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Desert Locust Surveillance and Control

Programmatic Environmental Assessment

October 2020

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US Agency for International Development

DESERT LOCUST SURVEILLANCE AND CONTROL
PROGRAMMATIC ENVIRONMENTAL ASSESSMENT

OCTOBER 2020

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DESERT LOCUST SURVEILLANCE AND CONTROL PROGRAMMATIC ENVIRONMENTAL ASSESSMENT

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East Africa Locust PEA Topline Outcome

This Programmatic Environmental Assessment (or "PEA") evaluates foreseeably significant environmental and human health impacts of USAID support to desert locust control, including pesticide procurement and/or use. The PEA evaluated desert locust operations in the three East African countries of Ethiopia, Kenya, and Somalia. The PEA now permits USAID to support the procurement and/or use of nine (9) pesticides, an expansion of seven pesticides from the two that were rapidly approved. While the USAID suite of pesticide tools have been expanded, not all that were requested met the criteria. Two (2) of the pesticides requested were deemed too high of a risk for broadcast aerial and land based application in the three countries. Chlorpyrifos and fipronil were NOT approved under USAID's pesticide safety procedures. It should be well-noted that the environmental and human health risks of such campaigns (including with the nine approved) are extremely high, without appropriate measures, as outlined in this USAID environmental regulatory PEA documentation.

Pesticide Class	**Nine (9) USAID Approved AIs for Ethiopia, Kenya, Somalia**
Biopesticide	Metarhizium anisopliae var acridum (also as: Metarhizium acridum) (1)
Insect Growth Regulators	Diflubenzuron, Teflubenzuron, Triflumuron (3)
Pyrethroids	Deltamethrin, Lambda-Cyhalothrin (2)
Carbamates	Bendiocarb (1)
Organophosphates	Malathion, Fenitrothion (2)

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LIST OF ACRONYMS

AGPMM	Locust and Transboundary Plant Pests and Diseases Groups
AI	Active Ingredient
ASAL	Arid and semi-arid lands
APHIS	US Animal and Plant Health Inspection Service
APLC	Australian Plague Locust Commission
BEO	Bureau Environmental Officer
BHA	Bureau for Humanitarian Assistance
BMP	Best Management Practices
CABI	Center for Agriculture and Biosciences
CEC	County Executive Committee (Kenya)
CFR	Code of Federal Regulations
DL	Desert Locust
DLCO-EA	Desert Locust Control Organization for Eastern Africa
DLIO	Desert Locust Information Officer
DFID	Department for International Development
EC	Emulsifiable Concentrate
EFCCC	Environment, Forest, and Climate Change Commission (Ethiopia)
EFSA	European Food Safety Authority
EIA	Environmental Impact Assessment
EHS	Environmental, Health, and Safety
ESK	Entomological Society of Kenya
ERA	Ecological Risk Assessment
EU	European Union
FAA	Foreign Assistance Act
FAO	Food and Agriculture Organization of the United Nations
FEWSNET	Famine Early Warning Systems Network
FGS	Federal Government of Somalia
FMS	Federal Member State (Somalia)
FSNAU	Food Security and Nutrition Analysis Unit
GHS	United Nations' Globally Harmonized System of Classification and Labelling of Chemicals
GIS	Geographic Information System
GPS	Global Positioning System
GUP	General Use Pesticide
HHRA	Human Health Risk Assessment
ICIPE	International Centre of Insect Physiology and Ecology

IGR	Insect Growth Regulator
IOBC	International Organization of Biological and Integrated Control
IRLCO-CSA	International Red Locust Control Organization for Central and Southern Africa
KMD	Kenya Meteorological Department
KWS	Kenya Wildlife Society
MITT	Multi-Institutional Technical Team (Kenya)
MoA	Ministry of Agriculture (Ethiopia)
MoA&I	Ministry of Agriculture and Irrigation (Somalia)
MoALFC	Ministry of Agriculture, Liestock, Fisheries, and Cooperative Development (Kenya)
MoH	Ministry of Health (Ethiopia)
NADFOR	National Disaster Preparedness and Food Reserve Authority (Somaliland)
NGO	Non-Governmental Organization
NLCU	National Locust Control Unit
OFDA	Office of Foreign Disaster Assistance
OP	Organophosphate
P&N	Purpose and Need
PCPB	Pest Control Product Board
PEA	Programmatic Environmental Assessment
PPE	Personal Protective Equipment
PPSD	Plant Protection Services Division (Kenya)
PSMS	Pesticide Stock Management System
PRG	Pesticide Referee Group
REA	Regional Environmental Advisor
RFS	Bureau for Resilience and Food Security
RUP	Restricted Use Pesticide
SAICM	Strategic Approach to International Chemicals Management
SDGs	Sustainable Development Goals
SNNPR	Southern Nations Nationalities and Peoples' Region
SOP	Standard Operating Procedures
SWALIM	Somalia Water and Land Information Management
ULV	Ultra Low Volume
US EPA	United States Environmental Protection Agency
USG	United States Government
WFP	World Food Programme
WHO	World Health Organization

1 SUMMARY

1.1 ABSTRACT

Technical Scope. This Programmatic Environmental Assessment (PEA) on Desert Locust Control and Surveillance evaluates the foreseeable significant environmental and human health effects of USAID support to desert locust (*Schistocerca gregaria (Forskal))* surveillance and control, including assistance to pesticide procurement and/or use. The PEA does not address surveillance and control of other locust species.

Geographic Scope. The PEA evaluated such desert locust operations for Ethiopia, Kenya, and Somalia, and anticipates future amendments to add additional geographies (as needs may arise) under the current East Africa desert locust outbreak or future outbreaks in East Africa or other regions.

Pesticide Use in Desert Locust Control Drives Environmental and Health Risks. All identified potentially significant adverse effects of desert locust operations on environment and human health derive from the use of pesticides in locust control, particularly as delivered by air and on the ground in wide-area application. These risks, elaborated in Section 7.1 of the PEA, include but are not limited to the following:

- Adverse effects on non-target organisms, including pollinators and beneficial insect predators;
- Water contamination affecting non-target organisms, livestock, and human health;
- Pesticide residue consumption within spray-affected communities and those who consume the products they produce;
- Spray/handler team and community exposure; and
- Multiple risks of residual and obsolete stocks and inadequate storage facilities.

Risks are High in Absence of Measures. It should be well-noted that the environmental and human health risks of pesticide locust control campaigns are extremely high, without appropriate measures. These measures include appropriate pesticide selection, a focus on early intervention with less toxic pesticides and rigorous safer-use measures. This is understood, and key actors such as the Food and Agriculture Organization of the United Nations (FAO), the Desert Locust Control Organization for Eastern Africa (DLCO-EA), and responsible entities within partner country governments endeavor to address these risks.

Risks are Higher than in the United States (US) and its Peer Economies. These efforts notwithstanding, the PEA finds that both history and current capacities and gaps indicate that the use of pesticides in desert locust control campaigns in the areas assessed will incur environmental health and safety (EHS) risks significantly higher than those arguably achieved in the US and its peer economies for control of pests of major importance to health, sustenance, or livelihoods involving pesticides delivered by air and on the ground in wide-area application.

Need for Desert Locust Control is Real. However, the economic and food security need for desert locust control is significant in the assessed countries, and in the context of desert locust outbreaks more broadly. USAID funding provides an important opportunity to achieve safer practices than would otherwise prevail.

Approved Desert Locust Control Pesticide Active Ingredients (AIs). To respond to emergency needs while minimizing risks and promoting standards of responsible practice, the PEA permits USAID to now support a wider scope of desert locust control actions in the assessed countries. This includes assistance to procurement and/or use of pesticide products containing the following—and *only* the following—pesticide active ingredients (AIs), subject to host country approval for such use.

Pesticide Class	Nine (9) USAID Approved AIs for Ethiopia, Kenya, Somalia
Biopesticide	*Metarhizium anisopliae var acridum* (also as: *Metarhizium acridum*) (1)
Insect Growth Regulators	Diflubenzuron, Teflubenzuron, Triflumuron (3)
Pyrethroids	Deltamethrin, Lambda-Cyhalothrin (2)
Carbamates	Bendiocarb (1)
Organophosphates	Malathion, Fenitrothion (2)

This PEA adds additional pesticides to the previously approved 22 CFR 216 analysis which included only the Biopesticide noted above and the organophosphate pesticide Malathion. The PEA assesses these AIs as having hazard and weight-of-evidence risk profiles that are similar to AIs in the same class registered by the US Environmental Protection Agency (US EPA) for similar use.

Two (2) Pesticides were NOT Approved. The approved pesticides (as above) include all but two of the AIs currently listed for locust control by the Food and Agriculture Organization of the United Nations (FAO's) Pesticide Referee Group (PRG). These two pesticides are chlorpyrifos and fipronil, which were rejected due to potentially higher risks. **Chlorpyrifos and fipronil are not approved by this PEA.**

Mandatory Safer User Measures. Such assistance is subject to mandatory safer use, i.e., environmental, health and safety (EHS) risk reduction restrictions. These requirements are enumerated in Section 9 of the PEA. Many also result in increased efficacy and efficiency of pesticide use.

NOTE: USAID support to community-led spray campaigns is not authorized under this PEA.

1.2 EXECUTIVE SUMMARY

Background and Context. Desert locust outbreaks can have severe effects on national and regional food security and agricultural and agro-pastoral livelihoods when they rise to upsurge or plague levels. Currently (mid-2020), Eastern Africa, the Arabian Peninsula, Iran, Pakistan, and India are experiencing a significant desert locust upsurge with high potential for these severe effects.

Desert locust surveillance and control actions are critical to preventing and containing upsurges; USAID's Bureau for Humanitarian Assistance (BHA) is currently providing support to desert locust surveillance and control in Ethiopia, Kenya, Somalia, and Sudan. (See Section 2.2.)

The use of pesticides is a key control measure at multiple life cycle and behavioral stages. Locust control pesticides listed by the Food and Agricultural Organization of the United Nation's (FAO's) Pesticide Referee Group (PRG)—the "PRG list"—are generally accepted by countries for use at the various intervention points.

Origins of this Programmatic Environmental Assessment (PEA). As the current East Africa upsurge evolved, BHA sought to have appropriate pesticide environmental and social analysis, authorizations, and guidance in place to enable it to efficiently and responsibly consider potential future support requests. As elaborated in Section 2.1, it is highly desirable that these authorizations extend to as much of the PRG list as is consistent with due regard for environmental and human health and safety.

While the FAO's PRG reviews and lists pesticides for a combination of efficacy and environmental and human safety (see Section 7.3.2), most pesticides on the PRG list are not registered by the US Environmental Protection Agency (US EPA) for same or similar use, and/or are listed by US EPA as restricted use pesticides (RUPs), or are simply not registered (see Section 7.3.1). Therefore, USAID's environmental procedures prohibit USAID from providing "assistance to procurement, use, or both" for much of the PRG list except as authorized via a duly approved (22 Code of Federal Regulations [CFR] 216) Environmental Assessment or PEA that fulfills the requirements of 22 CFR 216.3(b) ("Pesticide Procedures"), as well as the requirements of 22 CFR 216.6 ("Environmental Assessments"). There are only three exceptions to this requirement, one of which is for "projects under emergency conditions,"[1] where, *inter alia*, "insufficient time is available before the pesticide must be used to evaluate the proposed use in accordance with the provisions of this regulation."

BHA and the BHA Bureau Environmental Officer (BEO) jointly determined that sufficient time *does exist* for review per 22 CFR 216 of the pesticides that may be entailed in such support; the "emergency conditions" exception to the pesticide procedures, therefore, *does not apply* in the context of the current East Africa desert locust upsurge.

In addition, the wide-area use of pesticides in response to desert locust infestations presents potential for significant adverse impacts on environment and human health, and it is consistent with the intent of 22 CFR 216 that such actions be subject to an Environmental Assessment; i.e., the more stringent level of analysis under the regulation.

Finally, it is not certain, but foreseeable, that USAID operating units other than BHA may in the future engage in support to desert locust surveillance and control. This is particularly true as the current East Africa upsurge may be prolonged and long-term climatic changes in and around the Horn of Africa may favor outbreaks

[1] The other two exceptions are for 1) activities to which USAID is a minor donor, as defined in CFR §216.1(c)(12); and 2) research or limited field evaluation purposes by or under the supervision of project personnel.

Purpose of this PEA. BHA and the BHA BEO, in consultation with the Bureau for Africa (AFR) and Bureau for Resilience and Food Security (RFS) BEOs, determined to develop this PEA for desert locust surveillance and control to evaluate the reasonably foreseeable significant environmental and human health effects of current and potential USAID support to desert locust surveillance and control in conformity with 22 CFR 216.6 while also addressing the requirements of 22 CFR 216.3(b). Thereby, this PEA:

- Specifies (1) which pesticides listed for locust control by the 2014 FAO PRG may be supported with USAID funds and (2) associated limitations or required safer use measures;
- Provides a clear synthesis of generally accepted good practices in desert locust surveillance and control, to support evaluation of whether proposed actions are consistent with such practices and, as needs may arise, to inform design of future locust preparedness and response programming; and
- Articulates country-specific considerations and context important to effective engagement in/support for desert locust response, such as strengths and gaps, relevant institutional actors and coordination mechanisms, and particular vulnerabilities.

Geographic Scope. The PEA includes Ethiopia, Kenya, and Somalia, and anticipates future amendments to add additional countries and/or geographies as needs may arise under the current desert locust outbreak or future outbreaks in East Africa and/or other regions. (See Section 2.3. Geographic Scope and Annex B: Process for Amending this PEA).

Scope of Included Actions. The PEA is intended to include the full scope of current and foreseeable USAID-funded desert locust surveillance and control actions. The full scope of actions included are enumerated in Section 2.2.

Species Scope. This PEA evaluates and applies only to surveillance and control of the desert locust (*Schistocerca gregaria (Forskal)*). It does not apply to other locust species e.g., the locust species dominant in the Caucasus and Central Asia: the Italian locust (*Calliptamus italicus*), the Moroccan locust (*Dociostaurus maroccanus*), and the migratory locust (*Locusta migratoria*). Future amendments may broaden the scope of the PEA to other locust species.

Operating Units to which this PEA Applies. While this PEA is developed in response to BHA needs and with BHA (formerly, the Office of Foreign Disaster Assistance (OFDA)) funds, it is applicable to potential future support to desert locust surveillance and control by USAID operating units other than BHA, subject (1) to the approval of the cognizant mission director/Washington equivalent; the BHA BEO, and the cognizant BEO for the subject mission/operating unit/activity; and (2) that any necessary amendment for geographic scope is carried out. (see Section 2.5 and Annex B).

Technical Approach. Per 22 CFR 216.6 and consistent with international practice in environmental and social impact assessment, any PEA analysis must proceed from a formal statement of purpose and need, and must assess the impacts of *alternatives*, including the no-action alternative and the proposed action.

The formal *purpose and need* for this PEA is deliberately narrow, and reflective of USAID's operational reality: "*USAID has a current and foreseeable future need to support desert locust surveillance and control in*

response to Public International Organization (PIO) and partner government[2] *requests consistent with (1) effective and environmentally and safety-conscious control practices and strategies and (2) country context generally and in conformity with USAID's environmental safeguard procedures (22 CFR 216) specifically."* (See Section 4).

All the potential adverse impacts of desert locust control actions identified by the scoping process for this PEA are derived from the use of pesticides. (See Section 7.1). **Without appropriate pesticide selection, a focus on early intervention with less toxic pesticides and rigorous safer use measures, the environmental and human health risks of desert locust control campaigns are extremely high**.

It is also the case that completely uncontrolled spray operations with ill-considered pesticides is not a realistic scenario for USAID-supported control actions, and this is precisely the scenario that key actors like the FAO, the Desert Locust Control Organization for Eastern Africa (DLCO-EA), and responsible entities within partner country governments seek to avoid.

For this reason, the *alternatives* evaluated by this PEA (Section 5) make the following assumptions:

1. That control measures are undertaken with a commitment to FAO's *Desert Locust Guidelines (DL Guidelines)* and Standard Operating Procedures (SOPs) relevant to environment, health and safety (EHS) or equivalent (see Section 3.4);
2. That the interventions are consistent with effective control strategies/techniques (see Section 3.3. and Annex C); and
3. That interventions are consistent with and account for partner country limiting factors.

Given this, the key questions upon which this PEA analysis focuses are:

- To what extent is robust implementation of the above three assumptions *actually* protective of human and environmental health?
- What are the likely failure modes of these assumptions (i.e., failures to implement the safer use actions and other environment, health and safety safeguards built in to the FAO *DL Guidelines* and SOPs in practice) and the risk consequences of such failures?

Budget, time, and the many combinations of potential control measures and foreseeable environmental contexts—among other challenges to parameterization of human/ecological risk assessment models—preclude quantitative assessments of risk/impact to address these questions.

Accordingly, the PEA takes a *comparative, qualitative approach* for characterizing the risks of pesticidal locust control actions as follows:

1. The PEA first examines the extent to which the above assumptions limit the environmental, health and safety (EHS) risks of desert locust control operations to ***the standards deemed acceptable in the US or peer-developed economies*** for control of pests of major importance for health, sustenance, or livelihoods with pesticides delivered by air and on the ground in wide-area applications.[3] It does this through:

[2] BHA in its disaster assistance function (i.e., formerly OFDA) does not support partner governments directly. This aspect of the purpose and need statement anticipates *potential future USAID locust surveillance and control programming not conducted with disaster assistance* funds.

[3] Comparison to US standards is consistent with 22 CFR 216, which ties USAID's characterization and treatment of pesticide risk to US EPA registration status, and thus to US EPA's risk assessment process and determinations.

A. Comparative analysis of pesticide hazard and weight-of-evidence risk;[4] and

B. Qualitative evaluation of the EHS risk mitigation provided in-principle by FAO's relevant *Guidelines* and SOPs.

2. The PEA then examines the likely implementation gaps with respect to the posited EHS safeguards, and qualitatively characterizes how these gaps affect the risks of control actions (Section 7.7). This is assessed by examining:

   A. The EHS gaps identified in the multilateral evaluation of the 2003–2005 desert locust control campaign (Brader, et al. 2006) (Section 7.5.1), and

   B. Gaps and potential gaps identified by country consultations (Section 7.5.2; Annex A).

Based on this analysis, which satisfies the requirements of 22 CFR 216.3(b), the PEA:

- Identifies the recommended alternative (Section 8);
- Enumerates the pesticides for which "assistance to procurement or use or both" are authorized for desert locust control support (Section 9);
- Enumerates the required safer use conditions for these pesticides (Section 9); and
- Makes recommendations for longer-term desert locust preparation and response programming (Section 10).

This technical approach is supported by an extensive set of stakeholder consultations documented in Annex G. In-country consultations were designed to populate an information framework that captures key information regarding country desert locust response actors, capacities, and gaps. The resulting country briefings are presented in uniform format in Annex A.

Findings: Based on the above approach, the PEA found:

1. **With two exceptions, the pesticide active ingredients (AIs) listed by the FAO PRG for locust control are either (1) US EPA-registered for similar use, or (2) have hazards and weight-of-evidence risks that are similar to other AIs in the same class that are so registered.** The two exceptions are chlorpyrifos and fipronil, which have potentially higher risks. These two AIs were, therefore, determined to be ineligible for USAID support and eliminated from subsequent elements of the analysis.
2. **In principle, the chapters of the FAO *Desert Locust Guidelines (DL Guidelines)* and associated SOPs relevant to environmental, health and safety (EHS) do the following:**

   A. Provide risk control equivalent to the requirements for RUP application and for aerial pesticide application in the US; and

[4] Pesticide hazards are the potential harm that a pesticide may cause under specific conditions of use. These derive from the toxicological properties of the pesticide. For example, a pesticide that is neurotoxic has the potential to damage the nervous system. Risk is the probability that harm will actually occur under a given exposure scenario; in toxicology, risk = hazard X exposure. Sensitivity, dose, and route of exposure all influence the magnitude of risk. *Weight of evidence* is a method of assessment that synthesizes multiple sources of information, taking into account their relevance and quality, to reach a decision or characterization. This synthesis may be quantitative or qualitative. In this analysis, a qualitative synthesis based on expert judgement was used.

B. Address, with very limited and partial gaps, the adverse potential impacts and risks of locust control actions on environment and health as enumerated in Section 7.1. (See Section 3.4 for discussion of the FAO DL Guidelines and SOPs, which are the *de facto* international standard for safe and effective practice in locust control.)

3. **If the EHS-relevant FAO *DL Guidelines* and SOPs are implemented with fidelity** the environment, health and safety (EHS) risks of desert locust control operations using FAO PRG-listed pesticides (other than chlorpyrifos and fipronil) can reasonably be assumed to be limited to the standards deemed acceptable in the US or peer-developed economies for control of pests of major importance to health, sustenance, or livelihoods with pesticides delivered by air and on the ground in wide-area applications.
4. **However, implementation with fidelity cannot be assumed,[5] and foreseeable EHS gaps in desert locust control campaigns increase certain EHS risks substantially**, certainly well beyond those arguably achieved in the US and its peer economies for wide-area control campaigns.
5. **In light of the real economic and food security need for desert locust control**, and the opportunity afforded via USAID funding to achieve safer pesticide procurement and use practices, the primary requirement (and challenge) is to minimize risks to the greatest extent practicable and to promote recognized standards of responsible practice, while responding to the development need.

Pesticides Authorized for Desert Locust Control. In consideration of the above, the PEA permits USAID to support a wide scope of locust control actions in the included countries. This includes assistance to procurement and/or use of pesticide products containing the following—and only the following—active ingredients (AIs), subject to partner country approval for such use:

Pesticide Class	Approved AIs
Biopesticide	Metarhizium anisopliae var acridum (also referred to as Metarhizium acridum)
Insect Growth Regulators	Diflubenzuron, teflubenzuron, triflumuron
Pyrethroids	Deltamethrin, lambda-cyhalothrin
Carbamates	Bendiocarb
Organophosphates	Malathion, fenitrothion

Relation of Approved Pesticides to the FAO PRG List. The approved AIs constitute all but two of the AIs currently listed for locust control by the Food and Agriculture Organization of the United Nations (FAO's) Pesticide Referee Group (PRG). The two exceptions are chlorpyrifos and fipronil, which were rejected due to potentially higher risks, as noted above. **Chlorpyrifos and fipronil are not approved by this PEA.**

Mandatory Safer Use Requirements. Any assistance to procurement and/or use of pesticides for desert locust control must comply with 1) mandatory safer use (environment, health and safety (EHS) risk reduction) restrictions on individual AIs and the pesticide classes to which they belong, and 2) a set of safer use requirements that apply across all AIs.

