), spill prevention, and training.	• Routine site visits, as needed, to ensure accordance with operating plan

	properly managed. These materials require special care and management to minimize their expiration and/or damage.	FAO) and host country requirements. ● Provide training to workers on the approved SOPs or Waste Management Plan (WMP) developed for properly handling and disposing of wastes.			● Review training materials and logs to verify trainings were conducted ● Confirm during routine visits that SOPs are being effectively implemented and that workers are reporting EHS incidents ● Include date of visits, findings and any non-compliance issues in the annual EMMR ● Include photographs from site visits	
3. Public Health Commodities	N/A	N/A	N/A	N/A	N/A	N/A
4. Small-Scale Construction	Lack of necessary permits and assessments in place in advance Improper siting or construction techniques causing: - Deterioration of human and social environments: - Erosion or sedimentation	Obtain all needed authorizations prior to construction: permits, environmental and social impact assessments, etc. Retain competent, licensed professionals to design and supervise construction Establish health, safety and environmental obligations in all contracts. Complete a site emergency action plan	Abt Associates technical overseers and Environmental Compliance Officers, with assistance from USAID Mission personnel. Contractors	Permits on file Construction contracts are in place for engaged professionals and reflect requirements of USAID guidelines for small-scale construction Waste management	● Review all demolition, emergency, safety, waste management, and construction plans and contracts prior to renovations. ● Provide continual oversight of operations by regular site inspection visits. Review WMP to	Pre-, mid- and post construction. Inspect construction sites at least weekly

	- Creation of disease vector habitat Use of construction equipment can cause injuries to workers and bystanders. Construction activities during 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. Exposure to hazardous building materials during renovation activities can result in health impacts to workers. Waste produced during the construction or refurbishment	Provide safety training to all workers using construction equipment Identify closest health care facility to handle injuries 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 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 (IP). All results of the testing for asbestos shall be communicated to the COR. Develop and follow a waste management plan (WMP). Identify authorized recycling or disposal facilities prior to generation of waste. Minimize the generation of waste by: - Correctly assessing material needs (not over-buying) - Reducing amount of packaging used by suppliers - Reusing material on site, such as use of discarded materials for leveling ground and filling trenches, etc. Designate secure on-site waste storage facilities		plan in place and being followed to identify and characterize all waste streams from the project with the proposed final disposal option ● SOPs implemented ● Staff briefings on activities related to SOPs	ensure it is adequate ● Review records to verify trainings/ briefings were conducted	

	work can be harmful to the environment and human health. Use of environmentally unsustainable construction materials such as wood can lead to environmental degradation Lack of personal protective equipment may lead to accidents, injuries, or exposure of workers. Construction activities may produce noise and air pollution Construction activities can create standing water and breeding habitats for disease vectors.	Ensure all workers are trained and dispose of wastes properly. Complete and track hazardous waste manifests for all shipments Source all construction material from an ecologically safe provider. 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. Ensure first aid and spill clean-up kits are easily available ● Contractors must comply with the "Small-Scale Construction" chapter of the USAID Sector Environmental Guidelines (https://www.usaid.gov/environmental-procedures/sectoral-environmental-social-best-practices/seg-construction/pdf) Contractor will provide drinking water, latrine and a handwashing station to workers. Contractors will arrange working hours to minimize disruption to the community. If needed, construct drainage canals and infiltration pits for management of storm water and prevention of soil erosion. ● Post-construction: ensure leftover materials have been properly disposed of.				

5. Small-Scale Water and Sanitation	N/A	N/A	N/A	N/A	N/A	N/A
6. Nutrition	N/A	N/A	N/A	N/A	N/A	N/A
7.a. Vector Control - IRS	1. 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).	• 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. • Procurement and inventory logs must be maintained. • Ensure storage facility and personal protective equipment (PPE) are appropriate for the active ingredient used and in accordance with approved SOPs. • Distribute insecticides to facilities that can manage such commodities safely in storage, use, and disposal (i.e. in a manner generally equivalent to IP's own SOPs/WMP)	District Coordinator (DC), Operations Manager (OM), Abt Environmental Compliance Officer (ECO), Abt Vector Control Manager (VCM), Storekeepers (These positions are representative of the responsibilities required, but may not reflect the exact job title.)	• PMI BMPs reviewed and implemented • Procurement and inventory logs maintained • Proper PPE used by workers, if needed. • Operations facilities are sited appropriately • All insecticide management records are reviewed and maintained	• Inspection of facilities, conditions, PPE use, and logs • Review of waste management records and storekeeper performance checklists. • Verify that inspection reports and storage records are properly maintained and document verification in the annual EMMR. • ECO performs mid-application inspections. Verify that inspection reports are properly maintained and document verification in the annual EMMR	• Daily monitoring by storekeeper or site supervisor • Weekly monitoring by DC • Monthly review of procurement logs and inventories by OM