[5] Based on the in-country consultations and on the multilateral evaluation of the 2003–2005 locust control campaign in West Africa

These requirements are consistent with widely accepted elements of pesticide safer use and the risk-reduction principles identified by the PEA (see Section 9.2). They are enumerated in Sections 9.3 and 9.4 of the PEA. Many also result in increased efficacy and efficiency of pesticide use.

In summary, the safer use requirements include the following:

- Conformity to label, with certain minimum environmental and personal protective equipment (PPE) requirements, and with AI selection criteria presented in decision tree form.
- A credible commitment by the implementer to implement in a manner consistent with, and report on adherence to the *FAO Desert Locust Guidelines*, Chapter 6 "Safety and Environmental Precautions" and Chapter 4, "Control."
- That all personnel engaged in aerial application of pesticides will be properly trained, certified, and registered with relevant agencies.
- That all personnel engaged in ground applications will be properly trained and certified or supervised and monitored by fully trained and certified and registered pesticide applicators.
- That all individuals using pesticides must be provided with PPE consistent with the requirements established by the product label, and use of PPE must be monitored and enforced.
- That at-risk communities be properly informed, mobilized, and organized to avoid risk of short- and long-term exposure to hazardous pesticides.
- That all pesticide procurement, use, training, and monitoring be systematically documented, and that EHS monitoring be an integral part of operations and post campaign to ensure proper mixing, use, clean-up, and disposal of pesticides.
- Verification of sufficient funding for compliance with the above.
- Recognizable consistency with the "Understanding of Effective, Responsible Practice for Locust Response and Control" as presented in Annex C and summarized in Section 3.3 of the PEA.

NOTE: It is very unlikely that community-led spray campaigns can meet these safer use requirements. Therefore, support to community-led spray campaigns is not authorized under this PEA.

NOTE: This summary may NOT be provided to USAID implementing partners (IPs) as a basis for compliance or used by USAID as the basis for compliance monitoring. The full text of Sections 9.3 and 9.4 must be used.

Recommendations. The PEA goes beyond the authorized pesticides and required safer use conditions enumerated in Section 9 to offer recommendations regarding USAID engagement in desert locust preparation and response programming, with a focus on environment, health and safety, as well as sustainability more generally. Per the limited mandate of the PEA team, this section is deliberately brief.

The recommendations focus on 1) maintaining preparedness during recession periods by supporting common structures to effectively surveil and respond to the increasing problems of trans-boundary pests more generally; 2) using the country briefings provided in Annex A as a roadmap for engaging the correct actors, leveraging partner country strengths and addressing gaps; and 3) USAID support to research and evaluate desert locust control pesticides and control techniques and potentially the FAO Pesticide Referee Group (PRG) process. (See Section 10).

2 ORIGIN, SCOPE, INTENT, AND APPLICATION OF THIS PEA

This 22 Code of Federal Regulations (CFR) 216 Programmatic Environmental Assessment (PEA) addresses current and potential USAID support to desert locust surveillance and control. This section provides the context and origin of the PEA and enumerates the interventions assessed, geographic scope of, and the intent of the PEA.

ABOUT 22 CFR 216 PROGRAMMATIC ENVIRONMENTAL ASSESSMENTS

Under USAID's environmental safeguard procedures, 22 Code of Federal Regulations (CFR) 216, a Programmatic Environmental Assessment (PEA) is a detailed study of the reasonably foreseeable significant effects of a proposed class of actions on the environments of foreign country(ies). Where covered actions are expected to involve assistance to the procurement, or use, or both of pesticides, the PEA must specifically address human health and safety, among other analysis factors, per USAID's pesticide procedures (22 CFR 216.3(b)). The content, technical approach, and other elements of a PEA are developed in conformity with the Scoping Statement approved by the cognizant Office or Mission Director and the cognizant Bureau Environmental Officer (BEO).

2.1 ORIGIN AND CONTEXT

Background: East Africa Desert Locust Infestation. Desert locust outbreaks can have severe effects on national and regional food security and agricultural and agro-pastoral livelihoods when they rise to upsurge or plague levels. Throughout history, such infestations have recurred in the Sahel, Northern and Eastern Africa, the Arabian Peninsula, and Southwest Asia. (See list of most recent infestations in Section 3.1.)

Figure 1: Key Terminology

FAO and other key organizations involved in desert locust response use the following terminology to describe desert locust infestations.

- **Recession**. During recession periods, desert locusts are present at low densities and do not cause significant crop damage. Hopper bands or adult swarms are rare if not entirely absent.
- **Outbreak**. Outbreaks occur amid increases in locust numbers caused by concentration, multiplication, and gregarization over a period of several months. Outbreaks are generally localized or restricted to certain habitats, and the early stages of an outbreak are generally unobserved. However, when left unchecked, outbreaks can lead to the formation of bands and swarms.
- **Upsurge**. Upsurges occur when an initially small population dramatically expands due to successful breeding over multiple generations. With each successive generation, the proportion of locusts in bands or swarms increases until few scattered individuals remain. Several simultaneous outbreaks followed by at least two generations of transient-to-gregarious breeding are likely to lead to an upsurge.
- **Plague.** Plagues are periods of one or more years with heavy and widespread locust infestations. They occur amid favorable breeding conditions when control operations are unable to stop a series of outbreaks from developing into an unmanageable upsurge. The area in which plagues occur cover approximately 29 million km^2, nearly twice the size of the recession area.

Source: (FAO (Symmons, PM; Cressman, K.) 2001)

Currently (mid-2020), Eastern Africa, the Arabian Peninsula, Iran, Pakistan, and India are experiencing a significant desert locust upsurge with high potential for these severe effects. In the next 6 to 12 months the locusts may move into north and west Africa and other parts of Asia, depending on weather, rainfall,

and prevailing winds. (See Section 3.2 for description of the East African upsurge.). USAID's Bureau for Humanitarian Assistance (BHA) is currently providing desert locust surveillance and control support in Ethiopia, Kenya, Somalia, and Sudan. (See Section 2.2.)

Desert Locust Control, Pesticides, and the Current Need for a Desert Locust Control PEA. Desert locust surveillance and control actions are critical to preventing upsurges and in containing upsurges once they occur; the use of pesticides is a key control measure at multiple life cycle and behavioral stages. Locust control pesticides listed by FAO's Pesticide Referee Group (PRG) are those generally accepted by countries for use at the various intervention points.

While the FAO PRG reviews and lists pesticides for a combination of efficacy and environmental and human safety, most pesticides on FAO's PRG list are not registered by US EPA for same or similar use and/or are listed by US EPA as restricted use pesticides (RUPs) or are simply not registered (see Section 7.3.1). As such, USAID's environmental procedures prohibit USAID from providing "assistance to procurement, use, or both" for much of the PRG list except as authorized via a duly approved 22 CFR 216 Environmental Assessment or PEA that fulfills the requirements of 22 CFR 216.3(b) ("Pesticide Procedures"), as well as the requirements of 22 CFR 216.6 ("Environmental Assessments"). There are only three exceptions to this requirement, of which one is for the case of "projects under emergency conditions,"[6] where, *inter alia*, "insufficient time is available before the pesticide must be used to evaluate the proposed use in accordance with the provisions of this regulation."

The Bureau for Humanitarian Assistance (BHA) and the BHA Environmental Officer (BEO) have jointly determined that sufficient time *does exist* for review per 22 CFR 216 of the pesticides that may be entailed in such support; the "emergency conditions" exception to the pesticide procedures is, therefore, not claimed.

Accordingly, as the current East Africa upsurge evolves, BHA seeks to have appropriate pesticide environmental and social analysis, authorizations, and guidance in place to enable it to efficiently and responsibly consider potential future support requests.

Further, it is highly desirable that these authorizations extend to as much of the FAO's PRG list as is consistent with due regard for environmental and human health and safety given:

1. That different partner countries to register different subsets of the PRG list;
2. The need to manage pesticide resistance in desert locust and other non-target vectors (e.g., *Anopheles spp*.);
3. The desirability of using pesticides that are lower-risk given the specific conditions at individual sites, which requires a range of pesticide options;
4. The desirability of implementing the full PRG priority-of-use scheme, which is essential for matching the pesticide need to the magnitude of the swarms/bands and efficacy at specific life stages while minimizing quantity used and reducing health and environmental risks associated with this large-scale pesticide use, which also requires a range of pesticide options; and
5. Supply chain disruptions, including by the COVID-19 pandemic, that restrict availability of specific pesticides.

[6] The other two exceptions are for 1) activities to which USAID is a minor donor, as defined in CFR § 216.1(c)(12); and 2) research or limited field evaluation purposes by or under the supervision of project personnel.

Beyond these considerations, the wide-area use of pesticides in response to infestations presents potential for significant adverse impacts, and it is consistent with the intent of 22 CFR 216 that such actions be subject to an Environmental Assessment; i.e., the more stringent level of analysis under the regulation. It is not certain, but foreseeable, that USAID operating units other than BHA may, in the future, engage in support to desert locust control. This is particularly true as the current East Africa upsurge may be prolonged and long-term climatic changes in and around the Horn of Africa may favor outbreaks.

Therefore, BHA and the BHA BEO, in consultation with the Africa (AFR) and Resilience and Food Security (RFS) BEOs, determined to develop this 22 CFR 216 PEA for desert locust control.

2.2 SCOPE OF INTERVENTIONS ASSESSED: CURRENT AND POTENTIAL USAID SUPPORT TO DESERT LOCUST SURVEILLANCE AND CONTROL

The desert locust control interventions assessed[7] in this PEA are as follows:

- Ground, aerial, and satellite survey operations for early detection and during all infestation stages;
- The procurement of: vehicles; surveillance equipment such as eLocust3;[8] pesticides; personal protective equipment (PPE); acetylcholinesterase test kits or other test kits and apparatus for human exposure monitoring; pesticide application equipment (generally for ultra-low volume (ULV) formulations); and disposal equipment (e.g., drum crushers and solvent for proper pesticide disposal);
- Locust control and surveillance planning and logistics operations;
- Government and partner staff capacity building in (1) surveillance and (2) the safe and effective management and application of pesticides for aerial and ground control operations;
- Training on safe pesticide handling, storage, use and disposal;
- Training community focal points to report locust sightings to appropriate authorities;
- Community sensitization on desert locust control activities, including raising awareness on the location, time, and intended impact of control operations and how to protect the health of families and livestock; and
- Assessments on control efficacy and the livelihoods, human health, and/or environmental impact of infestations and control campaigns.

[7] These interventions are closely adapted from FAO (Food and Agriculture Organization of the United Nations) actions currently being funded by BHA in Kenya, Somalia and Ethiopia. In February 2020, the FAO requested $138 million for desert locust control efforts for the East Africa outbreak, with an additional $15.2 million requested in early March 2020 to support response efforts in Sudan and Yemen. In response, BHA (then the Office of Foreign Disaster Assistance (OFDA)) provided $18,000,000 in funding for the FAO under the activity "Desert locust response to mitigate impacts on food security and livelihoods." These USAID funded actions under the current FAO appeal are also the foreseeable universe of locust surveillance and control actions.

[8] A tablet-based system for locust surveillance data entry and satellite transmission.

2.3 GEOGRAPHIC AND SPECIES SCOPE

Geographic Scope. This PEA assesses the three East African countries for which there is a disaster declaration as of May 2020 and in which BHA is supporting desert locust surveillance, monitoring, and control actions involving pesticides, namely Ethiopia, Somalia, and Kenya.[9]

Species Scope. This PEA evaluates and applies only to surveillance and control of the desert locust. It does not apply to other locust species. These include the locust species dominant in the Caucasus and Central Asia: the Italian locust (*Calliptamus italicus*), the Moroccan locust (*Dociostaurus maroccanus*), and the migratory locust (*Locusta migratoria*).

Anticipated Future Amendments for Additional Geographies. This PEA is structured to facilitate future amendment to add additional countries/geographies. Annex B sets out the expected data and analytical requirements for amendment, and the amendment process. This includes development of country-specific information regarding locust vulnerabilities and locust response actors, capabilities, and gaps in the format consistent with the country information provided in Annex A for Kenya, Ethiopia, and Somalia.

While the PEA has been prepared in response to the current desert locust upsurge in East Africa (see Section 3.2); its applicability is not limited to the current East Africa infestation, future amendments may include countries outside Eastern Africa depending upon locust movement and outbreak severity.

Potential Future Amendments to Broaden Species Scope. Much of the PEA analysis is applicable to locusts more broadly. Potentially, future amendments may broaden the scope of the PEA to other locust species.

2.4 INTENT

The context for and origin of this PEA, as described above, dictate a succinct, narrowly focused PEA that:

- Satisfies the requirements of 22 CFR 216.3(b), specifying which pesticides listed for desert locust control by the 2014 FAO Pesticide Referee Group (PRG) may be supported with USAID funds, and associated limitations or required safer use measures.
- Provides a clear synthesis of generally accepted good practices in desert locust control, to support evaluation of whether proposed actions are consistent with such practices and, as needs may arise, to inform design of future locust preparedness and response programming.
- Articulates country-specific considerations and context important to effective engagement in/support for desert locust response, such as strengths and gaps, relevant institutional actors and coordination mechanisms, and particular vulnerabilities.

2.5 APPLICATION BY MISSIONS AND OPERATING UNITS OTHER THAN BHA

While this PEA is developed in response to BHA needs and with BHA (formerly, OFDA) funds, the above-stated intent and attributes of the PEA mean that it is applicable to potential future support to desert locust control by USAID operating units other than BHA, subject (1) to the approval of the

[9] This geographic scope is due to funding strictures: BHA (formerly OFDA) funding of this PEA development can only support country-specific information-gathering and analysis in countries with a disaster declaration.

cognizant mission director/Washington equivalent; the BHA BEO, and the cognizant BEO for the subject mission/operating unit/activity; and (2) that any necessary amendment for geographic scope is carried out (see Section 2.3, and Annex B).

3 BACKGROUND: DESERT LOCUSTS, THE CURRENT EAST AFRICA OUTBREAK, CONTROL TECHNIQUES

Evaluating the analysis in and applying the findings of this PEA require a basic understanding of (1) desert locust biology and behavior and the origins of outbreaks, (2) widely held essential elements and techniques for successful desert locust control, and (3) FAO's *DL Guidelines* and SOPs that serve as the effective standard for international desert locust control campaigns. This section provides an overview of each of these issues pertaining to desert locust control, with more detail provided in Annex C.

This section also briefs the current (as of May 2020) East African Outbreak to illustrate the roles played by both weather and insecurity, and to highlight the potential implications of projected climate change on desert locust prevalence with a focus in Eastern Africa. Most climate models predict increased precipitation for the region (USAID January 2020) and, as described, wetter conditions will tend to favor locusts.

3.1 DESERT LOCUST BIOLOGY AND BEHAVIOR

The desert locust (*Schistocerca gregaria (Forskal)*) is a member of the order *Orthoptera*—which includes locusts, grasshoppers, and crickets—and family *Acrididae*, which includes most short-horned grasshoppers. Locusts differ from their grasshopper cousins in their ability to change their behavior and morphology, as well as in their tendency to form bands or swarms (with some exceptions).

Life Cycle. Like all locusts and grasshoppers, there are three stages of the desert locust life cycle: egg, nymph (hopper), and adult. Characteristics of these different stages are summarized in Table 1.

TABLE 1: LOCUST LIFE CYCLE STAGES

Stage	Description	Relevance for Outbreaks
Egg	Egg pods are usually laid in bare, moist, sandy soil, about 5-10 cm below the surface. Female locusts that have recently experienced crowding (i.e., forced close proximity to other locusts) can add a gregarizing chemical to their egg pod foam to influence the behavioral stage (see discussion and table below) in which their offspring are born. It takes anywhere from 10-65 days for eggs to hatch, depending on temperature and moisture.	Swarms frequently lay tens or hundreds of pods per square meter in dense groups. It is estimated that around 13 percent of solitarious and 33 percent of gregarious egg populations are lost to predation, exposure or other factors. On average, there are around 10 days between laying.
Hopper (Nymph)	Eggs hatch into wingless larvae known as hoppers. Hoppers shed their skin (molt) 5 to 6 times as they mature, depending on their behavioral state. The stage between each molt is referred to as an *instar*. The transition from the final instar to the winged adult is called a fledging. Desert locusts remain in the hopper stage for an average of 36 days.	Hopper bands tend to move only during the day from shortly after dawn until about an hour before sunset. Hoppers are the most voracious stage in the locust life cycle.
Adult	After about 10 days, the wings of fledglings harden sufficiently to sustain flight. Adults remain sexually immature until reaching an area with ideal conditions (described above) to stimulate maturation. After reaching sexual maturity, adult locusts survive for 2-4 more months on average.	Large adult swarms can number billions of individuals acting as a cohesive unit. In optimal conditions, multiplication rates can reach 16-20.

Source: (FAO (Symmons, PM; Cressman, K.) 2001)

Behavioral States and Accompanying Morphology. The desert locust exists in either the solitarious or gregarious behavioral and morphological states, and it is able to swiftly shift its behavior (though not its morphology) from one state to the other. Changes are triggered by changes in environment and population density. As population density increases, solitarious locusts begin to cluster into groups and they will eventually behave as a single mass (swarms for adults, bands for hoppers). The different locust behavioral states are further detailed in Table 2.

TABLE 2: LOCUST BEHAVIORAL STAGES

Stage	Morphology	Behavior
Solitarious	*Soltanicolour* hoppers tend to be green with larger eyes and antennae than gregarized hoppers. Solitarious adults have longer hind legs and wings, lower fat densities, and a less varied deposit than their counterparts.	In the solitarious phase, desert locust populations occur at low densities, and individual locusts tend to avoid one another (repulsion).
Gregarious	*Gregaricolour* hoppers are black with yellow bands and develop more mechano- and taste receptors than solitarious hoppers. Adult gregarious locusts are pink while sexually immature and become yellow as they mature.	Gregarious hoppers and winged adults cluster in increasingly dense clusters until they begin to form as a single mass (swarms and bands). Swarm density varies considerably, but an average medium-density swarm can range from 20-150 million locusts. Gregarious adults have a broad diet, and groom themselves frequently.
Transient	Because full morphological changes can take multiple generations, there is often confusion regarding the color types of transient locusts. For example, it is possible to find swarms of *soltanicolour* locusts, indicating behavior as the most useful characteristic to determine the state a locust is in.	The transient phase is an intermediate phase in which locusts are either changing from solitarious to gregarious or from gregarious to solitarious. If locust density is increasing, the *transiens* are referred to as *congregans*. If density is decreasing, they are known as *dissocians*. These labels are often used to describe hoppers.

Source: (FAO (Symmons, PM; Cressman, K.) 2001)

Outbreaks, Upsurges, and Plagues. In most years, solitarious desert locusts are found "in recession in arid regions across a 16 million square kilometer region stretching from West Africa to Western India known as the recession area, where they cause only minimal crop damage. During the recession period, bands and swarms are rare, if not absent entirely. When favorable conditions emerge, locusts will begin to gregarize and occur in higher population densities, triggering an outbreak. It is rare that outbreaks progress into the upsurge or (in extremely rare events) plague stages, but it is much more likely if they are left uncontrolled and favorable weather and habitat conditions persist. Several simultaneous outbreaks followed by two or more generations of transient-to-gregarious breeding leads to upsurges, generally catalyzed by widespread rainfall in the normally arid recession area" (FAO (Symmons, PM; Cressman, K.) 2001). Of the five upsurges from 1970 to 2001, only one has developed into a plague, or a period of one or more years characterized by heavy locust infestations. Plagues generally decline due to natural factors and human interventions, such as a failure of rains. Plagues are usually followed by another recession period in which bands and swarms become rare or are completely absent and locust populations return to low densities (FAO (Symmons, PM; Cressman, K.) 2001).

Natural Enemies. Desert locust have several natural enemies, but they make little impacts during outbreaks due to the large number of individual locust and the migratory nature of the swarms (FAO

n.d., c). Other insects (including wasps, flies (*Diptera spp.*), and beetles) parasitize living locust eggs, nymphs, and adults (Government of Australia 2019c). Birds and small mammals are also important predators with the locust being an important dietary resource for migratory birds (Sánchez-Zapata, et al. 2007). However, feeding by avian species may be less effective during outbreaks due to olfactory aposematic signals emitted by locusts during swarming (Sánchez-Zapata, et al. 2007), (Wei, et al. 2019).

3.2 CURRENT EAST AFRICAN UPSURGE AS OF MAY 2020

Overview. Currently, East Africa is experiencing a desert locust upsurge. The origins of the upsurge can be traced back to Cyclone Mekunu in May 2018, which passed over the Arabian Peninsula's Empty Quarter and created ideal locust breeding conditions. Cyclone Luban followed in the same region in October 2018, enabling successful breeding late in the year (Stone 2020). The first swarms crossed the Red Sea from Yemen into Ethiopia and Somalia in June 2019, where unusually wet conditions from September to December allowed for good breeding conditions through the fall. Then, in December 2019, Cyclone Pawan struck Somalia and created rare late season wet conditions. By the end of the month, swarms had spread westward into Kenya, Djibouti, and Eritrea. Locust swarms continue to form and mature across East Africa. Late March rainfall created favorable conditions for further breeding in Ethiopia, Kenya, and Somalia. It is expected that new swarms will form in late June and July (USAID 2020). The FAO warns that the formation of new swarms will coincide with the start of the harvest season, causing an unprecedented threat to food security and livelihoods in several countries across East Africa (USAID 2020).

Favorable climate conditions (maximum daytime temperatures of 35 degrees Celsius (°C) and enough rain to sustain lush vegetation growth) were a principal driver enabling the present upsurge to reach its current extent. In dry, hot habitats with limited rainfall, locusts avoid one another in the solitarious state. However, optimal conditions allow for successive breeding, increasing population density and resulting in the concentration and gregarization of desert locusts. The 2018 cyclones enabled three successful generations of locust breeding over the course of nine months and increased the number of individuals in the Arabian Desert by roughly 8,000-fold. The unusually high autumn rainfall enabled at least two additional successful generations of locust breeding before a late-season cyclone in December (Stone 2020). Increased rainfall in late March 2020 has been conducive to further breeding in Kenya, Somalia, and Ethiopia (USAID 2020). The unusually stormy weather and high rainfall in 2018 and 2019 is tied to the recent extremely pronounced Indian Ocean Dipole[10] (an ocean temperature gradient), and as ocean temperatures continue to warm, it is likely that extreme weather conditions will become more likely in the region (Stone 2020).