	2. Occupational risks for workers involved in IRS campaigns.	• Inspect and certify vehicles used for insecticide or team transport prior to contract. • Train drivers • Ensure availability of cell phone, personal protective equipment (PPE) and spill kits during insecticide transportation. • Initial and 30-day pregnancy testing for female candidates for jobs with potential insecticide contact. • Health test all spray team members for duty fitness. • Procure, distribute, and train all workers with potential insecticide contact on the use of PPE. • Train operators on mixing insecticides and the proper use and maintenance of application equipment. • Provide adequate facilities and supplies for end-of-day cleanup. • Enforce application and clean-up procedures.	DC, OM, ECO, Chief of Party, and Abt Associates technical experts within the respective country	a. Transport vehicles have a valid inspection certificate on-board. b. Drivers have a certificate of training completion. c. Transport vehicles are equipped with cell phone, spill kit, and PPE. d. Records are kept of pregnancy testing for all female team members. e. Records are kept of medical exam results for all team members. f. Operators wear complete PPE during application and clean-up, according to SOP requirements. g. Operators mix insecticide properly, and equipment does not leak. h. All facilities are compliant, and	a-c. ECO inspection of vehicles in the field. d-e. ECO inspection of health records at operations sites. f-h. ECO performs pre-application inspections of inventories and training records, and mid-application inspections of PPE use and operator performance. i. Monitoring of on-line database for submission of inspection reports.	a-c. 2 inspections per week. d-e. One inspection per campaign, additional inspection if new hires or more than 30 application days. f-h. ECO pre-application inspections 2 per campaign, ECO mid-application inspections 5 times per week. i. Weekly

				materials required for clean-up are present. i. Inspections are performed as scheduled, 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)	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 b. Ensure health facility staff are aware of insecticide poisoning management	IEC officers, OM, ECO, host country MOH/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.	● Storage facilities and transportation vehicles must be physically secured to prevent theft. ● Maintain records of all insecticide receipts, issuance, and return of empty containers. ● Conduct analysis comparing number of houses treated vs. number of containers used. ● Examine houses treated to confirm application ● Perform physical inventory counts during the application season.	Storekeepers, District coordinators, sector managers, logistics coordinator, OM, ECO	● Storage facilities and transportation vehicles are secured. ● All insecticide management records are reconciled.	● Inspection of storage facilities and transportation vehicles. ● Inspection of insecticide management records. Storekeeper performance checklists. ● ECO mid-campaign inspections.	● Daily monitoring by storekeeper or site supervisor. Weekly monitoring by District Coordinator ● Examine houses during campaign according to schedule in SOPs. ● Physical inventory counts twice per campaign

						per store room.
	5. Ecological risk to non-target species and water bodies from use of insecticides	• 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. • 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 • Ensure application equipment and PPE are appropriate for the active ingredient used and in accordance with approved SOPs, and maintain equipment to avoid leaks. • Maintain application equipment • No application of insecticides within 30 meters of beekeeping sites	DC, OM, ECO	• Training materials and records • Equipment is maintained and operated to eliminate leaks. • Applicators only mix and apply insecticides according to SOPs	• Review training materials and records to verify trainings were conducted • Conduct inspections during operations. • Verify that inspection and incident reports are properly maintained and document verification in the annual EMMR. Include any issues identified during inspections in the annual EMMR	• Inspect work records once per campaign • Inspections during operations 3 times per week • Review training materials once per campaign
	6. Environmental risk from disposal of liquid and solid wastes	• Handling, treatment, and disposal of nonhazardous (general waste) and hazardous wastes must be in accordance with the approved WMP/SOPs	DC, OM, ECO	• WMP implemented and disposal sites inspected and certified	• Review WMP/SOPs to ensure it conforms to PMI BMPs and WMP	• Pre-application inspections: once per campaign

		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 ● Choose sites for disposal of liquid wastes, including fixed and mobile soak pit sites according to PMI BMPs ● Construct fixed and mobile soak pits with charcoal according to the BMPs to adsorb insecticide from rinse water ● Maintain soak pits as necessary during season ● Monitor waste storage and management during campaign ● Monitor disposal procedures post-campaign		before campaigns. ● Disposal sites near operations sites are appropriate according to PMI BMPs ● Soak pits are constructed according to PMI BMPs ● Soak pits perform properly throughout the application season ● Wastes are stored and managed according to PMI BMPs ● Waste disposal is conducted in accordance with the WMP/SOPs and records maintained	is available on site ● 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 ● 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. ● Review WMP/SOPs to for effectiveness and maintain on site	● Mid- and post-application inspections: twice per campaign ● Review of WMP/SOPs during campaign

	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.	• Wastes will only be disposed in incinerators that comply with PMI BMPs Collect and maintain treatment and disposal documents and records on file • Country-level USAID EC documentation must contain guidance on proper disposal of wastes • Contaminated solid wastes that requires incineration will be treated at 2 PMI-owned incinerators located in Mwanza and at the Kivunge Cottage Hospital Zanzibar. These incinerators are owned and operated by the project and are both Inciner 8 Model P25 M1 which has an operating temperature of 850-1200°C.	COR, Abt ECO, Abt Technical Experts	• Incinerator specifications • Maintenance of treatment and disposal records • Reg 216 documentation for incinerator procurement and management services reviewed by COR and GH BEO.	• Review incineration records and document in the annual EMMR	• Review incinerator specifications prior to disposal arrangement • Annual review of disposal records
7.b. Vector Control - Testing of Insecticide-Treated Nets.	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.
7.c. Vector Control - Distribution of Insecticide-treated Nets Applies only in countries where VectorLink distributes ITNs to beneficiaries and is	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	Visual observation and evidence (photos) of storage	Continuous observation

responsible for ITN transport, storage, distribution, disposal and/or SBC activities.				with country-specific and established guidelines	capacity, security, conditions	
	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.
	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	Ensure that SBCC messages	IEC coordinator,	Presence or	Visual observation	Annually.

	environmental impacts of bags and baling materials used to package LLINs	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.	ECO	absence of SBC materials on best practices included in MOH communication plans or materials developed with VectorLink support.	of MOH plans, materials developed with VectorLink support	
8. Emergency Response	N/A	N/A	N/A	N/A	N/A	N/A

9.6 ANNEX B: ENVIRONMENTAL MITIGATION AND MONITORING REPORT FORM

PMI VECTOR LINK TANZANIA PROJECT

Implementing Organization: Abt Associates

Geographic location of USAID-funded activities: Tanzania

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
2. Research and Development ● 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. ● 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. ● Provide training to workers on the approved SOPs or Waste Management Plan (WMP) developed for properly handling and disposing of wastes.			
4. Small-Scale Construction ● Obtain all needed authorizations prior to construction: permits, environmental and social impact assessments, etc. ● Retain competent, licensed professionals to design and supervise construction ● Establish health, safety and environmental obligations in all contracts. ● Complete a site emergency action plan			

● Provide safety training to all workers using construction equipment ● Identify closest health care facility to handle injuries ● 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 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 IP. All results of the testing for asbestos shall be communicated to the COR ● Develop and follow a waste management plan (WMP). Identify authorized recycling or disposal facilities prior to generation of waste. ● Minimize the generation of waste by: - Correctly assessing material needs (not over-buying) - Reducing amount of packaging used by suppliers - Reusing material on site, such as use of discarded materials for leveling ground and filling trenches, etc. ● Designate secure on-site waste storage facilities ● Ensure all workers are trained and dispose of wastes properly. ● Complete and track hazardous waste manifests for all shipments ● Source all construction material from an ecologically safe provider. ● 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. ● Ensure first aid and spill clean-up kits are easily available ● Contractors must comply with the “Small-Scale Construction” chapter of the USAID Sector Environmental Guidelines			

(https://www.usaid.gov/environmental-procedures/sectoral-environmental-social-best-practices/seg-construction/pdf). ● Contractor will provide drinking water, latrine and a handwashing station to workers. ● Contractors will arrange working hours to minimize disruption to the community. ● If needed, construct drainage canals and infiltration pits for management of storm water and prevention of soil erosion. ● Post-construction: ensure leftover materials have been properly disposed of.			
7a. Indoor Residual Spraying ● 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. ● Procurement and inventory logs must be maintained. ● Ensure storage facility and personal protective equipment (PPE) are appropriate for the active ingredient used and in accordance with approved SOPs. ● Distribute insecticides to facilities that can manage such commodities safely in storage, use, and disposal (i.e. in a manner generally equivalent to IP's own SOPs/WMP)			
● Inspect and certify vehicles used for insecticide or team transport prior to contract. ● Train drivers ● Ensure availability of cell phone, personal protective equipment (PPE) and spill kits during insecticide transportation.			