Management Status. The region is challenged in its monitoring and response to the current infestation, in part, by the insecurity across much of the region, particularly Kenya and Somalia. As of March 26, 2020, there had been at least 16 attacks in Kenya that can be attributed to Al-Shabaab, an armed insurgent group based in Somalia. In Somalia, Al-Shabaab's presence likewise limits the extent to which monitoring and control of locusts has occurred out of fears that airplanes spraying pesticides will be shot down by militants (Omondi 2020). Furthermore, insecurity in nearby active war zones such as Yemen (where the swarms that first entered East Africa originated) continues to delay or prevent locust control operations in much of the country (Roussi 2020), further challenging a coordinated multilateral response to the upsurge. In addition, many infected countries such as Somalia have been unable to pay their DLCO-EA membership fees in the Desert Locust Control Organization for Eastern Africa (DLCO-

[10] When the Indian Ocean Dipole is negative, South Africa sees additional rainfall. When it is positive, the westerlies weaken and allow warm water and rainfall to shift toward East Africa. In Fall 2019, the Indian Ocean Dipole was at its second-most positive state since 1870. Extremes in the Indian Ocean Dipole are likely to become more common as ocean temperatures continue to warm (Stone 2020).

EA) for years, leaving monitoring efforts severely underfunded. At the national level, these three countries have not invested significantly in training and research on desert locust control techniques and monitoring, most notably in Kenya (see additional details in Annex A). Finally, the COVID-19 pandemic and resulting border closures and delays have restricted the movement of personnel and equipment (including pesticides) to aid in the locust response (Omondi 2020).

Despite ongoing control efforts, the desert locust upsurge presents a current, significant threat to food security and livelihoods in Ethiopia, Somalia, and Kenya, with the potential for spread of significant impacts to other countries in the region. Table 3 presents the recent desert locust infestations including the affected countries or regions and stage of infestation.

TABLE 3: RECENT INFESTATIONS OF DESERT LOCUST

Year(s)	Countries/Regions Affected	Stage of Infestation
1986–1989	Northwest Africa, West Africa, Mediterranean, Near East, Southwest Asia, East Africa	Plague
1992–1994	Red Sea Basin, Southwest Asia, West Africa	Upsurge
1994–1996	West Africa, Red Sea Basin, Southwest Asia	Upsurge
1996–1998	Saudi Arabia, Egypt, Eritrea, Ethiopia, Northern Somalia, Sudan, Yemen	Upsurge
2003–2005	West and Northwest Africa, Sudan, Saudi Arabia, Egypt, etc.	Upsurge
2006	Eritrea, Mauritania, Niger	Outbreak
2007	Yemen, Ethiopia	Outbreak
2008	Western Sahara	Outbreak
2009	Mauritania	Outbreak
2012	Libya, Sudan	Outbreak
2013	Eritrea, Northern Somalia, Sudan, Yemen	Outbreak
2014	Sudan, Eritrea (Red Sea coast), Saudi Arabia (Red Sea coast)	Outbreak
2016	Saudi Arabia (Red Sea coast), Yemen, Mauritania, Sudan, Eritrea	Outbreak
2018–2020	Eritrea (Red Sea coasts), Sudan, Ethiopia, Kenya, Yemen, Oman, Saudi Arabia, South Sudan, Uganda, United Arab Emirates, Egypt, Somalia, Iran, India, Pakistan	Outbreak

Source: "Desert Locust Outbreaks". 2020. FAO.Org. http://www.fao.org/ag/locusts/en/archives/1032/index.html. with USAID reviewer additions.

3.3 UNDERSTANDING OF EFFECTIVE, RESPONSIBLE PRACTICE FOR DESERT LOCUST RESPONSE AND CONTROL

Experience with desert locust response and control over the past several decades has resulted in a widely held understanding of the essential elements of effective practice, of which pesticidal control actions—both aerial and ground-based[11]—are one aspect. This section, which is a synthesis of relevant FAO resources,[12] selected other resources,[13] and stakeholder consultations conducted for this PEA, summarizes this understanding.

This section is a summary of Annex C, which provides more detail.

Key Elements of Effective and Responsible Practice for Desert Locust Response and Control

1. **Surveillance-based Prevention:** Preventing upsurges with surveillance informed by forecasting and quick, targeted control actions.
   - Systematic surveillance by multiple modes (sensing, field scouts, community reporting), including transboundary surveillance, results processing combined with forecast modeling.
   - Ongoing reporting and information-sharing feedback loop.
   - Awareness building and training for communities in surveillance, monitoring, and reporting.
   - Operating mechanisms for reporting early sightings.
   - Response to early sightings with quick, targeted control actions.
   - Use of satellite imagery and remote sensing to monitor rainfall, soil moisture, and vegetative greening and identify locust breeding areas.

2. **Preparedness:** Be prepared for an adequate response if upsurge prevention measures fail.
   - Establishing, developing, staffing, providing expert advice, and building capacity of coordination and decision-making institutions, mechanisms, and leaders in partner countries.
   - Actively engaging, developing, and retaining experienced partner country subject matter experts.
   - Developing cost-benefit analysis scenarios for chemicals use decision making versus providing food aid (Abou-Ali and Belhaj 2008), (Hardeweg 2001).
   - Testing and pre-selection of least-toxic pesticides that minimize pesticide exposures of people and the environment.
   - Research on long-term integrated pest management regional solutions.
   - Contingency planning by decision makers in partner countries based on FAO's *DL Guidelines.*
   - Maintaining the necessary level of resources including infrastructure (roads, communications, warehouses), machinery and equipment (planes, cars, sprayers), and access to inventories (pesticides, PPE) by partner countries.

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[11] See *FAO Desert Locust Guidelines,* Chapter 4 "Control" for description of common control actions. (Description in 3.4, on-links provided.)
[12] Specifically, the *FAO Desert Locust Guidelines*, FAO SOPs, FAO Technical Series, FAO Post Campaign Evaluation Reports, FAO Contingency Planning Guide, FAO Practical Guidelines on Pesticide Risk Reduction for Locust Control for Caucuses and Central Asia, FAO brochures, mainly Human Health and Environmental Safety in Desert Locust Control Operations.
[13] Principally the 1989 USAID PEA

- Building capacity in safe pesticide handling including logistics (transporting, storing, handling), applications (mixing, applying, clean up) and management (monitoring operators, recording pesticide use).
- Establishing SOPs for mobilization in case of emergency.
- Establishing incident (e.g., accidents, spills, theft) reporting procedures.
- Planning establishment of public announcement systems and channels for mobilizing communities for awareness building about measures for avoiding exposure to pesticides, procedures in case of medical emergency, recruitment or engagement of community members in conducting surveillance activities, promoting non-chemical control method including locust harvesting prior to spray campaign, announcement of spray operations and all other relevant communications.
- Preparing formal and informal public health networks to address potential adverse impacts of pesticides to be used during locust control campaigns, including training communities in administering first aid, maintaining stocks of necessary medical supplies (e.g., atropine) and conducting follow on epidemiological monitoring.
- Building capacity of environmental health networks to monitor and test impacts of pesticides on water, sediment, soil, and biota.
- Building capacity to manage hazardous and non-hazardous waste, including leftover pesticide stocks and disposal and recycling of used pesticide containers.
- Conducting research for introducing new and improved technologies and techniques, such as use of drones, and integrating this research into prevention, preparedness, and implementation of locust control.
- Building capacity to both utilize satellite imagery (and associated products) to identify breeding areas and have ground survey/control teams ready to move to those areas and enact appropriate management operations.

3. Response: Implement effective, efficient and safe controls.

- Activating contingency plans, coordinating and communicating stakeholders' engagement mobilizing funds, resources and communications channels, and clear identification and mapping of insecure areas which may be off-limits for survey and control operations.
- Conducting ongoing surveillance of locust movements and forecasting, including the use of satellite imagery and other remote sensing information.
- Community engagement in surveillance, non-chemical pest control measures, enhancing awareness and enforcing safety measures during and after spray operations, which requires:
    - Engaging community leaders in affected/potentially affected communities to support community mobilization for these purposes.
    - Liaising with communities so that they are informed and motivated to support the campaign, are informed of spray operations, and undertake necessary steps such as withdrawing livestock from the spray area.
    - Ensuring access to water and necessary solvents for mixing and cleaning.
- Procurement and logistics
    - Managing logistics of aerial and ground operations and supervising aerial and ground operations.

    - Making available appropriate well-calibrated, well-functioning spray/delivery equipment, particularly ULV, and appropriate PPE.
    - Ordering as needed pesticides and equipment in appropriate amounts and quality and managing the logistics of the supply chain.
- Monitoring and Evaluation
    - Monitoring and evaluating quality and efficacy of control actions.
    - Establishing human health and environmental impact mitigation and monitoring systems that ensure implementation and oversight of procedures for safe transport, storage, mixing, handling, and safe cleaning of pesticide equipment and containers.
    - Planning and implementing monitoring of operations and record keeping of activities and pesticide use and inventories.
    - Conducting post campaign epidemiological and environmental monitoring, testing and studies.
- Safer Use Practices
    - Site characterization to ascertain appropriate pesticides and exclusion zones.
    - Using ULV formulations for aerial applications of pesticides, pesticides with lasting residual effects for barrier treatment and biological pesticides for ecologically sensitive areas.
    - Planning and managing operations to achieve optimal effective results with minimal rates and duration of exposure to non-target organisms and smallest possible area coverage.
    - Maintaining spray buffers, managing pesticide drift.
    - Following FAO's *DL Guidelines*, DL SOPs and best practices for safe storing, transporting, handling, mixing and applying pesticides aerially and on the ground.
    - Ensuring safe disposal and/or recycling of pesticide containers and other campaign generated waste.
    - Training all staff responsible for using pesticides in pesticide poisoning symptoms, first aid and emergency procedures and providing adequate relevant safety materials and supplies, including first aid kits, etc.
    - Ensuring local and regional hospitals and health clinics are aware of spray operations and doctors are trained to recognize and treat the effects of pesticide poisoning.
    - Conducting baseline and ongoing health checks for all personnel handling pesticides.

All of the above together make possible control campaigns that deliver the right amounts of the right pesticides and at the right time, consistent with a strategy focused on early control, and with adverse Impacts To Environment, Health And Safety Minimized And Monitored.

Known Failure Modes and Critical Gaps Leading to Ineffective Control and/or Elevated Environment, Health and Safety (EHS) Risks:

1. **Failing to Prevent an Upsurge**
    - Technologies cannot replace scouting in remote locations, which means that poor access to these locations due to insecurity or other reasons presents significant challenges.

- Not appropriately heeding early warning signs and mobilizing in advance, allowing an infestation to pass the threshold beyond ready control. For example, in Kenya, the government was taken by surprise by the December 2019 desert locust invasion, as it had not encountered desert locust in 70 years and did not heed warnings (see Annex A for details).
- Not utilizing available satellite imagery to identify probable areas of locust breeding

2. **Inadequate Preparedness**
    - Basic infrastructure gaps, including roads, communications, storage facilities, running water, electricity
    - Contingency plans that are too general, lacking detailed actions and processes for mobilization and SOPs.
    - Lack of permanent (autonomous/semi-autonomous locust control units that monitor weather and environmental conditions and carry out regular surveillance and monitoring to identify when conditions are right for locusts to start breeding. Such unit must have the technical, material and administrative capacity to develop action plans to launch preventive and in close collaboration with concerned national authorities, etc. For example, in Ethiopia and Somalia, stakeholders recommended that a desert locust control unit be organized and permanently established at the national level (see Annex A for details).
    - Maintaining inadequate inventories of critical equipment, such as sprayers and PPE.
    - Limited technical and managerial human resources capacity
    - Long-term research to develop a regional integrated pest management plan
3. **Constraints to Implementation of Safe and Effective Control Campaigns**
    - Climatic conditions (e.g., heavy rains and unexpected severe weather), difficult-to-access and/or remote locations, and unsafe or unfavorable security conditions. For example, in Somalia and Kenya, the location of locust infestation occurred in hard to access remote areas of each country, confounding surveillance and desert locust control (see Annex A for details).
    - Non-existing or Inadequate planning, coordination, and decision-making mechanisms necessitating their development or revision when an upsurge is already in process
    - Need for capacity building and training while an upsurge is already in progress
    - Poor infrastructure, including lack of roads, communications, storage facilities, water shortages
    - Limited availability and/or quality of accessible infrastructure and systems to safely store, return, triangulate remaining inventory of used pesticides or dispose of unusable stocks.
    - Insufficient supplies and poor supply chain management
    - Difficulties in using least toxic biological pesticide, e.g., due to mixing, temperature, equipment requirements, and availability..
    - Limited environment, health and safety (EHS) mitigation and monitoring systems
    - Insufficient amount or quality of appropriate PPE and inadequate training of pesticide applicators and handlers. For example, in Kenya and Ethiopia, where commercial pesticide application services are well developed, many applicators mobilized for ground application were not adequately trained (see Annex A for details)

- Inadequate community awareness and mobilization during spraying
- Failure to maintain pre-harvest and withholding intervals after spraying
- Limited systems and technical capacity to monitor exposure to pesticides. For example, in each of the three countries, the national ministry of health and local health agencies were not involved in any stage of desert locust control from planning to implementation and monitoring (see Annex A for details).
- Limited ability to address short and long-term adverse impacts on human health
- Limited ability to mitigate and monitor environmental impacts during and post operations

3.4 FAO'S DESERT LOCUST GUIDELINES AND SOPs

After-action reviews of the 1986–1989 desert locust plague in Northwest Africa, Mediterranean, Near East, Southwest Asia and East Africa showed that the preventative desert locust control strategy was not well developed. Field teams and campaign organizers lacked experience and there was little understanding of ULV spraying. In addition, there were inadequate or unsuitable resources and important breeding areas were inaccessible. These reasons were further exacerbated by allowing survey and control capacity in locust-affected countries to deteriorate during locust recession periods. To be better prepared for future desert locust upsurges, the FAO produced a series of *Desert Locust Guidelines* and SOPs primarily for use by national and international organizations and institutions involved in desert locust surveys and control (WMO & FAO 2016). The purpose of each document is described below; their contents are evaluated in Section 7.4.

FAO Desert Locust Standard Operating Procedures (DL SOPs). The FAO developed three booklet-form SOPs used in desert locust survey and control operations for use by field staff in locust-affected countries:

- SOPs for Desert Locust Ground Survey
  http://www.fao.org/ag/locusts/common/ecg/359/en/SOPSurveyEv3.pdf
- SOPs for Desert Locust Ground Control
  http://www.fao.org/ag/locusts/common/ecg/359/en/SOPControlE.pdf
- SOPs for Desert Locust Aerial Survey and Control
  http://www.fao.org/ag/locusts/common/ecg/359/en/SOPAerialE.pdf

The objective of the DL SOPs is to provide concise and easy to follow instructions to field staff who are involved in desert locust operations in order to help them to avoid hazardous, ineffective or inefficient control operations and adverse impacts on human health and environment. The SOPs focus on pesticide handling, mixing, loading, application, cleanup and spray equipment calibration.

FAO 2003 *Desert Locust Guidelines*. The content of the DL SOPs is derived from the 2003 FAO *Desert Locust Guidelines (DL Guidelines)* where more detailed information and references are available. Of the six chapters, those relevant to the above DL SOPs and environment, health and safety generally are:

- Chapter *6, Safety and Environmental Precautions,* focuses on reduction of environmental and human health risks from insecticide use during locust control http://www.fao.org/ag/locusts/common/ecg/347_en_DLG6e.pdf
- Chapter 4, *Control*, focuses on safe, effective and efficient equipment and techniques to carry out locust control. http://www.fao.org/ag/locusts/common/ecg/347_en_DLG4e.pdf

FAO's *2019 Practical Guidelines on Pesticide Risk Reduction for Locust Control* (FAO 2019), although developed for Caucasus and Central Asia, have broad applicability.

The safer use processes addressed by Chapter 6 of the *DL Guidelines* are summarized in Figure 2, below

Benchmark Standard for International Desert Locust Control Operations. Today, the FAO's DL SOPs and *DL Guidelines* are considered the *de facto* benchmark standard for international desert locust control operations.

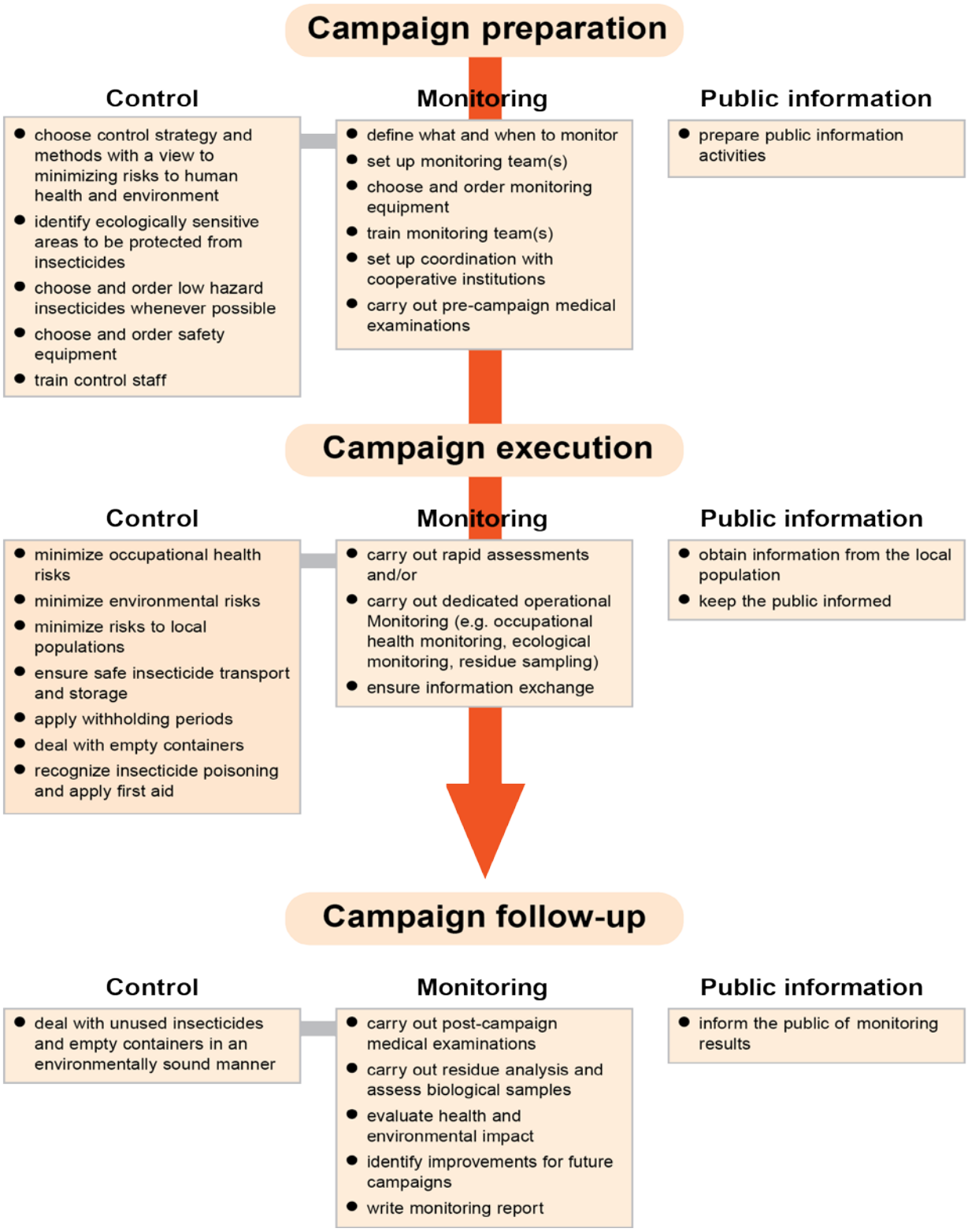
The FAO's Pesticide Referee Group (PRG),[14] an independent body of experts that advises FAO on the efficacy as well as the health and environmental risks of insecticides used in locust control, also reviewed and, overall, approved of FAO's comprehensive 2003 *DL Guidelines*.

In its last meeting (2014), the PRG noted that parts of the DL SOPs and *DL Guidelines*, such as training, health and safety, testing of workers handling pesticides, and campaign follow-up, were outdated. To date, there is no newer version of the *DL Guidelines* available. However, FAO now regularly posts updated desert locust campaign guidance as well as technical details on LocustWatch (FAO 2020f).

According to stakeholder consultations in Somalia (see Annex A), control and surveillance teams were trained based on best practices described in the *DL Guidelines* such as control operations, safe pesticide handling, proper storage and disposal of used biopesticides, containers and PPE, and environmental monitoring.

[14] See Annex D for a detailed description of the PRG, with summary in 7.3.2.

Figure 2: EHS Elements by Desert Locust Campaign Stages



Source: FAO Desert Locust Guidelines—Chapter 6: Safety and Environmental Precautions

4 PURPOSE AND NEED

4.1 STATEMENT OF PURPOSE AND NEED

The PEA addresses the following purpose and need (P&N).

USAID has a current and foreseeable future need to support desert locust surveillance and control in response to PIO and partner government[15] *requests consistent with (1) effective and environmentally and safety-conscious control practices and strategies and (2) country context generally and in conformity with USAID's environmental safeguard procedures (22 CFR 216) specifically.*

4.2 DISCUSSION OF PURPOSE AND NEED

Good practice in environmental and social impact assessment (ESIA) generally requires that P&N statements be focused on the development need, not the proposed intervention. For example,

> *Prevent significant deterioration of food security and livelihood in desert locust-impacted areas during outbreaks.*

Such a P&N would necessarily result in a *desert locust response* (versus a *desert locust surveillance and control*) PEA with a scope of interventions significantly broader than locust surveillance and control—e.g., it might consider alternatives such as food aid and cash assistance in lieu of control efforts.

However, a broader P&N statement of this nature would arguably assume that USAID has the time or ability to "re-litigate" a P&N—i.e., the pressing need for desert locust control efforts—that has already been determined by FAO and partner country governments. The narrow P&N presented here is reflective of USAID's operational reality.

[15] BHA in its disaster assistance function (i.e., formerly OFDA) does not support partner governments directly. This aspect of the purpose and need statement anticipates *potential future USAID locust surveillance and control programming not conducted with disaster assistance* funds.

5 ALTERNATIVES INCLUDING THE PROPOSED ACTION

This PEA assesses the following alternatives. See Section 7.2 for the technical approach to assessing these alternatives.

Alternative A: The No-action Alternative, as required by 22 CFR 216.6(c)(3). The no-action alternative is defined as no USAID funding of desert locust surveillance or control.

Under the no action alternative, and under all other alternatives, desert locust control actions may—and in all probability will—be carried out by partner country governments, FAO and/or other development actors.

The no-action alternative, while required, does not meet purpose and need as defined in Section 4. It could lead to significant increases in needed food aid and emergency humanitarian interventions.

Alternative B. USAID funding of surveillance, non-chemical desert locust controls, and "limited pesticidal controls" used with a commitment to conformity with FAO *DL Guidelines* and SOPs or equivalent[16] AND consistent with effective control strategies/techniques and partner country limiting factors.

Limited pesticidal controls are defined as assistance to procurement and/or use of pesticides being limited to pesticides containing active ingredients (AIs) on the FAO Pesticide Referee Group (PRG) list that, were they available in the US, would reasonably be designated by US EPA as General Use Pesticides (GUPs), and where US EPA has registered products containing these AIs for use similar to desert locust control.

Per analysis presented in 7.3.1, these pesticide AIs are Malathion and *Metarhizium* only.

Alternative C (Proposed Action). USAID funding of surveillance, non-chemical desert locust controls, and "fuller pesticidal controls" used with a commitment to conformity with FAO *DL Guidelines* and SOPs or equivalent[17] AND consistent with effective control strategies/techniques and partner country limiting factors.

Alternative C is identical to alternative B, except that the assistance to procurement and/or use of pesticides includes all pesticides on the PRG list that are approved by this PEA following a risk analysis that meets the requirements of 22 CFR 216.3(b)(1)(i) ("12-factor analysis"). These pesticides are presented in section 9 and include US EPA RUP pesticides, pesticides with no US EPA same/similar use and pesticides with no US registered products.

Alternative C is the proposed action because, as discussed in section 2.1, BHA seeks to have authorization to provide assistance to procurement and/or use of "as much of the PRG list as is consistent with due regard for environmental and human health and safety given:

1. That different partner countries to register different subsets of the PRG list;
2. The need to manage pesticide resistance in desert locust and other non-target vectors (e.g., *Anopheles spp*.);
3. The desirability of using pesticides that are lower-risk given the specific conditions at individual

[16] SOP for Desert Locust Ground Control (http://www.fao.org/ag/locusts/oldsite/PDFs/SOPControlE.pdf); SOP for Desert Locust Aerial Survey and Control (http://www.fao.org/ag/locusts/oldsite/PDFs/SOPAerialE.pdf); and *Desert Locust Control Guideline for Safety and Environmental Precautions* http://www.fao.org/ag/locusts/oldsite/PDFs/DLG6e.pdf.
[17] See above footnote

sites, which requires a range of pesticide options;

4. The desirability of implementing the full PRG priority-of-use scheme, which is essential for matching the pesticide need to the magnitude of the swarms/bands and efficacy at specific life stages while minimizing quantity used and reducing health and environmental risks associated with this large-scale pesticide use, which also requires a range of pesticide options; and
5. Supply chain disruptions, including by the current COVID-19 pandemic, that restrict availability of specific pesticides."

6 AFFECTED ENVIRONMENT AND COUNTRY CONTEXT FOR DESERT LOCUST CONTROL

Per section 2.3, the countries analyzed in this PEA are Kenya, Ethiopia, and Somalia. Key information on country desert locust response actors, capacities, and gaps for each country is presented in a uniform format in Annex A.

Extensive baseline environmental information for these countries is available via their Foreign Assistance Act (FAA) Section 118/119 Tropical Forest and Biodiversity analyses below:

- USAID/Somalia FAA 118/119 Analysis
- USAID/Ethiopia FAA 118/119 Analysis
- USAID/Kenya FAA 118/119 Analysis

For more information on the current situation in each of these countries, refer to Annex A.

7 ENVIRONMENTAL AND HEALTH RISKS AND CONSEQUENCES

Note: 22 CFR 216.34(b)(1)(iii) requires that Environmental Assessments prepared under the pesticide procedures include an analysis of the 12 factors identified in 22 CFR 216.3(1)(i).[18] This PEA fulfills this requirement. However, to maintain the outline for environmental assessments prescribed by 22 CFR 216.6(c) to the greatest extent practicable[19] while avoiding redundancy this PEA does not include a stand-alone 12-factor analysis. Rather, the analysis is integrated throughout and a cross walk of the analysis factors to PEA content is provided as Annex F.

7.1 POTENTIAL ENVIRONMENTAL & HEALTH IMPACTS OF LOCUST CONTROL

While the scope of this PEA assesses both desert locust surveillance and control, the scoping statement found that the impacts of surveillance are unlikely to be significant, and that the PEA is concerned with the following potentially significant impacts of desert locust control, all of which derive from the use of pesticides in desert locust control:

Desert Locust Control: Potential Risks/Adverse Impacts of Aerial and Ground Spray Operations

- **Non-target organisms.** Landscape-scale and more localized adverse impacts on non-target organisms, including beneficial pollinators and insect predators resulting from aerial and ground spray operations.
- **Water contamination.** Landscape-scale and more localized contamination of surface waters and potential on-contamination of groundwater, with potential adverse impacts on non-target organisms, livestock, and human health. (Overlaps with item immediately above.)
- **Pesticide residue consumption.**
    - Adverse impacts to human health from pesticide residues on crops and rangeland—potentially affecting both agricultural communities directly impacted by spray operations, and those outside spray areas who consume these products
    - Potential adverse impacts from consumption of contaminated locusts, in areas where they are an appreciated source of protein or a last-resort food source.
- **Spray/Handler Team Exposure.** Adverse impacts to spray team and mixer/handler health resulting from exposure during spray operations, mixing and clean-up.

[18] The 12 factors are: a) The US 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 integrated pest management 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 nontarget 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; and (l) The provisions made for monitoring the use and effectiveness of the pesticide.

[19] 22 CFR 216.6(d) states that "To the extent practicable, the form and content of the programmatic Environmental Assessment will be the same as for project Assessments."

- **Spray drift and environmental residuals.** Adverse impacts to community health from pesticide exposure via spray drift and pesticide residues in agricultural fields and rangeland.

Desert Locust Control: Potential Risks/Adverse Impacts of Pesticide Transport, Handling Storage and Disposal

- **Handler Exposure.** Adverse impacts to handler health resulting from exposure during transport and warehouse operations, both routine and as may be incurred in responding to spills.
- **Environmental and Community Exposure,** with many of the impacts enumerated under "spray operations," above, derive from spillage and improper mixing and clean-up operations that contaminate soil, surface, or groundwater.
- **Reuse of pesticide containers.** Risks to human health resulting from reuse of pesticide containers for water and food storage, leading to exposure and ingestion of pesticides.[20]
- **Residual and obsolete stocks.** Long-term storage of residual/obsolete stocks resulting from locust control operations can result in site contamination with community (or, via groundwater, broader area) exposure and thus health impacts, and also "leakage" of locust control pesticides to local markets, whose end users are likely untrained and unprepared to handle ULV formulations, resulting in all impacts listed under "Aerial and Ground Spray Operations," above.[21] Inadequate storage facilities and facilities management heightens these risks; see next item.
- **Inadequate storage facilities and facilities management.** Improper storage (e.g., insecure, overheated, poorly ventilated and without provision for spill containment) presents multiple human health and local environmental risks, principally resulting from contamination/exposure from spills and from increases in obsolete stocks resulting from prolonged and poor storage conditions. Lack of security may allow area residents to "liberate" pesticides for use at home or in an agricultural situation, not only risking exposure, but also use not as intended. Increases in obsolete stocks incur all of the impacts described under "residual and obsolete stocks," above.

7.2 APPROACH TO CHARACTERIZING RISK AND IMPACTS

As noted in 7.1, all the potential adverse impacts of desert locust control actions identified by the scoping process for this PEA derive from the use of pesticides. Without appropriate pesticide selection, a focus on early intervention with less toxic pesticides, and rigorous safer use measures, the environmental and human health risks of locust control campaigns are extremely high.

It is also the case that completely uncontrolled spray operations with ill-considered pesticides is not a realistic scenario for USAID-supported control actions, and this is precisely the scenario that key actors

[20] Metal and plastic pesticide containers are frequently in high demand among local populations, as they can be repurposed to store and transport water and sometimes food. While metal drums can be sanitized with the proper equipment, plastic containers cannot be cleaned sufficiently to prevent toxic residues.

[21] The unpredictable nature of desert locust infestations makes it difficult to determine the correct amount of pesticides to procure. If countries purchase too little pesticide, stocks will likely run out if the infestation lasts longer than anticipated. If they purchase too much, they may be left with large quantities of unused pesticides that may then become obsolete, posing additional risks to environment and human health.

like the FAO, the DLCO-EA, and responsible entities within partner country governments seek to avoid.

For this reason, the alternatives evaluated by this PEA (section 5) posit that control measures are undertaken with a commitment to environment, health and safety- (EHS-) relevant FAO *DL Guidelines* and SOPs or equivalent (see section 3.4) AND that the interventions are consistent with effective control strategies/techniques (see Section 3.3. and Annex C) and partner country limiting factors.

Given this, the key questions that analysis must address are:

- To what extent are these EHS-relevant FAO *DL Guidelines* and SOPs and these other assumptions protective of human and environmental health?
- What are the likely failure modes of these assumptions (i.e., failures to implement the safer use actions and other EHS safeguards built into the FAO *DL Guidelines* and SOPs in practice) and the risk consequences of such failures?

Budget, time, and above all the very high number of combinations of potential control measures and foreseeable environmental contexts—among other challenges to parameterization of human/ecological risk assessment models—preclude quantitative assessments of risk/impact to address these questions.

Accordingly, the PEA takes a *comparative, qualitative approach* for characterizing the risks of pesticidal desert locust control actions under Alternatives B and C, as follows:[22]

1. The PEA first examines the extent to which assumptions limit the environment, health and safety (EHS) risks of desert locust control operations to the standards deemed acceptable in the US or peer developed economies for control of pests of major importance for health, sustenance or livelihoods with pesticides delivered by air and on the ground in wide-area applications.[23]

   This is addressed in 2 parts: A) Comparative analysis of pesticide hazard and weight-of-evidence risk;[24] and B) a qualitative evaluation of the risk mitigation provided in-principle by FAO's relevant *DL Guidelines* and SOPs.

   <u>A. Comparative Analysis of Pesticide Hazard and Weight-of-Evidence Risk</u>. This analysis has three components:

   a) Review of FAO Pesticide Referee Group's 2014 Methodology and Analysis. (7.1.2, summarizing Annex D). This review examines whether the FAO Pesticide Referee Group (PRG) methodology indeed gave full weight to EHS concerns alongside efficacy. Validation

[22] The analyses described here address the 12 analysis factors specified by 22 CFR 216.3(b)(1)(i), which are also required for EA-level analyses, per 22 CFR 216.3(b)(1)(iii). See Section 7.1.

[23] Comparison to US standards is consistent with 22 CFR 216, which ties USAID's characterization and treatment of pesticide risk to US EPA registration status, and thus to US EPA's risk assessment process and determinations.

[24] Pesticide <u>hazards</u> are the potential harm that a pesticide may cause under specific conditions of use. These derive from the toxicological properties of the pesticide. For example, a pesticide that is neurotoxic has the potential to damage the nervous system. <u>Risk</u> is the probability that harm will actually occur under a given exposure scenario; in toxicology, risk = hazard X exposure. Sensitivity, dose, and route of exposure all influence the magnitude of risk. *Weight of evidence* is a method of assessment that synthesizes multiple sources of information, taking into account their relevance and quality, to reach a decision or characterization. This synthesis may be quantitative or qualitative.

of the PRG methodology from an EHS perspective provides an essential "basis of trust" for remaining components of the analysis.

b) Toxicology and Physical Properties Comparison (7.3.3). This analysis assesses the extent to which non-US registered pesticides and/or those with no same/similar use on the PRG list have hazard profiles and weight-of-the-evidence risk profiles consistent with US-registered/ same-similar-use products in the same pesticide class.[25] The analysis relies on aggregated information databases from various governmental and scientific institutions and reflects a time-bound, qualitative, expert-judgement analysis of information available via these sources.

c) Identification of the extent to which the PRG list pesticides are registered for use against locusts in Australia (7.4.4). Australia is the US-peer economy that both has significant domestic locust control needs and a pesticide regulatory system generally acknowledged to embed USD-comparable risk reviews and standards.

B. Qualitative evaluation of the risk mitigation provided in-principle by FAO's SOPs and use strategies. The PEA then evaluates the extent to which the relevant chapters of FAO's *Desert Locust Guidelines* and relevant SOPs (1) provide, *in principle*, risk/impact mitigation consistent with requirements for RUP application and for aerial pesticide application in the US (7.4.1), and (2) address the potential environmental and health risks and impacts of desert locust control identified in section 7.1 (7.4.2).

2. The PEA then examines the likely implementation gaps with respect to the posited EHS safeguards, and qualitatively characterize how these gaps affect the risks of control actions (7.7). This is assessed by examining 1) the EHS gaps identified in the multilateral evaluation of the 2003-05 desert locust control campaign (Brader, et al. 2006) (7.6.1), and 2) gaps and potential gaps identified by country consultations (7.6.2; Annex A).

Based on this analysis, the PEA:

- identifies the recommended alternative (Section 8)
- enumerates the pesticides for which "assistance to procurement or use or both" are authorized for desert locust control support (Section 9)
- enumerates the required safer use conditions for these pesticides (Section 9)
- makes recommendations for longer-term desert locust preparation and response programming (Section 10)

This technical approach is supported by an extensive set of stakeholder consultations documented in Annex G. The in-country consultations were designed to populate an information framework that captures key information regarding country desert locust response actors, capacities, and gaps. The resulting country briefings are presented in uniform format in Annex A.

[25] Same/similar use is defined in 7.3.1: "pesticides for similar uses registered by US EPA have been defined for the purpose of this evaluation as those used in agriculture (particularly those registered for control of grasshoppers), or those used in public health sectors for control of pests of major importance for health, sustenance or livelihoods and allowed for delivery by air and on the ground in wide-area applications." However, where the toxicological analysis employs US-registered AIs not on the PRG list as comparatives, it focuses on those specifically registered for orthoptera control to best assure that efficacy is considered.

7.3 EXTENT TO WHICH ASSUMPTIONS RESULT IN COMPARABLE RISKS vs US STANDARDS, PART 1: ANALYSIS OF PESTICIDE RISK PROFILES

7.3.1 BACKGROUND: PRG PESTICIDES AND THEIR US EPA REGISTRATION STATUS

Table 4, below, presents the pesticide active ingredients (AIs) listed by the FAO Pesticide Referee Group (PRG) for locust control in 2014[26] and their US EPA registration status, including (1) registered uses and (2) the extent to which products containing these AIs are restricted use pesticides, and the basis for such restrictions.

Relevance of US EPA Registration Status. US EPA registration status is relevant to both the definition of alternatives for this PEA, as presented in Section 5, and to our technical approach, as presented in Section 7.2:

- Alternative B is limited to assistance to procurement and/or use of products containing AIs on the PRG list that, were they available in the US, would reasonably be designated by US EPA as GUPs, and where US EPA has registered products containing these AIs for similar use to desert locust control.
- Our technical approach assesses, *inter alia*, the extent to which non-US registered pesticides or those with no same/similar use on the PRG list have risk profiles consistent with US-registered/ same-similar-use products. This is consistent with USAID's pesticide procedures (22 CFR 216.3(b)), which ties analysis and approval of USAID "assistance to the procurement, use, or both" of any pesticide to US EPA registration status in multiple ways, including (1) whether the pesticide is registered for same or similar use by US EPA to the use proposed (i.e., desert locust control), and (2) whether US EPA has designated the pesticide a GUP or a RUP—and if RUP, if this is for reason of user hazard, or for other reasons.[27]

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[26] See section 7.3.2.

[27] 22 CFR 216,3(b)(1) (i) When a project includes assistance for procurement or use, or both, of pesticides registered for the same or similar uses by US EPA without restriction, the Initial Environmental Examination for the project shall include a separate section evaluating the economic, social and environmental risks and benefits of the planned pesticide use to determine whether the use may result in significant environmental impact. Factors to be considered in such an evaluation shall include, but not be limited to the following:
(a) The US 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 integrated pest management 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 nontarget 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 non-chemical 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; and
(l) The provisions made for monitoring the use and effectiveness of the pesticide.
ii) When a project includes assistance for the procurement or use, or both, of any pesticide registered for the same or similar uses in the United States but the proposed use is restricted by the US EPA on the basis of user hazard, the procedures set forth in §216.3(b)(1)(i) above will be followed. In addition, the Initial Environmental Examination will include an evaluation of the user hazards associated with the proposed US EPA restricted uses to ensure that the implementation plan which is contained in the Project Paper incorporates provisions for making the recipient government aware of these risks and providing, if necessary,

Definition of "Same or Similar Use" for Purposes of this Analysis. US EPA does not register products specifically for desert locusts (or any locust species) as these pests are not present in the US. However, some pesticide uses in the US are similar:

- **Rangeland grasshopper and Mormon cricket control.** Although US rangeland grasshoppers (numerous sp.) (Whipple, et al. 2012) and Mormon crickets (*Anabrus simplex*) are non-swarming, they still can cause economically significant damage, and upticks in populations have occurred requiring supplemental government intervention in the form of major spray campaigns, such as the efforts that took place in western US states in 2011 and 2017 (Oregon Department of Agriculture 2019). The US Animal and Plant Health Inspection Service (APHIS) has been operating a Rangeland Grasshopper and Mormon Cricket Suppression program since 2002, which primarily addresses suppression efforts on public lands, with private lands being the responsibility of the landowner (USDA 2020).[28] However, it is important to note, that although ULV formulations improve product safety, unlike in the US or Australia where large industrial or medium size agriculture fields and vast rangelands are sprayed aerially, in East Africa where desert locust must be controlled, agricultural areas are often densely populated with homesteads dispersed within the fields and rangelands, or in very close proximity.
- **Aerial disease vector control.** In the US, repeated aerial applications of pesticides are conducted for control of vectors of disease by Federal, State, Tribal, or local government officials responsible for public health or vector control, or by persons certified in the appropriate category or otherwise authorized by the State or Tribal lead pesticide regulatory agency to perform adult mosquito control applications, or by persons under their direct supervision. While the vectors (generally mosquitoes) are not notably similar to locusts, the human and environmental risk profiles are similar to locust control in the East Africa context: both involve aerial applications of insecticides, and fungicides that are used for control of other agricultural pests in the US, and aerial vector control is moreover conducted in inhabited areas.

Therefore, pesticides for similar uses registered by US EPA have been defined for the purpose of this evaluation as those used in agriculture (particularly those registered for control of grasshoppers), or those used in public health sectors for control of pests of major importance for health, sustenance or livelihoods and allowed for delivery by air and on the ground in wide-area applications.

Table 4, below, provides a breakdown of the US EPA Products Registration status and Registered Uses in the US, and US Product Restrictions, for each of the 11 AIs listed by the FAO Pesticide Referee Group (PRG) for locust control.

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such technical assistance as may be required to mitigate these risks. If the proposed pesticide use is also restricted on a basis other than user hazard, the procedures in §216.3(b)(l)(iii) shall be followed in lieu of the procedures in this section.

(iii) If the project includes assistance for the procurement or use, or both of:
(a) Any pesticide other than one registered for the same or similar uses by US EPA without restriction or for restricted use on the basis of user hazard; or
(b) Any pesticide for which a notice of rebuttable presumption against re-registration, notice of intent to cancel, or notice of intent to suspend has been issued by US EPA,

The Threshold Decision will provide for the preparation of an Environmental Assessment or Environmental Impact Statement, as appropriate (§216.6(a)). The EA or EIS shall include, but not be limited to, an analysis of the factors identified in §216.3(b)(l)(i) above.

[28] During the APHIS suppression campaigns, carbaryl (carbamate) solid bait and ULV spray, diflubenzuron (IGR) ULV, and malathion (organophosphate) ULV products were used, consistent with US EPA registrations. https://www.aphis.usda.gov/plant_health/ea/downloads/2020/mt-20-02-draft.pdf.

TABLE 4: PRG LISTED AIs FOR LOCUST CONTROL AND THEIR US EPA REGISTRATION STATUS			
AI	**Class**	**Products Registration and Registered Uses in the US Similar to Locust Control**	**US Product Restrictions**
Bendiocarb	Carbamate	No federally active products contain this chemical	N/A
Chlorpyrifos	Organophosphate	Registered for agriculture, public health, other uses. Approved for adult mosquito control.* Some formulations may be applied by either ground or aerial equipment.	Sale and use of almost all products of all formulations containing this chemical is restricted to certified applicators. The restrictions are based on user and environmental hazards.
Deltamethrin	Pyrethroid	Registered for agriculture, public health, other uses. Some formulations may be applied by either ground or aerial equipment.	Sale and use of some products containing this chemical, particularly Emulsifiable concentrate (EC) formulations, is restricted to certified applicators. The restrictions are based on environmental hazards.
Diflubenzuron	Benzoylurea Insect Growth Regulator (IRG)	Registered for agriculture, public health, other uses. Some formulations may be applied by either ground or aerial equipment. Approved for control of grasshoppers and crickets in rangeland.	Sale and use of many products containing this chemical is restricted to certified applicators. The restrictions are based on environmental hazards.
Fenitrothion	Organophosphate	Only technical grade AI is registered in the US	N/A US EPA products registration was voluntarily withdrawn by the manufacturer Sumitomo Co. Japan. Aquatic toxicity data provided by the registrant was deemed insufficient by US EPA.
Fipronil	Phenylpyrazole	Registered for agriculture, veterinary and other uses. Some formulations may be applied by either ground or aerial equipment.	Sale and use of most products containing this chemical is restricted to certified applicators.
Lambda-cyhalothrin	Pyrethroid	Registered for agriculture, public health, animal health, other uses.	Sale and use of almost all products of all formulations containing this chemical is restricted to certified applicators.

TABLE 4: PRG LISTED AIs FOR LOCUST CONTROL AND THEIR US EPA REGISTRATION STATUS			
AI	**Class**	**Products Registration and Registered Uses in the US Similar to Locust Control**	**US Product Restrictions**
		Some formulations may be applied by either ground or aerial equipment.	Most of its products restrictions are based on environmental hazards.
Malathion	Organophosphate	Registered for agriculture, public health, other uses. Some formulations may be applied by either ground or aerial equipment. Approved for control of grasshoppers and crickets in rangeland.	Sale and use of products containing this chemical as a single ingredient is not restricted to certified applicators.
Metarhizium anisopliae	Biological, microorganism derived	Registered for agriculture, other uses (strains F52 and ESF1)	Sale and use of products containing this chemical is not restricted to certified applicators.
Teflubenzuron	Benzoylurea Insect Growth Regulator (IGR)	No federally active products contain this chemical	N/A
Triflumuron	Benzoylurea Insect Growth Regulator (IGR)	No federally active products contain this chemical	N/A

**In 2015, US EPA provided notice to revoke all tolerances for chlorpyrifos due to neurodevelopmental effects, in response to a 2007 administrative petition by Pesticide Action Network North America (PANNA) and the Natural Resources Defense Council (NRDC). In 2017, following change in Administration, US EPA reversed this order. A coalition of environmental groups led by EarthJustice sued in US District Court and in 2018 the Court ordered a ban on chlorpyrifos, stating that US EPA violated the law. The Administration appealed the ruling, and on April 19, 2019 the 9th Circuit Court of Appeals ordered US EPA to decide by mid-July whether to ban chlorpyrifos. On July 18, 2019, US EPA announced in a ruling that it would not ban chlorpyrifos. Some US states have passed laws banning the use of chlorpyrifos.* (US EPA 2019)

Note regarding aerial application: In the US, all aerial pesticide applications, including those of GUP products, are restricted to licensed commercial pilots who are also registered as commercial pesticide applicators in the states in which they conduct the subject aerial pesticide application. This is a restriction distinct from RUP registration, but highlights the multiple risks of aerial application.