• Initial and 30-day pregnancy testing for female candidates for jobs with potential insecticide contact. • Health test all spray team members for duty fitness. • Procure, distribute, and train all workers with potential insecticide contact on the use of PPE. • Train operators on mixing insecticides and the proper use and maintenance of application equipment. • Provide adequate facilities and supplies for end-of-day cleanup. • Enforce application and clean-up procedures.			
• 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 • Ensure health facility staff are aware of insecticide poisoning management			
• Storage facilities and transportation vehicles must be physically secured to prevent theft. • Maintain records of all insecticide receipts, issuance, and return of empty containers. • Conduct analysis comparing number of houses treated vs. number of containers used. • Examine houses treated to confirm application • Perform physical inventory counts during the application season.			
• 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. ● 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 ● Ensure application equipment and PPE are appropriate for the active ingredient used and in accordance with approved SOPs, and maintain equipment to avoid leaks. ● Maintain application equipment ● No application of insecticides within 30 yards of beekeeping sites			
● 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 ● Choose sites for disposal of liquid wastes, including fixed and mobile soak pit sites according to PMI BMPs ● Construct fixed and mobile soak pits with charcoal according to the BMPs to adsorb insecticide from rinse water ● Maintain soak pits as necessary during season ● Monitor waste storage and management during campaign ● Monitor disposal procedures post-campaign			
● Wastes will only be disposed in incinerators that comply with PMI BMPs Collect and maintain treatment and disposal documents and records on file			

• Country-level USAID EC documentation must contain guidance on proper disposal of wastes			
7b. Testing of ITNs • Store nets only in storerooms secured with sturdy doors, locks, and barred windows.			
7c. Distribution of ITNs • 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			
• Store LLINs in dry, ventilated facilities			
• Store in a secure facility to prevent theft or unauthorized access. Post guard or use barred windows as needed			
• Do not store LLINs with food, feed, or potable water supplies			
• Provide worker training on the proper handling of 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)			
• 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.			

9.7 ANNEX C: SUMMARY OF ACUTE EXPOSURE SYMPTOMS & TREATMENT OF IRS PESTICIDES

9.7.1 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.

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

Organophosphate	Human Side Effects	Treatment
Malathion	Malathion is an indirect cholinesterase inhibitor. The primary target of malathion is the nervous system; it causes neurological effects by inhibiting cholinesterase. 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.	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). Exposure to high levels of malathion that result in respiratory distress, convulsions, and unconsciousness should be treated with atropine and a re-activator. Morphine, barbiturates, phenothiazine, tranquillizers, and central nervous system stimulants are all contraindicated.
Fenitrothion	Fenitrothion is the most toxic to humans of the insecticides recommended for residual house spraying, and has a relatively low margin of safety. It is absorbed through the gastrointestinal tract as well as through intact skin and by inhalation and a cholinesterase inhibitor.	Dermal exposure to fenitrothion should be treated by removing contaminated clothing, rinsing the skin with water, washing the exposed areas with soap and water, then seeking medical attention. If fenitrothion gets into the eyes, they should be rinsed with water for several minutes. Contact lenses should be removed if possible and medical attention should be sought. Ingestion of fenitrothion should be treated by rinsing the mouth and inducing vomiting if the person is conscious. Inhalation exposures require removal to fresh air and rest in a half-upright position. Artificial respiration should be administered if indicated, and medical attention should be sought.
Pirimiphos-methyl	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.	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. 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.

		Atropine sulfate: Administer atropine sulfate intravenously, or intramuscularly if intravenous injection is not possible. Glycopyrolate has been studied as an alternative to atropine and found to have similar outcomes using continuous infusion.

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

Pyrethroids	Human Side Effects	Treatment
Bifenthrin	Acute exposure symptoms include skin and eye irritation, headache, dizziness, nausea, vomiting, diarrhea, excessive salivation, fatigue, irritability, abnormal sensations of the face and skin, and numbness. No skin inflammation or irritation observed; however, can cause a reversible tingling sensation. Incoordination, irritability to sound and touch, tremors, salivation, diarrhea, and vomiting have been caused by high doses.	Depends on the symptoms of the exposed person. Casual exposures require decontamination and supportive care. Wash affected skin areas promptly with soap and warm water. Medical attention should be sought if irritation or paresthesia occurs. Eye exposures should be treated by rinsing with copious amounts of water or saline.
Deltamethrin	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. 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 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.”	If exposed immediately remove any contaminated clothing. Soak any liquid contaminant on the skin; clean affected area with soap and warm water. Rinse copiously with water when eye exposures occur, or with 4% sodium bicarbonate. Vomiting should not be induced following ingestion exposures, but the mouth should be rinsed.