Summary of Same/Similar Use Registrations and GUP/RUP Status for PRG Pesticides. Of the PRG list, only malathion and *Metarhizium* can reasonably be described as pesticide AIs for which there are US EPA-registered GUPs for similar use to desert locust control. For the remainder of PRG pesticide AIs for which there are active US product registrations, products that could reasonably be used for locust control are RUP, either for reason of environmental hazards, or a mix of use and environmental hazards. Three of the PRG AIs have no active US registrations and for one (fenitrothion), only technical grade is registered.

As such, (1) pesticides included in PEA Alternative B are limited to malathion and *Metarhizium*; and (2) under 22 CFR 216.3(b)(1)(iii), all other pesticides on the PRG list can only be approved via an EA-level analysis such as the present one.

7.3.2 REVIEW OF FAO PESTICIDE REFEREE GROUP'S 2014 METHODOLOGY AND ANALYSIS.

Note: This section is a summary of a longer analysis provided in Annex D

The FAO's Pesticide Referee Group (PRG) is an independent body of experts[29] that advises FAO on the efficacy, as well as the health and environmental risks, of insecticides used in locust control. The PRG reviews insecticide efficacy trial reports and establishes recommended dose rates against the desert locust and other species of locusts; evaluates environmental impact studies and classifies insecticides with recommended rates as to their environmental and health risks; reviews operational use of insecticides in locust control and possible constraints; and identifies gaps in knowledge and recommends further studies to be conducted. The PRG advises on other matters pertaining to locust control as requested by FAO.

Review of the 2014 PRG report (Pesticide Referee Group 2014) as well as stakeholder interviews with members of the 2014 PRG revealed that the pesticides published in the PRG list are the result of a deliberative process that, alongside efficacy, overall considered environment, health and safety (EHS) rigorously and robustly.

Overall, the PRG approved of FAO's comprehensive 2003 *DL Guidelines* on Safety and Environmental Precautions (FAO (Valk, H. van der; Everts, J.W.) 2003). These comprehensive guidelines address major environmental and human health risks related to desert locust control and provide guidance on risk reduction, campaign preparation, campaign execution, and campaign follow-up.

After careful evaluation of EHS risks, the 2014 PRG report noted that emphasis should be given to the least toxic compounds already evaluated in relation to human health and environmental impact, provided they are effective against the locust target that has to be controlled (Pesticide Referee Group 2014). Successful, early intervention permits use of more selective, generally safer pesticides in lower volumes.

The PRG noted that locust control campaigns in the past had heavily relied on organophosphate (OP) insecticides, likely due to availability and relatively low purchase cost. However, in consideration of international concerns about the use of insecticides and the absence of new products evaluated for locust control, the PRG stressed that emphasis should be given to the least toxic compounds already evaluated in relation to human health and environmental impact, provided they are effective against the locust target requiring control.

[29] For membership at the time of last assembly in 2014, see (Pesticide Referee Group 2014).

Therefore, the PRG considered *Metarhizium acridum* to be the most appropriate control option, with second priority given to IGRs, and third priority to neurotoxic insecticides as a last resort when rapid control is needed to protect agricultural crops in the immediate environment of a locust population.

7.3.3 TOXICOLOGY AND PHYSICAL PROPERTIES COMPARISON.

Purpose of this Section. The purpose of this section is to assess the extent to which non-US registered pesticides and/or those with no same/similar use on the FAO Pesticide Referee Group (PRG) list have hazard profiles and weight-of-the-evidence risk profiles consistent with US-registered/ same-similar-use products.

Toxicological and Physical Properties of PRG-listed AIs. Toward this end and to provide a high-level overview, Table 5 below presents toxicology and environmental properties (persistence/mobility) information for the pesticide active ingredients (AIs) listed by the PRG for locust control. AIs appear in the use order priority presented by the PRG in its 2014 report (see Annex D).

In addition to the PRG-listed AIs, diesel is included as the suspension solvent for *Metarhizium*, as it presents more toxicological hazard concerns than *Metarhizium* itself.

TABLE 5: TOXICOLOGICAL AND PHYSICAL PROPERTIES OF PRG LISTED AIs**											
AI	**Registered by US EPA for same/ similar use? (a)** **RUP/GUP?**	**Leaching Potential (b)** **Persistence in Water**	**Persistence in Soil (c)**	**Bioconcen-tration Potential (d)**	**WHO Class/ Acute Human Toxicity**	**Suspect Chronic Human Toxicity**	**Acute Toxicity to. . .**				
							Other Mammals	**Bees**	**Birds**	**Soil**	**Aquatic Organisms**
PRG Priority 1: Biological/Mycoinsecticide											
Metarhizium anisopliae	*No* *GUP*	None	Mod	None	Not Listed Low	None	Low	Low	Low	Low	Low
Diesel (suspension solvent for *Metarhizium*)	*n/a*	Low	Mod	Mod	Not listed Mod	Probable Human Carcinogen	Mod	High	High	Mod	Mod
PRG Priority 2: Insect Growth Regulators (Benzolyurea)											
Diflubenzuron	*Yes* *RUP some*	Low Mod Persist	Low	Mod	Low	Mod Endo	Low	Mod	Low	Mod	High
Teflubenzuron	*No products*	Low	Mod	Mod	Unclassified Low	None	Low	Mod	Low	Mod	High
Triflumuron	*No products*	Low	Low	Mod	Unclassified Low	None	Low	Low	Mod	Mod	High

TABLE 5: TOXICOLOGICAL AND PHYSICAL PROPERTIES OF PRG LISTED AIs**											
AI	**Registered by US EPA for same/ similar use? (a)** **RUP/GUP?**	**Leaching Potential (b)** **Persistence in Water**	**Persistence in Soil (c)**	**Bioconcen-tration Potential (d)**	**WHO Class/ Acute Human Toxicity**	**Suspect Chronic Human Toxicity**	**Acute Toxicity to. . .**				
							Other Mammals	**Bees**	**Birds**	**Soil**	**Aquatic Organisms**
PRG Priority 3: Neurotoxic Pesticides											
Class: Phenyl pyrazoles											
Fipronil	*No* *RUP most*	Mod	High	Mod	Mod	High neuro Med endo Med Rep/dev Possible human carcinogen	High	High	High	Mod	Mod
Class: Pyrethroids											
Deltamethrin	*Yes* *RUP many*	Low to Mod	Mod	Mod	Mod	High Neuro Mod Endo Mod Rep/dev	High	High	Low	Low	High
Lambda-Cyhalothrin	*Yes* *RUP many*	Low	Mod	Mod	Mod	Mod neuro Mod rep/dev	High	High	Low	Mod	High

TABLE 5: TOXICOLOGICAL AND PHYSICAL PROPERTIES OF PRG LISTED AIs**											
AI	**Registered by US EPA for same/ similar use? (a)** **RUP/GUP?**	**Leaching Potential (b)** **Persistence in Water**	**Persistence in Soil (c)**	**Bioconcen-tration Potential (d)**	**WHO Class/ Acute Human Toxicity**	**Suspect Chronic Human Toxicity**	**Acute Toxicity to. . .**				
							Other Mammals	**Bees**	**Birds**	**Soil**	**Aquatic Organisms**
Class: Carbamates											
Bendiocarb	*No products*	Low	Low	Low	Mod	High Neuro Mod Rep/dev	High	High	High	Mod	High
Class: Organophosphates											
Malathion	*Yes* *GUP*	Low	Mod	Mod	Low	High neuro Mod rep/dev Mod endo Probable human carcinogen	Mod	High	Mod	Mod	High
Fentitrothion	*No products* *Only technical grade*	Low	Low	Low	Mod	High neuro High Endo Mod Rep/dev	Mod	High	High	Mod	High

TABLE 5: TOXICOLOGICAL AND PHYSICAL PROPERTIES OF PRG LISTED AIs**											
AI	**Registered by US EPA for same/ similar use? (a)** **RUP/GUP?**	**Leaching Potential (b)** **Persistence in Water**	**Persistence in Soil (c)**	**Bioconcen-tration Potential (d)**	**WHO Class/ Acute Human Toxicity**	**Suspect Chronic Human Toxicity**	**Acute Toxicity to. . .**				
							Other Mammals	**Bees**	**Birds**	**Soil**	**Aquatic Organisms**
Chlorpyrifos	*Yes* *Most products RUP*	Low	Mod	Mod	Mod	High Neuro High Rep/dev	High	High	High	Mod	High

The following thresholds are used for physical properties

(a) EPA Pesticides Database https://iaspub.epa.gov/apex/pesticides/f?p=PPLS:1 9

(b) Solubility in Water (mg/l): Low <50 | Moderate 50-500 | High > 500

Groundwater Ubiquity Score (GUS): > 2.8 = High leachability 2.8–1.8 = Transition state < 1.8 = Low leachability

Aqueous photolysis DT50 (days at pH 7): < 1 Fast | 1–14 Moderately fast | 14–30 Slow | > 30 Stable

Aqueous hydrolysis DT50 (days at 20°C and pH7): < 30 Non-persistent | 30–100 Moderately persistent | 100–365 Persistent | > 365 Very persistent

(c) Soil degradation (days): < 30 Non-persistent | 30–100 Moderately persistent | 100–365 Persistent | > 365 Very persistent

(d) Bioconcentration Factor (BCF): <100 Low | 5000–100 Moderate | >5000 High; BCF are reported to estimate potential for accumulation from the aqueous phase to organic phase. Terrestrial based BCF (Soil to organic) or Bioaccumulation factor (BAFs) are often not commonly available and consensus is difficult since values can differ significantly depending on the organism. BCFs for aquatic systems do not necessarily represent the same potential for accumulation in terrestrial systems. Because aquatic systems are avoided per FAO's SOPs, bioaccumulation in the terrestrial system is of greater concern; however, limited spray events, low concentration sprays, and generally low or moderate persistence reduces the likelihood for bioaccumulation.

Estimates are based on WHO data and the International Union of Pure and Applied Chemistry database

**See 7.1.2 for detail.*

*** Note: The table presents properties of the AIs themselves. Formulation, including but not limited to percentage of the AI, affect hazard. The ULV (ultra-low volume) formulations that are predominantly used for locust control are mainly oil-based. ULV formulation may approach close to 100 percent AI or to be diluted with only small quantities of specified solvents. ULV is considered a best solution for control of significant insect issue that need to be eradicated quickly; the term refers to formulations with an application rate of 0.5 gallons/acre or less (1.89 liter or less per hectare). ULV formulations have higher drift hazard due to small droplet size; because the product is applied as fine droplets it may have higher dermal and inhalation exposure risk.*

Analyses and Discussion of Comparative Toxicology with Weight-of-Evidence Risk Summary. The following subsections provide analysis and discussion of the ecological and human toxicology of each PRG-listed AI, in comparison to (1) other PRG-listed AIs of the same class and, where available and informative, (2) same-class AIs registered in the US for grasshopper and cricket control.[30] US and European Union (EU) registrations are discussed for each PRG AI and comparative. These registrations are an indicator of the quality of submitted data, breadth and depth of endpoints analyzed, and constitute some consensus on hazards of toxicology data available to support the comparative approach to risk on which the PEA technical approach is based (see Section 7.2).[31]

The order of presentation is identical to the table above. For each class of AIs, a narrative summary is followed by a table with more detailed information by AI.

These analyses do not comprise, and are not in the form of, detailed literature reviews. Detailed literature reviews are outside the scope of this PEA for time and cost reasons. They rather rely on aggregated information databases from various governmental and scientific institutions (below) and reflect targeted collection and time-bound, qualitative, expert-judgement analysis of information available via these sources.

Sources for these analyses are as follows:

- **US EPA Registration: US EPA Pesticides Database** https://iaspub.epa.gov/apex/pesticides/f?p=PPLS:1
- **EU Registration: EU Pesticides Database** https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=homepage&language=EN
- **Product Registration and Uses:**
    - **Pesticide Action Network (PAN) Database** http://www.pesticideinfo.org/Search_Chemicals.jsp
    - **US EPA Label registry;** https://www.epa.gov/ingredients-used-pesticide-products/how-search-information-about-pesticide-ingredients-and-labels;
    - **Internet-sourced label searches.**
- **Toxicity Studies:**
    - **PAN Database** http://www.pesticideinfo.org/Search_Chemicals.jsp;
    - **HSDB Database in PubChem** https://pubchem.ncbi.nlm.nih.gov/;
    - **Toxline in PubMed** https://pubmed.ncbi.nlm.nih.gov/?term=tox%20%5Bsubset%5D%20AND%20;
    - **FAO 2014** http://www.fao.org/3/a-bu337e.pdf;
    - **ATSDR Toxicological Profiles** https://www.atsdr.cdc.gov/toxprofiledocs/index.html;
    - **NPIC** http://www.npic.orst.edu/;
    - **Supplementary internet searches on specific issues.**

[30] Grasshoppers and crickets, with locusts, comprise the order *Orthoptera* and are closely related organisms. This focus on *Orthoptera* approval by US EPA is a narrower form of same/similar use than is set out in section 7.3.1, and is intended to best assure efficacy against desert locust of the non-PRG-listed AIs used as comparatives.

[31] Note that lack of registration is not necessarily contrary evidence to data quality or quantity, but it may be related to the lack of need, similar uses, or limited economic reasons for registering a product.

- **PPE Recommendation:** Based on example product labels. (Not definitive: *Always follow specific instructions on the label of the product used.)*
- **Weight-of-Evidence Risk Summaries are based on:** Comparison of above references; available standalone comparative risk assessments; EU Review Reports.

Metarhizium anisopliae

Product Registration: *Metarhizium anisopliae* strain F52 (general strain) is registered in the US and Europe but not for locust control. The specific desert locust control *Metarhizium anisopliae var acridum* strain IMI 330189 (i.e., the AI in the Green Muscle™ product) is not registered. *Metarhizium anisopliae var. acridum* (i.e., Green Guard® ULV) is approved for locust control in Australia (Australian Plague Locust Commission (APLC) 2010). [32]

Ecological Toxicology Several risk assessments in Africa, the US, and Australia are available and the toxicity is negligible to almost all receptors. Following inoculation, locusts may be more susceptible to predation, but infection with *Metarhizium* decreased scavenging of cadavers (Arthurs and Thomas 1999). There is no anecdotal evidence of predation following field use in Africa, the US, or Australia due to direct exposure to *Metarhizium* or consumption of infected locusts in birds or mammals; however, some questions still exist about toxicity to lizards (Lomer, et al. 2001).

Human toxicology: Toxicity is negligible to humans, but may cause allergic reaction (i.e., asthma) with repeated exposure (Ward, et al. 2011).

All users minimum PPE recommendations: overalls, hat, elbow-length gloves, faceshield, shoes, socks, and dust/mist respirator (US EPA 2011).

TABLE 6: REGISTRATION AND USE INFORMATION FOR METARHIZIUM ANISOPLIAE

AI	US EPA Registered? If yes, registered uses	EU Registered ?	Good availability of acute and chronic endpoint studies?	Weight of evidence risk summary
Metarhizium anisopliae var. acridum (PRG-listed)	No, *Metarhizium anisopliae* strain F52 is registered for greenhouses but not IMI 330189.*	No, strain F52 is registered but not IMI 330189.	Yes. Numerous endpoints for each class of receptors (acute/chronic; terrestrial/aquatic, mammalian/avian) (US EPA n.d., c). Unlikely endocrine disruptor, but US EPA noted that more studies may be warranted. Inhalation and dermal exposure routes were waived in the biopesticide registration	Low human toxicity and not suspected as an endocrine disruptor. *Metarhizium anisopliae* is known for producing destruxins, which have some cytotoxic action in cell lines (European Commission n.d., d) (Skrobek and Butt 2005). However, the product itself appears to have minimal mammalian toxicity. 24h re-entry interval. Low environmental toxicity across nearly all endpoints, except targeted species, but

[32] F52 is *Metarhizium anisopliae* and the "parent" is *Metarhizium anisopliae var acridium*. The F52 is a generalist strain with the var *acridum* the most effective against resistant insects. F52 is indistinguishable from the variant based on spore shape or size but has rDNA differences. Var *acridum* is more effective when the grasshopper has to thermoregulate (likely making it more effective in these hot climates) (Lomer, et al. 2001).

TABLE 6: REGISTRATION AND USE INFORMATION FOR METARHIZIUM ANISOPLIAE				
AI	**US EPA Registered? If yes, registered uses**	**EU Registered ?**	**Good availability of acute and chronic endpoint studies?**	**Weight of evidence risk summary**
			due to the registered use in greenhouses.	potential to affect bees (Toriello, et al. 2009), (Lomer, et al. 2001)

**NOTE: USAID 22 CFR 216.3(b) practice usually does not distinguish between variant strains of biopesticides in characterizing registration status. We do so here for maximum accuracy and transparency.*

Insect Growth Regulators (Benzoylureas)

Product Registration: Of the PRG-listed AIs in this category, diflubenzuron is the only one registered by US EPA for use on grasshoppers. Triflumuron is registered in the EU, but no products are registered by US EPA. Teflubenzuron is not registered by the EU (may have individual country registration), has no products registered in the US, but is used for aquaculture, in greenhouses, and for fruit crops in Latin American countries.

The lack of US registrations for triflumuron and teflubenzuron appear to be related to the lack of applications by manufacturers to register products.

Three other benzoylureas are registered in the US: hexaflumuron (for termites), novaluron (some products as agricultural herbicides), and noviflumuron (for termites). No other similar class benzoylurea products are registered in the US for use on rangeland or crops to use for comparison.

Ecotoxicology: All AIs have high toxicity to aquatic invertebrate organisms, but teflubenzuron has comparatively fewer studies available on which to rely. Mammalian and avian toxicity is low, especially from a single dose of IGRs.

Human toxicology: All AIs generally have low mammalian acute toxicity; however, there is some evidence of renal and hepatic damage from teflubenzuron and triflumuron and lung irritation in all AIs reviewed.

All users minimum PPE recommendations: overalls, chemical resistant gloves, shoes, and socks. Mixers and loaders handling powders must wear a dust/mist filtering respirator (Chemtura AgroSolutions n.d.).

**There generally is less information available on teflubenzuron and triflumuron than on diflubenzuron as these are newer products than the first-in-class benzoylurea diflubenzuron.*

TABLE 7: REGISTRATION AND USE INFORMATION FOR INSECT GROWTH REGULATORS				
AI	**US EPA Registered? If yes, registered uses**	**EU Registered ?**	**Good availability of acute and chronic endpoint studies?**	**Weight of evidence risk summary**
Diflubenzuron (PRG-listed)	Yes. E.g., Dimlin 2L (RUP) same or similar use registered for	Yes	Yes. Numerous endpoints for each class of receptors (acute/chronic; terrestrial/aquatic, mammalian/avian).	Low mammalian toxicity, but suspected as an endocrine disruptor. Moderate to very high toxicity to aquatic invertebrates or copepods.

TABLE 7: REGISTRATION AND USE INFORMATION FOR INSECT GROWTH REGULATORS				
AI	**US EPA Registered? If yes, registered uses**	**EU Registered ?**	**Good availability of acute and chronic endpoint studies?**	**Weight of evidence risk summary**
	grasshopper control; APHIS uses on rangeland and adjacent croplands for control of grasshopper and Mormon cricket (USDA 2019)			12h re-entry interval.
Teflubenzuron (PRG-listed)	No.	No. Used in some EU countries for aquaculture, greenhouses, and fruit crops (Pesticide Properties DataBase 2020)	No. Extremely limited toxicity data, mostly on mosquitos and for aquaculture (Macken, Lillicrap and Langford 2015). Tolerances (residue limits) established in the US to allow import of crops on which this AI is used (US EPA 2015b). Specific issues with the lack of information on bee toxicity, aquatic organisms, and operator or worker safety. EU review report requested additional information in 2010 on these topics that does not appear to have been updated (European Commission n.d., e). Lack of data on endocrine disruption.	Lack of registration in the US or EU and limited availability of toxicity data increases uncertainty for evaluating human health and environmental risk. Little evidence of acute mammalian toxicity, but repeated doses may cause hepatocellular damage (FAO n.d., a). 24h re-entry interval. Comparable ecotoxicity risks to diflubenzuron based on available information, but higher uncertainty. Uncertainty around chronic human toxicity.
Triflumuron (PRG-listed)	No	Yes	Marginal (PubChem n.d.) (PAN n.d., b). Limited bee toxicity data but reasonable aquatic toxicity data on multiple endpoints. Lack of data on endocrine disruption. Uncertainty around chronic human toxicity.	Gaps in estimating risk exist, but registered in EU and ecotoxicity data available. Possible hepatic and renal toxicity (Timouni, et al. 2020). Comparable ecotoxicity risks to diflubenzuron based on available information.

Phenyl pyrazoles

Product registration: No same or similar use registered products in the US by US EPA or in the EU. However, fipronil has been used in Australia for locust control for pasture and sorghum, but is not approved for use on cereals (Government of Australia 2019b). There are no AIs in this class registered by US EPA for orthopteran control and thus no comparatives are presented.

Ecological toxicology: Significant avian and non-target arthropod mortality is a concern. In field studies on aquatic systems conducted after locust control campaigns, Australian researchers did not see population effects on aquatic invertebrates (Gagliardi, et al. 2011). Terrestrial arthropods are also a concern due to the acute toxicity, including bees and other beneficial insects. Avian toxicity varies depending on the species.

Human toxicology: Generally, fipronil is noted as moderately hazardous, and if waiting periods for grazing are not observed, animal products can become contaminated.

All users minimum PPE recommendations: overalls, hat, chemical resistant gloves, shoes, and socks. Sprayers must wear goggles (BASF Chemical Company n.d.).

TABLE 8: REGISTRATION AND USE INFORMATION FOR PHENYL PYRAZOLES

AI	US EPA Registered? If yes, registered uses	EU Registered?	Good availability of acute and chronic endpoint studies?	Weight of evidence risk summary
Fipronil (PRG-listed)	Not registered for *orthoptera* (grasshopper or cricket) control or aerial use. Registered uses include: some domestic animals, ant/roach control, termites, and limited agricultural uses.	No.	Marginal data is available, with many studies based on non-ULV formulations.	Moderate acute toxicity. Technical grade is considered more toxic to terrestrial mammals than fenitrothion, but is used at lower concentrations that are more persistent (Government of Ausralia n.d.). 14-day waiting period before grazing or feeding fodder to animals. Re-entry upon drying. Possible human carcinogen. Products in the US note that fipronil is very toxic to aquatic systems. Highly toxic to terrestrial arthropods. Mortality in birds (but not waterfowl) and mammals have been documented in the field. Metabolites may be a concern in aquatic systems. Honeybees may be of concern.

Pyrethroids

Product registration: Both deltamethrin and lambda-cyhalothrin are registered by US EPA for grasshopper control with GUP granular formulations available. All aerial applications are likely RUP.

Ecotoxicology: Pyrethroids are highly toxic to aquatic systems and bees, but have lower toxicity to mammals and birds than organophosphates. Pyrethroids have issues of resistance, which is an important consideration when the same locations are targets for disease vectors.

Human toxicology: Mammalian toxicity is generally the same with minimal risk from deltamethrin or lambda-cyhalothrin, although deltamethrin may be slightly less toxic through oral and inhalation exposures.

All users minimum PPE recommendations: coveralls, hat, chemical resistant gloves, goggles or faceshields, shoes, and socks. RUP aerial formulations require chemical resistant headwear, footwear, and apron and protective eye equipment (Arysta LifeScience n.d.). Mixers of granular/powder formulations must wear dust-mist respirators in accordance with the label (Arysta LifeScience n.d.) NIOSH approved respirator with any R, P or HE filter for outdoor handlers of spray (US EPA 2009). GUP granular formulations typically require shoes, socks and coveralls (BAYER n.d.).

TABLE 9: REGISTRATION AND USE INFORMATION FOR PYRETHROIDS

AI	US EPA Registered? If yes, registered uses	EU Registered?	Good availability of acute and chronic endpoint studies?	Weight of evidence risk summary
Deltamethrin (PRG-listed)	Yes, for agriculture aerial and barrier applications for grasshopper, but RUP in the US for aerial application of Decis 1.5 EC (US EPA n.d., d). Delta G (PAN n.d., f) is a GUP granular formulation for grasshopper.	Yes.	Yes. Extensive studies across multiple endpoints available. Insufficient information for endocrine disruption and limited acute toxicity data.	RUP classification is based on toxicity to aquatic systems. Moderate toxicity to mammals. Not classifiable as a carcinogen. 12 h re-entry interval. Highly toxic to bees. High potential to bioconcentrate in aquatic organisms but not bioaccumulate in terrestrial organisms. Low toxicity to birds.
Lambda-cyhalothrin (PRG-listed)	Yes. Multiple products registered for grasshopper control in agricultural settings that are RUP (e.g., Karate 1ec) and GUP (e.g., Kendo 9.7 cs). Some formulations may be applied by either ground or aerial equipment.	Yes.	Yes. Extensive studies across multiple endpoints available but most studies are based on cyhalothrin. The lambda isomer is not considered to have significantly different toxicity.	Moderately toxic to mammals with oral exposure and inhalation responsible for the highest toxicity. Dermal exposure can result in skin irritation. 24 h re-entry interval. Not classifiable as a carcinogen. RUP products pose a risk to aquatic environments including invertebrates and fish. Nontoxic to avian species. Highly toxic to bees.

Carbamates

Products Registration: Bendiocarb currently has no US EPA registered uses in the US. There were at least 5 products previously registered for use in the US (granular and wettable powder formulations) on crickets; however, the products were cancelled for what appears to be reasons of non-payment for re-registration, or cancelled at the registrant's request.

Carbaryl is another Carbamate AI with US EPA-registered products for the control of crickets and grasshoppers, and is used as a comparative.

Ecotoxicology: Both AIs are highly toxic to bees and have moderate acute aquatic toxicity. High avian toxicity of bendiocarb with carbaryl being generally lower than bendiocarb. Carbamates have broad resistance issues.

Human toxicology: The two products differ; bendiocarb is considered to have a greater acute human (mammalian) toxicity (specifically, high oral toxicity) than carbaryl based on US EPA labelling, primarily for neurologic symptoms. Carbaryl is noted as a likely carcinogen by US EPA while bendiocarb is unlikely a carcinogen. Information is lacking to determine if bendiocarb is an endocrine disruptor.

All users minimum PPE recommendations: coveralls, hat, chemically resistant gloves, chemically resistant apron, shoes, and socks. Aerial mixers and loaders must wear a NIOSH approved respirator (US EPA n.d., f).

TABLE 10: REGISTRATION AND USE INFORMATION FOR CARBAMATES

AI	US EPA Registered? If yes, registered uses	EU Registered?	Good availability of acute and chronic endpoint studies?	Weight of evidence risk summary
Bendiocarb (PRG-listed)	No. 351 cancelled products, with many due to non-payment of registration and/or registrant requires (NPIC 2002), (US EPA 1999). Previous registrations were in granular and wettable powder formations including 2.5% to 20% concentrations registered for cricket control (PAN n.d., e).	No	Yes. Numerous endpoints for each class of receptors (acute/chronic; terrestrial/aquatic, mammalian/avian). Lack of information on endocrine disruption.	Higher acute human toxicity than carbaryl (US EPA label category 1), particularly for oral exposure. High dermal and inhalation acute toxicity. Unlikely carcinogen. Concern over bee toxicity. Moderate aquatic toxicity. Less data available than for carbaryl, but there are toxicity studies across a broad set of endpoints.
Carbaryl (Comparative)	Yes. 300 active products for grasshopper.	No (European Commission n.d., b). Concerns cited	Yes. Human Health Risk Assessment (HHRA) and Ecological Risk	Suspected carcinogen and suspected endocrine disruptor. Moderate acute oral, dermal, and inhalation

TABLE 10: REGISTRATION AND USE INFORMATION FOR CARBAMATES				
AI	**US EPA Registered? If yes, registered uses**	**EU Registered?**	**Good availability of acute and chronic endpoint studies?**	**Weight of evidence risk summary**
	APHIS uses Carbaryl on rangeland and adjacent croplands for control of grasshopper and Mormon cricket in a bait and ULV spray formulation (USDA 2019). GUP products: Sevin® XLR Plus (aerial), Sevin® 5 Bait, and 2% Sevin® Bait (barrier)	over breakdown of products, carcinogenic properties, acute toxicity to aquatics, and herbivorous mammals and birds.	Assessment (ERA) conducted for APHIS use on grasshopper and cricket suppression provides summary (USDA 2019). RED documentation provides PPE recommendations for each user scenario (US EPA 2008). Not evaluated by PRG (FAO 2014).	toxicity. Specific applicator scenario PPE requirements noted by US EPA (US EPA 2008). Concern over honeybee toxicity, moderate aquatic toxicity.

Organophosphates (OPs)

Product Registration: Numerous OPs have products registered by US EPA for control of grasshopper species. Of the PRG-listed OP AIs for locust control (malathion, chlorpyrifos, fenitrothion), only malathion has US EPA registered GUP products for use on grasshopper or cricket in the US. The US EPA designated chlorpyrifos products as RUPs for agricultural uses and has cancelled fenitrothion, which had previously been approved for ornamentals, forestry, and mosquitos. Fenitrothion and malathion were largely replaced by pyrethroids due to shorter persistence and need for repeated blanket treatments (Lomer, et al. 2001). Canada stopped using fenitrothion for spruce budworm due to bird mortality (Douthwaite, Landewald and Harris 2001). Fenitrothion is approved for use on locust in Australia (Government of Australia 2019a). (See also discussion in 7.3.1 regarding the extended legal actions around US EPA's registration of chlorpyrifos.)

Several other AIs have products approved by the US EPA for grasshoppers, including for aerial spraying (i.e., acephate, diazinon, and dimethoate). Comparisons with diazinon were not included as products with this AI or designated as RUPs by the US EPA and the AI was not listed by the PRG.

Ecotoxicology: Chlorpyrifos, followed by fenitrothion, has the highest toxicity across most aquatic receptors. Dimethoate and malathion are slightly less toxic across aquatic endpoints, followed by acephate, although fewer studies are available for dimethoate and acephate compared to other OPs.

Studies vary on the effects on honeybees, but acephate and malathion are also relatively lower risk to honeybees from contact exposure, especially compared to chlorpyrifos; however, breakdown of products could be a concern (Sanchez-Bayo and Goka 2014). Chlorpyrifos and dimethoate are considered the highest risk for honeybees. Acephate and dimethoate present concerns for consumption by birds. The potential for groundwater contamination is possible with dimethoate and acephate, but unknown in fenitrothion.

Organophosphates have associated resistance issues.

Human toxicology: Acute toxicity (oral LD50) is greatest for chlorpyrifos and dimethoate, followed by fenitrothion, and then acephate and malathion. Significant debate remains regarding the safety of chlorpyrifos, especially for chronic exposures. All are suspected endocrine disruptors. Both acephate and dimethoate are possible human carcinogens, malathion is suggestive for carcinogenicity, while fenitrothion and chlorpyrifos are unlikely. There is some evidence for mutagenicity with chronic exposures for fenitrothion.

All users minimum PPE recommendations: coveralls, chemically resistant gloves, shoes, and socks. Low pressure wand users must wear a NIOSH approved respirator (US EPA 2015a). Dimethoate must also have protective eyewear and chemically resistant apron (Greenbook n.d.) (Drexel Chemical Company n.d.).

TABLE 11: REGISTRATION AND USE INFORMATION FOR ORGANOPHOSPHATES

AI	US EPA Registered? If yes, registered uses	EU Registered?	Good availability of acute and chronic endpoint studies?	Weight of evidence risk summary
Fenitrothion (PRG-listed)	No. All products cancelled both voluntarily and due to lack of engagement on label changes required for hand applications. Previously registered for ornamental, forestry, and mosquito use in the US (PAN n.d., c).	No, but Australia has approved use for locust control with strict institutional controls. (See 7.3.4)	Yes. Numerous available studies with multiple endpoints and receptors. Lack of data on mammalian inhalation endpoints and limited information on groundwater contamination (NRA n.d.). Previously labelled as RUP as human toxicity classification was changed due to lack of information.	Dermal exposure is considered the primary exposure route for workers, but inhalation toxicity information is largely absent. Suspected endocrine disruptor. Unlikely human carcinogen. Australian approvals for use in locust campaigns require numerous institutional controls via aerial ULV applications with a re-entry interval of 48 h required. Do not graze for 7 days or feed fodder for 14 days to livestock. Very toxic to aquatic systems and possibly birds.
Acephate (Comparative)	Yes. Aerial, granular, and wettable powder formulations are approved for GUP. (E.g., LIVID 97) (US EPA n.d., a) (PAN n.d., d).	No (European Commission n.d., a). Insufficient information presented for registration in the EU.	Yes. Studies available across multiple endpoints and receptors, but much fewer than other organophosphates. Not evaluated by PRG (FAO 2014).	Possible carcinogen and suspected endocrine disruptor. 24h re-entry interval. Lower toxicity across environmental receptors for comparable organophosphates. Methamidiphos metabolite is a concern for bees and also has high acute toxicity in mammals (US EPA 2002).
Dimethoate (Comparative)	Yes. 32 products active with several products for grasshopper and GUP for ground and aerial	No. Non-renewal due to in vivo mutagen of a metabolite, high risk to mammals, arthropods, and	Yes. Studies available across multiple endpoints, but much fewer than other organophosphates. Some data lacking for effects on birds	Moderately toxic to humans. Irritant to eyes. Dermal exposure routes. Possible carcinogen. Suspected endocrine disruptor. 24h re-entry interval. May have relatively lower toxicity across

TABLE 11: REGISTRATION AND USE INFORMATION FOR ORGANOPHOSPHATES				
AI	**US EPA Registered? If yes, registered uses**	**EU Registered?**	**Good availability of acute and chronic endpoint studies?**	**Weight of evidence risk summary**
	application (US EPA 2013).	honeybees (European Commission 2016b).	and for groundwater residues. Insufficient information for endocrine disruption. Not evaluated by PRG (FAO 2014).	environmental receptors for comparable organophosphates except acephate. Breakdown production of omethoate is a concern for bees, other arthropods, and mammals (CDC 2017).
Malathion (PRG-listed)	Yes. Registered for agriculture, public health, other uses. Some formulations may be applied by either ground or aerial equipment. Approved for control of grasshoppers and crickets in rangeland and used by APHIS (USDA 2019).	Yes	Yes. Extensive studies across multiple endpoints available.	Re-entry interval of 12 h recommended. Suggestive carcinogen and suspected endocrine disruptor. Significantly more information around human health risks and endpoints than dimethoate, fenitrothion, and acephate. Has relatively low mammalian toxicity across the organophosphates. Breakdown production of malaoxon is a concern (ASTSDR 2003). Moderate toxicity to fish but very toxic to most aquatic receptors.
Chlorpyrifos (PRG-listed)	Yes (PAN n.d., a), following extended legal action (see 7.3.1); All products are RUP for agricultural applications. Products registered in the US include chlorpyrifos 4E AG and lorsban 4E.	No (European Commission 2016a). Not renewed as of 2019 due to genotoxicity, and developmental neurotoxicity concerns.	Yes. Extensive studies across multiple endpoints available.	Suspected endocrine disruptor. >24h re-entry interval. Significant debate around chronic human health risks (particularly neurodevelopmental effects) with moderate acute human toxicity. Very toxic to fish, aquatic organisms, and birds.

7.3.4 PESTICIDES REGISTERED FOR LOCUST CONTROL IN AUSTRALIA

Why Australian Pesticide Registrations for Locust Control are Relevant. Australia provides the example of a US peer economy which, unlike the US, has an economically significant locust problem and conducts wide-area control campaigns through the national government, but also has control

campaigns at the local level with farmers and through the state authorities. Locust species in Australia include:

- The Australian plague locust (*Chortoicetes terminifera*), which is the most important pest species in Australia due to the large areas infested, the frequency of outbreaks and its ability to produce several generations in a year.
- The spur-throated locust (*Austracris guttulosa*), which can rise to plague proportions but are infrequent compared to the Australian plague locust outbreaks.
- The migratory locust (*Locusta migratoria),* which is normally confined to the Central Highlands of Queensland, though low numbers are common as far south as northern New South Wales.
- The *Gastrimargus musicus (Fabricius),* which occurs in all mainland states.

As such, Australia has registered pesticides specifically for locust control, considering environment, health, and safety in a rigorous way arguably comparable to US EPA's decision-making processes and risk tolerance. As such, if FAO Pesticide Referee Group- (PRG-) listed pesticides are to a significant extent also registered for locust control in Australia, this provides a validation of the PRG list from an efficacy and environment, health and safety (EHS) perspective.[33]

Australian Locust Control Campaigns and Pesticides Employed. Where plague locust presents an interstate threat, the Australian Plague Locust Commission (APLC), an organization with joint state and national funding, will implement nationwide control measures (Biosecurity Queensland n.d.).

Pesticide ULV formulations used by APLC for aerial control of Australian plague locust outbreaks nationwide are:

- Fenitrothion
- Fipronil
- *Metarhizium anisopliae var. acridum (*Green Guard® ULV)

In addition to APLC control campaigns for plague locust outbreaks, commercial farmers, local governments and the Australian Department of Agriculture and Fisheries engage in locust control and coordinate strategic, preventative locust control operations selecting from the range of registered products and conducting situation appropriate aerial and ground applications. The following insecticides are registered in Australia by the national Australian Pesticides and Veterinary Medicines Authority for control of locust (DPIRD 2018):

- Pyrethroids: Alpha-cypermethrin, Beta-cyfluthrin, Cypermethrin, Gamma cyhalothrin; Lambda-cyhalothrin
- Carbamate: Carbaryl
- Phenylpyrazole: Fipronil
- Organophosphate: Diazinon, Chlorpyrifos, Fenitrothion, Malathion
- Biological: *Metarhizium anisopliae var. acridum*

[33] Australian locusts in all four varieties are distinct from, but highly similar organisms to, the Desert Locust, and experience indicates the pesticide efficacy tends to be markedly similar for such closely related organisms.

TABLE 12: COMPARISON OF PESTICIDES REGISTERED FOR LOCUST CONTROL IN AUSTRALIA TO THOSE LISTED BY PRG FOR CONTROL OF LOCUST*		
Class of pesticides	***Active Ingredients (AIs) Registered in Australia for locust control***	***Reviewed by PRG for Desert locust control***
Pyrethroids	Alpha-cypermethrin, Beta-cyfluthrin, Cypermethrin, Gamma cyhalothrin**; Lambda-cyhalothrin**	Deltamethrin, **Lambda-cyhalothrin**
Carbamates	Carbaryl	Bendiocarb
Phenylpyrazoles	***Fipronil***	***Fipronil***
Organophosphates	Diazinon, **Chlorpyrifos**, **Fenitrothion**, **Malathion**	**Chlorpyrifos, Fenitrothion, Malathion**
Microorganism derived biological	***Metarhizium anisopliae (Green Guard)***	***Metarhizium anisopliae (Green Muscle)***
Benzoylurea Insect Growth Regulator (IGR)	None	*Diflubenzuron, Teflubenzuron, Triflumuron*

Source https://portal.apvma.gov.au/pubcris
Note: AIs registered for locust control in Australia AND listed by the PRG for locust control are ***bolded***

Analysis. As shown in the table, there is significant overlap between the PRG list and Australian registrations, with 6 of the 11 pesticide AIs on the PRG list also registered in Australia for locust control. An additional PRG reviewed pesticide AI, Bendiocarb that has no registered products in the US is of the same class (N-methyl carbamate) as Carbaryl registered in Australia for treatment of plague locust and is registered in the US for control of grasshoppers in agriculture and rangelands. Pyrethroids AIs registered in Australia for locust control are also used in the US for control of grasshoppers in agriculture (e.g., Alpha-cypermethrin, Gamma-cyhalothrin). See comparative discussion of the human and ecotoxicology of the AIs within each class in 7.3.3. Overall, IGRs, carbamates, and pyrethroids recommended by the PRG do not align with the Australian pesticide registration for locust control. Organophosphates, fipronil, and the use of Metarhizium aligns closely with the Australian Federal authorities using Fenitrothion for aerial applications and Fipronil for barrier control and biopesticide for control in ecologically sensitive areas.

7.3.5 SYNTHESIS: COMPARATIVE RISKS OF PESTICIDES

The comparative review of the hazards and risks of FAO Pesticide Referee Group- (PRG-) listed pesticide active ingredients (AIs) presented in 7.3.3 highlights differences in hazards and weight-of-evidence risk between each PRG-listed AI and (1) other PRG-listed AIs of the same class and, where available and informative, (2) other same-class AIs registered in the US for grasshopper and cricket control. Such differences are expected: no two AIs, even close chemical cousins, have exactly the same toxicology and environmental persistence. Also, products vary in their formulations, application rate, and concentration, which is not fully captured in this comparison.

However, with the exceptions of chlorpyrifos and fipronil, elaborated below, this analysis indicates that FAO's PRG-listed AIs, where not US EPA-registered for similar use, have hazard and weight-of-evidence risks that are similar to AIs in the same class that are so registered.

This general conclusion is subject to the limitations of our analysis: i.e., time-bound, qualitative, expert-judgement analysis of information available from aggregated information databases from various governmental and scientific institutions. However, when taken in the context of a PRG process determined to indeed be robust in its consideration of environment, health and safety (EHS) alongside efficacy (7.3.2), and with the corroboration provided by (1) AIs approved for locust control in Australia (7.3.4) and (2) EU registration status (see comparative analyses in 7.3.3), this conclusion is more robust.

Chlorpyrifos and fipronil were found to have potentially higher risks and are therefore *excluded from further analysis and approval* under this PEA:

- **Chlorpyrifos.** Chlorpyrifos is excluded from approval under this PEA. While, after an extended series of legal challenges and court and agency actions (see note to table 4 in 7.3.1), chlorpyrifos remains US EPA-registered for similar use to locust control, the considerable evidence—albeit disputed—regarding its chronic effects (particularly neurodevelopmental effects in children) and non-renewal of EU registration over exactly these concerns strongly suggests that the precautionary principle should apply. The lack of consensus and the possible hazards posed long-term to both adults and children are driving factors in excluding chlorpyrifos from approval under this PEA.

  Further, use of chlorpyrifos products in the US are subject to strict engineering and professional user controls, thereby reducing exposure to the general public or to non-agricultural ecosystems. Additionally, in the US grazing and cutting of fodder is restricted for 7–14 days post spray, which will be an extremely difficult control to enforce in pastoralist desert locust control areas; thereby creating significant uncertainty regarding risk to local residents and migratory herders through this exposure pathway. These controls required for use in the US may be extremely difficult to ensure in the context of desert locust control. Toxicity is high to fish, aquatic invertebrates, and bees, like many other AIs proposed by the PRG; however, toxicity is exceptional to avian species as well. These are additional factors for eliminating chlorpyrifos.

- **Fipronil.** Fipronil is excluded from approval under this PEA due to a combination of factors. First, data availability is marginal or lacking for acute and chronic endpoints of interest for desert locust spray campaigns, particularly for ULV formulations. Additionally, there is no similar use registration by US EPA or the EU and; no same/similar use comparatives available. Australia has approved the use of fipronil for locust control, but excludes application to cereal crops. Cereal crops (e.g., maize, sorghum, millet) are very commonly planted in small plots across Africa as a primary food staple, so avoidance of such crops is likely to be difficult in any desert locust spray campaign.

  Fipronil, like chlorpyrifos, has strict engineering and professional user controls in the US that require proper application, mixing, and spray drift requirements in order to limit worker risk and environmental impacts. Additionally, in the US a waiting period of 14 days must also be enforced for open grazing and fodder crops, which like chlorpyrifos, could pose significant potential for exposure in humans and livestock. Finally, fipronil is one of the most persistent active ingredients considered on the PRG list, and therefore, even at low concentrations at application, foraging terrestrial insects may bioaccumulate toxic concentrations and there is also some evidence of biomagnification to upper trophic level predators (e.g., birds, small mammals) (Qin, et al. 2014). One study suggested that chlorpyrifos may be responsible for bee decline in

France in the 1990s (Holder, et al. December 2018). These cumulative factors for eliminating fipronil from the list of approved AIs under this PEA.[34]

These conclusions are based purely on comparative hazard and weight-of-evidence risk and the assumptions that appropriate equipment is in place and used in accordance with labelling. They are *not* a determination that USAID assistance to procurement and/or use of any PRG-listed AI is appropriate for desert locust control. Such determinations must take on board the use context and are presented in Section 9.

These conclusions should not be taken to equate hazard and risk between the various classes of AIs in the PRG list. The PRG use priority (see Table 5 in Section 7.3.3), which prioritizes early intervention with lower quantities of more selective pesticides, is essential to reduce overall worker, community and environmental risk.