Lambda-cyhalothrin	Skin exposure leads to transient skin sensations such as periorbital facial tingling and burning. Can irritate the eyes, skin, and upper respiratory tract. Oral exposure can cause neurological effects, including tremors and convulsions. Ingestion of liquid formulations may result in aspiration of the solvent into the lungs, resulting in chemical pneumonitis.	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.
Alpha-cypermethrin	Acute exposure symptoms include skin rashes, eye irritation, itching and burning sensation on exposed skin, and parasthesia. Acute inhalation exposures may cause upper and lower respiratory tract irritation. Ingestion of alpha-cypermethrin is also harmful.	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.
Cyfluthrin	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.	If exposed, immediately remove any contaminated clothing. Soak any liquid contaminant on the skin; clean affected area with soap and warm water. Rinse copiously with water when eye exposures occur, or with 4% sodium bicarbonate. Vomiting should not be induced following ingestion exposures, but the mouth should be rinsed.
Etofenprox	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.	If exposed, immediately remove any contaminated clothing. Soak any liquid contaminant on the skin; clean affected area with soap and warm water. Rinse copiously with water when eye exposures occur, or with 4% sodium bicarbonate. Vomiting should not be induced following ingestion exposures, but the mouth should be rinsed.

9.7.4 Summary of Acute Exposure Symptoms and Treatment for Chlorfenapyr

Human side effects	Treatment
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. 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.	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. 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. 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. 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. 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. 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. 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.

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

Human Side Effects	Treatment
Clothianidin is a systemic insecticide belonging to the nitroguanidine subgroup of nicotinoid insecticides. It is also referred to as a chloronicotinyl or neonicotinoid. 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. Large deliberate ingestions have caused agitation, seizures, metabolic acidosis, coma, hypothermia, pneumonitis, respiratory failure, hypotension, ventricular dysrhythmias, and death. 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.	MANAGEMENT OF MILD TO MODERATE TOXICITY Treatment is symptomatic and supportive. Administer IV fluids for hypotension. MANAGEMENT OF SEVERE TOXICITY 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.

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

Clothianidin/Deltamethrin combination	
Human side effects	**Treatment**
Local: Skin and eye paresthesia which may be severe, Usually transient with resolution within 24 hours, Skin, eye and mucous membrane irritation, Cough, Sneezing 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	**Systemic treatment**: 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. **Contraindication:** atropine. **Contraindication:** derivatives of adrenaline. There is no specific antidote. Recovery is spontaneous and without sequelae. In case of skin irritation, application of oils or lotions containing vitamin E may be considered.
Environmental Impacts	
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. 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.	

9.8 ANNEX D: CLIMATE RISK MANAGEMENT

BUREAU FOR GLOBAL HEALTH

CLIMATE RISK MANAGEMENT SCREENING TEMPLATE

The PMI VectorLink Project

9.8.1 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	$471 million
Screening prepared By	Allison Belemvire, Malaria Technical Advisor
Management Unit Contact Person	Kristen George, COR
Current Date	March 4th, 2020

9.8.2 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 1st, 2016. [77]

[77] 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.

9.8.3 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.

PMI/Tanzania recommended that 6 districts in Mainland Tanzania and to be determined for Zanzibar who are doing targeted IRS. The 2020/21 spray campaign using Actellic® 300 CS, SumiShield® 50 and Fludora® Fusion. The 2020/21 IRS campaign will be implemented in two phases, November – December 2020 and February – March 2021.

9.8.4 CLIMATE RISK MANAGEMENT SUMMARY TABLE

The PMI VectorLink Tanzania

Project Elements	Potential Climate Risk	Climate Risk Rating[78]	How Risks are Addressed at the Project Level	Further Analysis or Actions for Activity Design or Implementation	Opportunities to Strengthen Climate Resilience
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
	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	Moderate risk	Ensure alternative energy sources (i.e. generators and solar panels) and	N/A	Explore utilization of solar panels as an energy

[78] 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.

	networks and internet in offices and field sites.		maintain an alternate communication plan in case of emergency.		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	
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.
Long lasting insecticide treated bed net 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 bed nets.	N/A	
	Increased temperatures can decrease bed net usage	High risk	Monitor bed net 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.

9.9 ANNEX E: NAMES AND POSITIONS OF THE STAKEHOLDERS INTERVIEWED

No	Full name	Company/Organization	Tittle	Phone #
1	Jarome A Kayombo	NEMC	Health Officer	+255 713 296 112
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4	Jane Kadoda	NEMC	Engineer	+255 787 192 132
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17	Dotto Samweli	Ukerewe	IRS Site Supervisor	+255 768 917 844
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