Implications for Alternatives Analysis. With chlorpyrifos and fipronil excluded from Alternative C, this alternative contains no hazard/risk outliers vs. US EPA-registered same/similar use AIs. As such, there is no basis in a comparative hazard/risk approach to prefer Alternative B.

7.4 EXTENT TO WHICH ASSUMPTIONS RESULT IN COMPARABLE RISKS VS US STANDARDS, PART 2: IN-PRINCIPLE RISK MITIGATION PROVIDED BY FAO *DL GUIDELINES* AND SOPs

This section evaluates the extent to which the relevant chapters of FAO's *Desert Locust Guidelines (DL Guidelines)* and relevant SOPs (see 3.4) (1) provide, *in principle*, risk/impact mitigation consistent with requirements for RUP application and for aerial pesticide application in the US, and (2) address the potential environmental and health risks and impacts of desert locust control identified in section 7.1.

7.4.1 EXTENT TO WHICH FAO'S *DL GUIDELINES* AND SOPs MEET US RUP REQUIREMENTS

This sub-section characterizes the extent to which FAO's relevant *DL Guidelines* and SOPs for desert locust control are equivalent to the requirements for RUP application and for aerial pesticide application in the US. This section is a summary of a longer analysis provided in Annex E.

FAO's Guidelines and Standard Operating Procedures for Desert Locust Control as Related to Environment, Health and Safety (EHS)

The FAO's *Desert Locust Guidelines Chapter 6, Safety and Environmental Precautions* (FAO (Valk, H. van der; Everts, J.W.) 2003), focus on reduction of environmental and human health risks from insecticide use during locust control. Chapter 4 of these Guidelines, *Control* (FAO (Dobson, H.M.) 2003), focuses on safe, effective and efficient equipment and techniques to carry out locust control. The FAO's SOPs for Desert Locust Aerial Survey and Control (FAO n.d., f) and Desert Locust Ground Control (FAO n.d., g) specify implementation of key elements of both Guideline Chapters in more specific terms, with particular respect to pesticide handling, mixing, loading, application, cleanup and spray equipment calibration. Both these Chapters of the *DL Guidelines* and the DL SOPs were reviewed.

US Requirements for RUP Application and for Aerial Pesticide Application

In the US, federal law requires any person who applies or supervises the use of RUPs to be certified as a

[34] As the sole AI in the phenyl pyrazoles group and no comparatives available, fipronil cannot be compared within its class.

private or commercial applicator[35] in accordance with US EPA regulations, and state, territorial and tribal laws (US EPA n.d., e). US EPA has oversight of state, territory, tribal and federal agency certification programs to ensure they meet certain standards. US EPA regulations (40 CFR Part 171) (Code of Federal Regulations 2016) establish minimum standards of competency for pesticide applicators that apply or supervise the use of RUPs.

In 2017, the US EPA finalized updated requirements for RUP applicators such as a minimum age and streamlined requirements for states. All states were required to submit their new compliance plans to US EPA by March 4, 2020. Upon submission, US EPA has two years to review and approve the state plans.

In the US, all aerial pesticide applications, including those of GUP products, are restricted to licensed commercial pilots who are also registered as commercial pesticide applicators in the states in which they conduct the subject aerial pesticide application. (This is a restriction distinct from RUP registration, but highlights the multiple risks of aerial application.)

While US states administer their own applicator certification programs, a number of states utilize the National Pesticide Applicator Certification Core Exam, which is, *de facto*, a national standard. To assess the content of US RUP and aerial application requirements, this PEA reviewed the two standard manuals developed for the National Pesticide Applicator Certification Core Exam. Each is described below.

- **National Pesticide Applicator Certification Core Manual.** The 2014 National Pesticide Applicator Certification Core Manual was developed jointly by the US EPA and the Pest Management Regulatory Agency of Canada, and serves as a study guide for those preparing to take the National Pesticide Applicator Certification Core Exam. It addresses pest management, federal laws, labeling, formulations, hazards and first aid, PPE, environmental concerns, transportation, storage and security, emergency response, and application procedures.
- **National Pesticide Applicator Certification Aerial Applicators Manual.** The Pesticide Applicator Certification Aerial Applicators Manual focuses on how to apply pesticides properly and safely from an aircraft. The manual discusses laws and regulations for the aerial applicator pilot, operation and application safety, pesticide drift, and calibration of aerial application equipment.

Comparison of FAO's SOP and US RUP Application Requirements for ULV Aerial Spraying and Ground Fogging

The FAO's SOPs and *DL Guidelines* address pesticide handling, mixing, loading, application, cleanup, spray equipment calibration and PPE in a manner generally consistent with and equivalent in rigor to the US *de facto* national standards described above.

Beyond this, the FAO's *DL Guidelines* provide guidance related to campaign preparation and follow-up

[35] A private applicator is defined as someone who applies pesticides for the production of an agricultural commodity on land that they or their employer owns or rents. A commercial applicator is anyone that does not meet the description of a private applicator (US EPA n.d., e).

that is beyond the scope of US commercial and aerial applicator certifications. For example, the *DL Guidelines* stress that beyond the campaign itself, it is essential to be well prepared. If campaign preparation has been done well, the actual risk reduction activities that need to be carried out during the control operations will be explicit. Similarly, the FAO's *DL Guidelines* underline that health and environmental risk reduction activities should not be considered completed when the locust has been eliminated. Essential campaign follow-up includes properly managing the unused insecticides and empty containers; analyzing residues and identifying biological samples; post-campaign health checks of control staff; evaluating the monitoring results and identifying improvements for future campaigns; and writing a detailed report of the risk reduction activities and conclusions (FAO (Valk, H. van der; Everts, J.W.) 2003).

Further, FAO stresses the importance of thorough pre-campaign planning and training. Although not a requirement, FAO recommends that locust control staff be officially licensed or certified in the handling and application of insecticides, after having successfully completed the training. FAO currently does not suggest a minimum age for pesticide applicators.

7.4.2 EXTENT TO WHICH FAO'S *DL GUIDELINES* AND SOPs ADDRESS POTENTIAL ADVERSE IMPACTS

This sub-section outlines the extent to which the FAO's *Desert Locust Control Guidelines for Safety and Environmental Precautions* (FAO (Valk, H. van der; Everts, J.W.) 2003) and FAO's relevant SOPs for desert locust control address the potential risks or adverse impacts of aerial and ground spray operations and pesticide transport, handling, storage and disposal as identified in section 7.1. A more detailed analysis can be found in Annex E.

Ecotoxicity, Adverse Impact on Non-target Organisms. Almost all the insecticides that are at present used for desert locust control have broad-spectrum activity that may adversely affect other organisms in the environment. The *DL Guidelines* stress the importance of selecting an appropriate insecticide, control strategy and method. Environmental protection measures should strictly be applied. In addition control teams should always verify that no livestock or people are present in areas to be sprayed.

Water Contamination. The *DL Guidelines* explain that local people may be exposed to pesticides during or after locust control operations through contaminated drinking water. However, ecosystem impacts that can result from contamination of surface waters are insufficiently discussed in the Guidelines.

Pesticide Residue Consumption. Individuals can be exposed through entering sprayed fields, consuming contaminated crops, consuming animal products without maintaining withholding period or consuming pesticide-treated locust. The *DL Guidelines* mention that locusts killed by insecticides should never be consumed, since they may still contain toxic levels of insecticides. Additionally, the *Guidelines* emphasize the need to raise awareness about and maintain adherence to recommended pre-harvest intervals and withholding periods. However, the *DL Guidelines* do not elaborate on the need for awareness building and informational campaigns to prevent people from consuming sprayed locusts.

Spray/Handler Team Exposure. Almost all field staff, including drivers, pilots, transporters, survey and monitoring staff and flagmen are at risk of insecticide poisoning. To minimize this risk, FAO uses the WHO classification of hazards as a guideline on occupational and bystander risk. Extremely hazardous

pesticides are not recommended for use in desert locust campaigns (the FAO Pesticide Referee Group (PRG) list contains no such pesticide active ingredients (AIs)).

Spray Drift and Environmental Residues. Aerial and large treatment areas have a higher risk of uncontrolled drift. The *DL Guidelines* emphasize that spray campaigns should start downwind and move upwind to avoid walking, driving or flying through the pesticide cloud. Anyone not directly involved in the campaign should stay upwind at a safe distance.

Improper Formulation and Application. The *DL Guidelines* provide a table with correct formulations for each pesticide as an annex. Mixing of pesticides is not usually a problem as most of the insecticides used in desert locust control are ready for use in ULV formulations. However, in some countries, concentrated ULV formulations are diluted in the field. The FAO stresses that personnel carrying out the mixing or diluting of pesticides should be well trained. The *DL Guidelines* do mention that appropriate PPE such as gloves, face shield, and impermeable apron as well as appropriate pumping/mixing equipment should be available. However, it is unclear from the *DL Guidelines* whether or not PPE is actually required.

Timing of Application. The *DL Guidelines* state that inhabitants should be warned the evening before spraying. However, specifics about the timing of application and appropriate mitigation measures are only vaguely discussed in the *DL Guidelines* and SOPs.

Environmental and Community Exposure. Despite local populations generally not being involved in desert locust control campaigns, consumers, bystanders and inhabitants of nearby villages can still be exposed to pesticides. Almost all the insecticides that are at present used for desert locust control have broad-spectrum activity and are thus not specific to locusts. As a result, they may adversely affect other organisms in the environment. The *DL Guidelines* stress the importance of selecting an appropriate insecticide, control strategy and method. Environmental protection measures should strictly be applied. In addition control teams should always verify that no livestock or people are present in areas to be sprayed.

Reuse of Pesticide Containers. Empty insecticide drums, bags or other containers are a health risk to humans and the environment due to small amounts of insecticide remaining in containers even after cleaning. ULV formulations are especially difficult to clean out. The *DL Guidelines* stipulate that empty and rinsed insecticide containers should be returned to a designated storage site where appropriate arrangements can be made. The best option would be if the drums can be returned to the manufacturer for reconditioning.

Residual and Obsolete Stocks. Planning the quantity of insecticides needed can be challenging. Environmental risks increase with the amount of pesticides stored and/or disposed of. If locust populations have to be controlled on a regular basis in the country, leftover pesticides can be safely stored for future use. Pesticides that will not be used for locust control in the near future can be used for other pests (given the insecticide has been registered for use against such pests). Large amounts of leftover pesticides can be sold or donated to neighboring countries who may have a need for the pesticides.

7.5 POTENTIAL EHS SAFEGUARD IMPLEMENTATION GAPS

This section summarizes the environment, health and safety (EHS) gaps (1) identified by the FAO-coordinated multilateral evaluation of the 2003-05 desert locust control campaign, and (2) identified by in-country consultations conducted for this PEA. These two analyses provide insights into the extent to which adherence to the EHS-relevant chapters of FAO's *Desert Locust Guidelines* and relevant SOPs (see 3.4) can realistically be expected to hold in the field. The implications of these findings for EHS risks of desert locust control actions are then assessed in section 7.7.

7.5.1 EHS FINDINGS OF THE MULTILATERAL EVALUATION OF THE 2003–2005 CAMPAIGN

Over November 2005 to March 2006, FAO conducted a multilateral evaluation of the desert locust control campaign of 2003 through 2005 (Brader, et al. 2006). This sub-section provides a brief background on the 2003 to 2005 desert locust control campaign, and then summarizes the findings and recommendations from the 2006 FAO evaluation specific to the implementation of environment, health and safety (EHS) safeguards during the campaign.

Background:

The key issues in the desert locust campaign can be summarized in the following brief points:

1) The upsurge was limited in duration, from June to December 2004, and was characterized by a large dense desert locust invasion in the FAO-designated "Western Region" of the desert locust distribution area, including Algeria, Burkina Faso, Chad, Libya, Mali, Mauritania, Morocco, Niger, Senegal and Tunisia. It originated in the Sahel region rather than in the typical breeding areas in southern Arabia and the Horn of Africa.
2) The control campaign focused on mobilizing the resources to apply chemical pesticides to the vulnerable areas, <u>without</u> executing adequate environmental safeguards.
3) The campaign was not as effective as expected, and more expensive than anticipated due to a delay in funding from outside donors, and associated delay in implementing the locust control interventions.
4) Approximately 8 million people in the Sahel needed food assistance and agricultural rehabilitation. The food insecurity resulted from the combination of the existing drought and the locust upsurge and was not forecast.
5) In general, the Sahelian countries were not prepared, and launched ineffective desert locust control campaigns.
6) Countries from the Maghreb, primarily Libya, Morocco and Algeria, were well prepared for the desert locust upsurge, and, as a result, were able to provide extensive assistance to affected countries in the Sahel.
7) Effective aerial spraying in Algeria and Morocco in the fall of 2004 and in the winter of 2004/2005, combined with poor breeding conditions (unusually cool weather) in northwestern Africa, resulted in an accelerated decline in the locust upsurge in the Sahel in the Spring of 2005. These operations indicate that the available locust control techniques can work to arrest desert locust upsurges.
8) The cost effectiveness of the desert locust control varied widely from $200+/hectare to $15/hectare across the affected region.
9) Approximately 6.2 million liters of pesticide remained and needed disposal at the conclusion of the campaign. Notably, in the final months of the campaign, countries procured excessive amounts of

insecticides. Better coordination and the capacity to rapidly procure pesticides could have prevented the accumulation of unused pesticides.

10) The total cost of the campaign was estimated at $400 million, $280 million for actual locust control spent by Algeria et al, of which $80 million contributed from donors, and $90 million for food assistance.

Findings and Recommendations from the Evaluation Specific to Human Health and the Environment:

The findings of the FAO evaluation include the following gaps and recommendations to address environmental, health, and safety (EHS) safeguards include the following.

1) The availability of experts in desert locust control was limited, and such experts were difficult to rapidly mobilize to provide technical assistance during the campaign. The FAO evaluation recommended that the FAO plant protection division develop a roster of experienced, qualified experts, to rapidly fill campaign positions, especially in the field, as needed during the next upsurge.
2) The communities in areas of spraying were exposed to undue hazards. Similarly the local environment was not sufficiently protected during the spray campaign. FAO recommended that the following actions be implemented:
    a) Training (and logistical and financial support) for EHS professionals on regulatory requirements, enforcement, potential impacts and mitigation measures
    b) Training and outreach to pesticide applicators to provide the background and understanding of the regulatory safeguards and to ensure that they comply with these requirements
    c) Medical surveillance of staff involved in direct handling/management and application of pesticides, as well as provision of appropriate PPE for each.
    d) Prohibition of the involvement of village and phytosanitary brigades in chemical locust control.
    e) Training and strengthening of involvement of village and phytosanitary brigades in locust monitoring.
3) Empty containers were not effectively collected and disposed of during the campaign. Depending on the country, 30 to 80% of the empty containers were collected in the Sahelian countries impacted by the DLs. In areas where village brigades were issued 1 to 5 liter containers to assist in pesticide handling, the containers became a major source of contamination as they were subsequently reused for household functions. The FAO evaluation recommended the following:
    a) Avoid procurement and distribution of pesticides in containers with a capacity of less than 50 liters in volume.
    b) Procure pesticides in large metal containers of capacity of 100 to 200 liters in volume.
    c) Provide drum crushers to all affected countries to provide destruction and (suggested) recycling of metal containers (at local foundries).
    d) Develop an agreement with pesticide manufacturers to collect and recycle empty containers, in collaboration with FAO and the Commission de lutte contre le criquet pèlerin dans la région occidentale (CLCPRO, Commission for Controlling the Desert Locust in the Western Region) or the relevant Desert Locust commission.
4) Although human and livestock poisonings and negative environmental impacts were noted during the campaign, it was not easy to assess the negative consequences of the pesticides in

each country. Most of the countries do not have existing strategies or facilities (i.e., specialized laboratories) to monitor potential environmental impacts, nor qualified technical professionals to track the fate of the pesticides in the environment and on human health in local communities. In addition excess supplies of unused pesticides (approximately 6.2 million liters) remained at the end of the campaign. To address these issues, the FAO evaluation resulted in the following recommendations for each affected country:

a) Limit procurement to pesticides registered by the Comité permanent inter-États de lutte contre la sécheresse dans le Sahel (CILSS, Permanent Interstate Committee for Drought Control in the Sahel)[36] or the relevant regional/country level governing body and set up the correct conditions for their appropriate use.

b) Strengthen regulatory compliance with, and enforcement of, the EHS requirements for safer handling, use, and storage of pesticides.

c) Avoid overestimating the needs for, and procuring unnecessary quantities of, pesticides.

d) Strengthen the technical capacity of EHS specialists in collaboration with regional EHS training and licensing organizations (e.g., EMPRES[37] Western Region, and CERES-Locustox[38] in Senegal).

e) Establish pesticide contractual arrangements, including a mechanism to establish a pesticide "bank," (1) to reduce the accumulation of excess pesticides, and (2) to dispose of empty containers, in collaboration with FAO, local desert locust control commissions, donors, and pesticide manufacturers.

7.5.2 POTENTIAL EHS GAPS IDENTIFIED VIA COUNTRY CONSULTATIONS

This section first summarizes, by country, the findings from the in-country consultations completed in May 2020 in Kenya, Ethiopia, and Somalia regarding the implementation of safeguards to address the potential impacts to the environment and to the health and safety of workers and communities associated with the ongoing desert locust control campaign. (See Annex A for the country briefings resulting from these consultations.)

Synthesizing across the three countries, this section then (1) characterizes overall environment, health and safety (EHS) gaps and (2) compares these gaps to those identified by the multilateral evaluation of the 2003–2005 campaign during the current upsurge (see Section 7.6.1).

Kenya:

1) Kenya has no existing structure to manage a locust upsurge, and is not a member of the FAO Desert Locust Control Organizations. As a result, the government of Kenya was not prepared for the desert locust upsurge of 2019. Local research on DLs has not been performed as it is not considered a major agricultural pest in Kenya.

2) The government has limited resources and attention to focus on the disposal of contaminated PPE and equipment. At field operational areas, used disposable PPE is burned in open fires. Empty containers (assumed to be drums) are collected at the six regional operation control centers. Drum cleaning/crushing equipment has been ordered but has not arrived at the control centers.

[36] The CILSS member countries defer pesticide review and registration to the CILSS structure.

[37] Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases

[38] Fondation CERES/LOCUSTOX Centre de Recherche en Écotoxicologie pour le Sahel

3) Equipment for ground spray operations has been inadequate. Neither the number of vehicle mounted spray units, nor the number of knapsack sprayers for ground spraying meets the needs. The initial lack of aircraft for aerial spraying has been addressed.

4) Surveillance and monitoring in Kenya have generally been inadequate during the first upsurge of December 2019 through February 2020. The data from each county has been inconsistently gathered and archived as reports were collected via SMS or voice messages. Although the FAO mobile phone software for desert locust surveillance, eLocust3m, was provided during training in March 2020, surveillance is often performed by volunteer scouts, who are hampered by poor cell phone coverage and lack of smartphones.

5) Warehouse storage space for insecticides is inadequate. At two of the six operation control centers, storage space is not available indoors. At these two locations, insecticide stocks are being stored under outdoor tents.

6) There have been an insufficient number of professionally trained applicators for ground spraying available to meet the demand created by the locust upsurge.

7) Accessibility to many locations affected by the desert locust upsurge has been constrained due to terrorist activity (especially in Wajir and Mandera counties); the remote nature of the affected areas and the poor conditions of road networks, notably in the Northeastern areas of Kenya.

8) Despite the provision of PPE and training to workers, there have been reports of operators handling insecticides without wearing PPE.

9) There have been unconfirmed reports of two birds killed in areas where ground spraying was performed.

10) Despite training on how to avoid spraying near sensitive habitats, many spray operators with knapsack sprayers have been spraying hopper bands in such areas.

11) There is expected to be significant amounts of excess pesticides after the locust control campaign, due to donations. It is not clear that Kenya has the facilities and capacity to manage these excess pesticides.

Somalia

1) The Somalia pesticide regulatory program is poorly managed; the legislation is inadequate and technical capacity and decision support mechanisms (laboratories) to monitor the use of the pesticides are insufficient. The biopesticides used in the control operations have not been available in the market, and are imported and distributed by FAO Somalia.

2) Even with dissemination of, and communication on, FAO-developed tools and technical information, the current limited capacity of the Ministry at both federal and state levels results in insufficient quality collection of field data to inform effective control activities.

3) Even though coordination structures have been established both at the national and regional level and a National Action Plan for Desert Locust Control was developed, Somalia does not have the emergency funds or a contingency plan to address the desert locust upsurge.

4) Large agrochemical dealers in Mogadishu and other larger towns and retail shops in rural areas have_limited training in the use and application of pesticides. Additionally, fake and counterfeit pesticides are available in the market as a result of limited quality control and regulation of pesticide imports.

5) The desert locust control campaign faces several challenges.

A. Due to the insufficiency of human, material, and financial resources, the country lacks adequately resourced autonomous national desert locust control units and, thus, the means to start a campaign.

B. There are no plant inspectorate services and no enforcement of pesticide regulations at major ports, among local storage facilities, and local markets.

C. Limited staffing and poor training of the existing staff results in reduced survey and control efficacy and safety.

D. The desert locust breeding areas are located in the vast and remote areas within the infested regions. Insecurity, conflicts, and access constraints in reaching these areas prevents technical experts from conducting comprehensive surveillance activities in these areas. Further, movement of personnel, equipment, and logistics are hindered by the current restriction on movement by COVID–19 pandemic.

6) There are institutional challenges to effective response and coordination in Somalia. At both the federal and state levels, there is limited involvement of the Ministry of Health in monitoring health impacts on populations—health systems across Somalia are weak with limited coverage of rural areas, and the existing capacities were focused on managing the COVID–19 pandemic. The institutional set up for the Ministries at federal and state level are different. For example, while some regions such as Galmudug, Somaliland, South West, Hirshabelle, and Jubaland have a Ministry of Environment, Puntland and the Federal Government of Somalia have a Directorate of Environment – in Puntland it lies within the Ministry of Agriculture and at the Federal Government of Somalia it likes within the Office of the Prime Minister.

Ethiopia

1) The major challenges in safe procurement, storage, transport, and application of pesticides include:

A. Lack of sufficient quantities of PPE and application equipment such as sprayers of any type;

B. Lack of aircraft for aerial spraying;

C. Lack of funds for control operations;

D. Lack of outreach to the local community to provide information on the locust control program; including potential hazards of the pesticides and reentry intervals;

E. Lack of knowledge and skill on proper handling and use of pesticide at local levels; and,

F. Absence of a disposal system for contaminated containers and PPE.

2) PPE is lacking in many places and instances, because it is frequently damaged, particularly when operations are conducted in remote areas with heavy brush. PPE stocks have been depleted quickly. While spray applicators have been trained, knowledge gaps remain, as does a shortage of cleaning materials (for sprayers, pesticide containers and applicators?).

3) Contaminated containers and materials are not properly stored at designated locations. Disposal systems are not standardized or available. Technical capacity for proper storage and disposal of such materials is lacking.

Assessment of Identified Gaps in EHS Safeguards:

The gaps in environment, health and safety (EHS) safeguards identified during in-country consultations are summarized as follows:

1) Surveillance and reporting has been inadequate.

2) Equipment for locust control is inadequate.

3) Waste management equipment and disposal facilities are not available.

4) Technical capacity to manage pesticide contaminated wastes and to monitor EHS impacts is not available.

Addressing Existing Gaps in EHS Safeguards. FAO, in collaboration with each partner country, has attempted to address many of these gaps by training stakeholders and implementers, and by providing appropriate equipment. Unfortunately, it does not appear that many of these gaps can be addressed in the very near term (i.e. May and June 2020).

Comparison with Gaps Identified in the FAO 2006 Evaluation. The FAO's 2006 evaluation identified environment, health and safety (EHS safeguard gaps (see 7.6.2, above), which are similar to those noted during in-country consultations for this PEA; below is a synthesis of how the 2006 evaluation's EHS gaps compare to those identified in this PEA:

1) Technical capacity of in-country EHS experts remains an issue. It appears that FAO is providing limited training for locust control managers but that partner governments have not sufficiently invested in such training.

2) Monitoring of locust control, including the potential impacts on the environment, and potential health impacts on pesticide handlers, does not exist in the partner countries.

3) It is not clear that FAO or the partner countries have developed an up to date list of expert consultants who can provide technical support and assistance on EHS safeguards.

4) PPE has been provided to the pesticide sprayers; however, it appears that during use (notably in Ethiopia) the PPE is worn out quickly (or damaged by vegetation) and is not replaced frequently.

5) The disposal of pesticide containers remains inadequate. While FAO and partner countries are procuring or planning to procure drum washers/crushers, these have not yet arrived. It is assumed that the pesticides containers are large, metal drums; however, there may be smaller containers of other pesticides used by each country.

6) The over-procurement of pesticides was an issue in the 2003–2005 desert locust control campaign. Oversupply appears to be a problem in Kenya but has not been reported as an issue in Somalia or Ethiopia.

7.6 EXTENT TO WHICH ASSUMPTIONS RESULT IN COMPARABLE RISKS VS US STANDARDS, PART 3: FINDINGS

Based on the analysis presented in Sections 7.3.5 and 7.4, respectively:

- With chlorpyrifos and fipronil excluded, the FAO Pesticide Referee Group- (PRG-) listed active ingredients (AIs) that are *not* US EPA-registered for similar use have hazard and weight-of-evidence risks that are similar to AIs in the same class that are so registered by US EPA. [39]

[39] Again, this conclusion is subject to the noted limitations and assumptions of our analysis (see 7.3.5), including that appropriate equipment is in place and all use is in accordance with labelling.

- *In principle,* the relevant Chapters of FAO's *Desert Locust Guidelines* and associated SOPs (1) provide risk control equivalent to the requirements for RUP application and for aerial pesticide application in the US, and (2) address, with very limited and partial gaps, the adverse potential impacts and risks of locust control actions on environment and health as enumerated in Section 7.1.[40]

Therefore, were these *DL Guidelines* and SOPs to be implemented with fidelity, the EHS risks of locust control operations can reasonably be assumed to be limited to the standards deemed acceptable in the US or peer developed economies for control of pests of major importance for health, sustenance or livelihoods with pesticides delivered by air and on the ground in wide-area applications.

Implications for Alternatives Analysis: Alternative C arguably provides superior risk control to Alternative B, as the fuller set of pesticides it offers allows selections more appropriate (i.e., lower hazard) to the specific conditions at individual sites, and enables the full PRG use priority to be implemented, which is essential for minimizing quantity and toxicity of pesticides employed.

7.7 CONSEQUENCES OF FORESEEABLE EHS IMPLEMENTATION GAPS

This section characterizes qualitatively the extent to which various categories of "in principle" risks may significantly increase in actual desert locust control operations for the current outbreak.

As documented in 7.6.2, in summary the primary environment, health and safety (EHS) gaps identified during the in-country consultations are:

1) Inadequate surveillance and reporting.
2) Inadequate training and equipment for locust control.
3) Lack of waste management capacity (equipment, disposal facilities and technical skills).

The primary EHS gaps identified in the FAO-coordinated multilateral evaluation of the 2003–2005 desert locust control campaign (documented in 7.6.1) potentially continuing during the present campaign (and not listed above) are:

1) Monitoring of locust control, including the potential impacts on the environment, and potential health impacts on pesticide handlers, does not exist in the partner countries.
2) PPE has been provided to the pesticide sprayers; however, it appears that during use (notably in Ethiopia) the PPE is worn out quickly (or damaged by thorny vegetation) and is not replaced frequently.
3) The over-procurement of pesticides was an issue in the 2003–2005 desert locust control campaign. Oversupply appears to be a problem in Kenya but has not been reported as an issue in Somalia and Ethiopia.

In this section, we assess the extent to which these gaps would significantly increase the risks or adverse impacts outlined in Section 7.1. Each gap is addressed in turn below:

1. Inadequate Surveillance and Reporting. Poor surveillance in itself may not directly increase potential risks or adverse impacts; however, if surveillance and reporting are not performed or the

[40] As noted in section 7.1.1, unlike in the US or Australia where large industrial or medium size agriculture fields and vast rangelands are sprayed aerially, in East Africa where locust must be controlled, agricultural areas are often populated with homesteads dispersed within the fields and rangelands, or in very close proximity. This increases risk of aerial spraying. However, as documented, the FAO *Guidelines* go significantly beyond US RUP requirements in addressing these risks.

results are not accurate, indirect adverse impacts may arise. If data on geographic locations and life cycle phases of locusts are not accurate or has not been collected, the desert locust control strategy may change from early intervention, including precise insecticide application on hopper bands via ground sprayers, to the later intervention, including less precise, aerial spraying of swarms. In addition, actual spraying based on poor geographic data may not be accurate (e.g., aerial spraying in areas where locusts are not present) thereby increasing the scale and scope of potential impacts (i.e., by unnecessarily spraying larger areas, and potentially more areas where sensitive habitats and human settlements are located.)

According to in-country consultations, surveillance has been poor or nonexistent during the recession period, which for Kenya and Ethiopia effectively dates to 1989. It is not clear how well the implementing governments and partners will be able to maintain the strategy to implement early intervention ground spraying techniques against the locust in their hopper bands on the ground. If, due to lack of knowledge on the geographic locations and the life cycle phase of the desert locust continues, then the partners may have to change their strategy to the late intervention aerial spraying techniques. **If this occurs, then the scale and scope of the indirect impacts to the environment and communities may increase significantly. These increased indirect impacts would include the following:**

- adverse impacts on non-target organisms
- contamination of surface waters (and indirectly groundwater) and associated adverse impacts on consumers (i.e., humans, animals and other non-target organisms
- adverse impacts to humans from consumption of agricultural products (with pesticide residues), as well contaminated locusts
- adverse impacts to community health from spray drift and residuals in agricultural field and rangeland.

2. Inadequate Locust Control Equipment and Training. The lack of locust control equipment may result in potential spills and leakage, and improper application of the insecticides, which increases the risks related to the following:

- Spray/Handler Team exposure – Mixing and loading equipment that is old and is not properly maintained can be difficult resulting in a higher potential for exposure to insecticides. Accidental spills during loading or ruptures during pressurization of faulty equipment can directly expose workers. Similarly, replacement equipment that is not appropriate to spraying the insecticides or is old, may have leaks or result in accidental spraying of workers during application. For example, a leaking backpack sprayer (either at the spray wand or the backpack container itself) will expose the worker directly to insecticide.
- Inadequate training often leads to failure to follow safer use practices, which can increase the probability of spills, leaks, and associated exposure to operators. There appears to be greater potential for lack of adherence to correct procedures and associated misuse of backpack sprayers for insecticides in EC or SC formulations with a proportionally higher risk of exposure to operators, when compared to the potential for the misuse of more sophisticated backpack sprayers for ULV formulations. The ULV equipment requires a more thorough understanding of its use than equipment for EC or SC formulations.
- It is not clear that the adverse impacts due to handler exposure would be significantly increased due to the lack of equipment. In some cases, where lack of equipment prevents actual application (i.e., less mixing and loading of insecticides results in few opportunities to direct exposure from spills and leaks), then the risk would diminish accordingly. However, if the

equipment proposed to replace the new equipment (pending arrival), is old and not maintained, then the risks may be significantly increased. For example, if old, unmaintained backpack sprayers are used, then the risk of exposure to operators due to leaks and accidents is substantially increased.[41] Similarly, if operators use manual means to apply insecticides, e.g., brushes or brooms dipped in containers of insecticide, the potential for risks to exposure by the handler increases several fold.

- Based on the in-country consultations, it appears that the gap is from the lack of equipment for the most part, and not the use of outdated unmaintained equipment or manual methods. **As a result, the significance of potential adverse impacts from this gap probably has not increased.**
- Exposure of non-target organisms - It is not clear that the risks or adverse impacts to non-target organisms, including beneficial pollinators, and insect predators would be significantly increased due to the lack of equipment. In some cases, where lack of equipment prevents actual execution of insecticide application (i.e., fewer airplanes results in fewer hectares of land sprayed with insecticides), then the risk would diminish accordingly. **As a result, the significance of potential adverse impacts from this gap probably has not increased.**
- Similarly, for the risks of exposure from water contamination, pesticide residue consumption, or spray drift, the level of significance **would not be increased by lack of control equipment.**

3. Lack of Waste Management Capacity (Equipment, Disposal Facilities and Technical Skills. The lack of waste management and disposal equipment, and facilities, as well as the lack of technical capacity to manage these systems, may increase adverse impacts from the following (for pesticide transport, handling, storage and disposal as noted in Section 7.1):

- Handler exposure
- Environmental/community exposure
- Reuse of pesticide containers
- Inadequate storage facilities

The exposure of workers to insecticide contaminated wastes can be increased if proper equipment is not available to collect, store and transport such wastes. For example, if proper containers are not available to collect and transport contaminated rags, piles of such rags would have to be picked up by workers who may have direct contact with them. Similarly, if residual liquids from cleaning equipment or emptying containers, are not collected in appropriately sealed containers, workers involved in cleaning or liquid waste collection operations may be exposed directly to these contaminated waste liquids, either from splashing, spills or leaks, or standing in such liquids (it is noted that the concentrations of pesticides may be diluted in the wash water).

Environmental and community exposure may be increased for the reasons noted above, if waste management equipment is not available. For example, when liquid residuals from cleaning of contaminated equipment are not collected properly, they may be spilled into the nearby environment to contaminate soil, surface and groundwater. Similarly, solid waste including contaminated rags, used cleanup materials, and PPE, which are not stored in a dry shelter or inside sealed containers, may be

[41] It should be noted that not all locust control actions are governmental or international; In some cases, Ethiopian farmers have been spraying insecticides using their own equipment (without the involvement of the government or other partners)

accessed by, picked through by children, feral dogs, and livestock, which would lead to potentially direct exposure in the community.

If pesticide containers are not cleaned and crushed, they may pose significant risk to human health from reuse for household uses, or for livestock. The FAO plans to order drum cleaners and crushers; however, until this equipment arrives at the operational sites, the risk of reuse of containers, and potential adverse impacts to human health remains elevated.

As noted above, secure, dry storage is necessary for insecticide-contaminated wastes to prevent exposure to rainfall or weathering and the ultimate release or spill in the environment and spread to the community. This risk has been noted in our in-country consolations. For example, two control centers in Kenya do not have adequate storage areas for pesticides, which are stored in outdoor tents.

Based on this assessment, the significance of potential adverse impacts from the lack of waste handling capacity probably will increase.

4. Nonexistent Monitoring Capacity (Equipment, and Technical Skills). The lack of partner country capacity for monitoring desert locust control campaigns for the potential impacts on the environment, and the potential health impacts on pesticide handlers, potentially increases the risks and adverse impacts associated with both pesticide handling (transport, handling, storage and disposal), and pesticide application (ground-based or aerial spraying) as noted in Section 7.1.

Although the monitoring itself may not pose potentially significant direct adverse impacts (potential impacts from laboratories excepted), monitoring during the desert locust control campaign, can prevent direct or indirect adverse impacts to human health and the environment from exposure. For example, conducting medical exams and testing of pesticide handlers and sprayers before, during and after locust control operations, can potentially identify worker exposure that can be mitigated during the on-going locust control operations, in the next phase of the campaign, or in future campaigns. Similarly, if scientists are monitoring crops, livestock, as well as sensitive flora and fauna, during the campaign, then insecticide contamination can be identified and mitigated.

Conversely, the lack of monitoring during the desert locust control campaign, and the associated lack of capacity to identify ongoing exposure, could increase the risks and adverse impacts posed throughout the operations., as noted above. **Based on this assessment, the potential adverse impacts from the lack of monitoring capacity probably will increase significantly.**

5. Lack of PPE for Spray Operations. According to in-country consultations in Ethiopia, PPE is in limited supply, specifically for those performing spray operations. The PPE is worn out quickly (e.g., destroyed by vegetation), and cannot be replaced frequently. In some cases, Ethiopian farmers have been spraying insecticides using their own equipment, presumably without adequate PPE (without the involvement of the government or other partners).

When workers cannot don PPE (due to limited availability of PPE) during ground spraying, which is the operation with the most potential for acute exposure, the risk and potential for adverse impacts to human health increases dramatically. **Based on this qualitative assessment, this gap definitively increases adverse impacts significantly.**

6. Remaining Supply of Pesticide after the Locus Control Campaign. The over-procurement of pesticides was an issue in the 2003–2005 desert locust control campaign in West Africa. Oversupply appears to be a problem in Kenya but has not been reported as an issue in Somalia and Ethiopia.

If large amounts of insecticides remain in Kenya and other countries after the campaign, storage of this excess supply may result in an increase in risks and adverse impacts. As noted in Section 7.1, managing these residual stocks of pesticides, and as they age, potentially obsolete pesticides over the long term, will pose several risks and adverse impacts including:

- Exposure in local communities due to groundwater or soil contamination, and the concomitant adverse impacts to public health
- "Leakage" of locust control pesticides to local markets, whose end users are likely untrained and unprepared to handle ULV formulations, resulting in adverse impacts to workers, the community and the environment (as enumerated in Section 7.1)
- Inadequate storage facilities, without security, adequate indoor climate control, or spill containment, can create conditions for exposure related primarily to contamination/exposure from spills and releases of pesticide.

Even though Kenya appears to be receiving/procuring excess quantities of pesticide at this stage of the locust control campaign, it is not clear that Ethiopia and Somalia are, or will, experience this issue. Given similar issues encountered after the 2003–2005 locust control campaign, and FAO proposed solutions to address oversupply (e.g., contract agreements with vendors to take back supplies of unused pesticides), it is expected that FAO and its partners will be able to mitigate the effects of this gap. **Based on this expectation, this gap will probably <u>not</u> increase adverse impacts significantly.**

Contrast to the Presidential Malaria Initiative's Indoor Residual Spraying Program. USAID's primary recent experience with large-scale pesticide-based control campaigns is anti-malarial indoor residual spraying (IRS): village-to-village, house-to-house efforts to spray the inside walls of residences with residual-action pesticides to kill malaria-transmitting mosquitoes. The intensive spray campaigns present significant occupational risks for spray crews, and the use of pesticides in homes likewise presents intrinsic risks. PMI's generally highly successful approach to controlling these risks is described in the box below. This model, however, has limited applicability to desert locust control, which has far more diverse, far less controlled application environments, and necessarily must be conducted on a rapid response basis as infestations appear, rather than the highly planned IRS campaigns.

Summary. Based on the in-country consultations and comparison with the 2003–2005 desert locust control campaign in West Africa, four of the identified gaps could significantly increase the risks and adverse impacts described in Section 7.1. These gaps include; (a) lack of surveillance and reporting, (b) lack of waste handling capacity, (c) lack of monitoring capacity, and (d) lack of PPE for spray operations. On the other hand, the gaps including: (a) inadequate locust control equipment supply, and (b) excess supply of residual/obsolete pesticides are not expected to significantly increase these adverse impacts.

FIGURE 3: DOES THE CASE OF IRS BMPs OFFER INSIGHTS?

USAID has more than 10 years of monitoring experience on the implementation of detailed Standard Operating Procedures, here known as Best Management Practices (Chandonait, 2015), for the President's Malaria Initiative (PMI) Indoor Residual Spray Program (IRS). The Best Management Practices (BMPs) provide field level protocols for several insecticide classes for the preparation and use, donning PPE, spraying instructions, storage, transport, and disposal. Companion SOPs (Abt Associates n.d.) also detail monitoring and reporting requirements accompanied with biannual third-party inspections for each spray campaign and serve as a record of the quality and safety of the spray campaigns. This complex system serves as a point for comparison for the EHS guidelines (van der Valk 2003) and FAO SOPs. Clear advantages can be gathered based on reporting documented in the annual end of spray reports and the biannual field evaluations for having such a system in place.

According to regional workshops on EHS implementation, challenges have been at the ground level in ensuring EHS standards are followed including stock management, health center preparedness, transportation services, workers personal insecticide use, and disposal (FAO Commission for Controlling the Desert Locust in the Central Region 2016). Lessons learned from the IRS campaigns that may applicable to improving implementation of the FAO SOPs are:

- Detailed and stream-lined "pocket" versions of SOPs (Abt Associates, n.d.), in local languages, provide information to a continuum of audiences (e.g., warehouse managers, spray operators, washers, storekeepers) and helps to ensure all managers and workers understand expectations that are strictly enforced across the project.
- Numerous layers of managerial personnel and oversight tools are necessary to ensure compliance (e.g., pre-field inspections, health center inspections, spray campaign daily checklists, red flag or corrective action systems, biannual inspections).
- Regular training, refreshers, and daily messaging are necessary for reinforcing the SOPs.
- The monitoring and year to year tracking systems provide a record of safety standards and documents needs for longer-term and broadly improvement of BMPs.

8. RECOMMENDED ALTERNATIVE

As established in Section 7.5, assuming that environment, health and safety- (EHS-) relevant FAO *Desert Locust Guidelines* and SOPs (see Section 3.1) are implemented with fidelity, the EHS risks of desert locust control operations using PRG-listed pesticides *except for chlorpyrifos and fipronil* can reasonably be assumed to be limited to the standards deemed acceptable in the US or peer developed economies for control of pests of major importance to health, sustenance or livelihoods with pesticides delivered by air and on the ground in wide-area applications.

However, the analysis of the preceding section makes clear that implementation with fidelity *cannot be assumed*, and foreseeable EHS gaps in desert locust control campaigns increase risks substantially, certainly well beyond those arguably achieved in the US and peer economies for wide-area control campaigns.

This said, the economic and food security need for desert locust control is real, and USAID funding provides an important opportunity to achieve safer practices than would prevail in the absence of such funding. The no-action alternative leaves USAID non-responsive to this need and does not leverage USAID funding to promote recognized standards of responsible practice to the benefit of communities, control workers, and the environment.

Setting the no-action alternative aside for these reasons, Alternative C *subject to the conditions elaborated in the next section* is the recommended alternative. While the consequences of foreseeable EHS gaps enumerated in the previous section apply to both Alternatives B and C, Alternative C provides superior risk control to Alternative B: the fuller set of pesticides under Alternative C allows selections more appropriate (i.e., lower-hazard) to the specific conditions at individual sites, and enables the full PRG priority-of-use scheme to be implemented, which is essential to minimizing quantity and toxicity of pesticides employed.

9. RISK MITIGATION: AUTHORIZED PESTICIDES AND REQUIRED SAFER USE CONDITIONS

9.1 INTRODUCTION

As noted in the presentation of alternatives in Section 5, it is assumed there is a commitment by desert locust control implementers to FAO's *Desert Locust Guidelines* and SOPs as related to environment, health and safety (EHS), or equivalent. As elaborated in 7.7, however, even given such a commitment, significant EHS gaps are likely in actual desert locust control operations—particularly in the early stages of control campaigns and in countries where key capacities are lacking.

As a consequence, and as noted in the previous section:

- It is unrealistic to attain US-equivalent EHS risk control in the areas where USAID operates environmental and health risks for desert locust control operations will be higher than those arguably achieved in the US and peer economies for control of pests of major importance to health, sustenance or livelihoods involving pesticides delivered by air and on the ground in wide-area application.
- However, the economic and food security need for desert locust control is real, and USAID funding provides an important opportunity to achieve safer practices than would prevail in the absence of such funding.

The challenge, therefore, is to minimize risks to the greatest extent practicable and to promote recognized standards of responsible practice while responding to the development need.

To achieve this, this section sets out:

1. Principles for risk reduction. These follow from the analyses of this PEA.
2. The pesticide active ingredients (AIs) for which USAID assistance to procurement and/or use is permitted for desert locust control and mandatory restrictions that apply to individual AIs and/or all pesticides in the same class.

   Consistent with the selected alternative, the comparative toxicology findings set out in Section 7.5, and the risk reduction principles: (a) the full FAO Pesticide Referee Group (PRG) list is permitted, except for fipronil and chlorpyrifos, which were eliminated in Section 7.5; and (b) straightforward restrictions are utilized to control AI-specific risks.
3. Requirements regarding USAID assistance to procurement and/or use of pesticides for desert locust control activities under this PEA. These also follow from the principles for risk reduction, observed and foreseeable failure modes in safer use practices and EHS safeguards (see Section 7.7), and the principles of and experience with pesticide safer use.[42]

Each is addressed in its own subsection.

[42]See Section D.4.3 of USAID's *Sector Environmental Guidelines* for Crop Production for a succinct summary of elements of safer pesticide use.

9.2 PRINCIPLES FOR RISK REDUCTION

The preceding analyses of this PEA result in the following principles for such minimization:

- Minimizing risk requires surveillance-based early intervention, and a commitment to PRG priority-of-use, with use of knockdown pesticides as a last resort. This approach allows use of more limited quantities of less toxic pesticides.
- Beyond effective surveillance, reducing risk requires both that a menu of pesticides suited to use priorities as articulated by the PRG are available, and that institutional knowledge of the pest control and planning by leading authorities is passed on to local agents in clearly articulated strategies and techniques.
- Well-functioning, fit-to-purpose equipment, training, and supervision are critical, non-severable requirements for implementing guidelines and SOPs for safer pesticide use.
- Ensure that local and regional hospitals and health clinics are aware of spray operations and area doctors are trained to recognize and treat the effects of pesticide poisoning.
- Develop and have in place an achievable plan for empty pesticide container collection and disposal during spray operations. This may include drum crushers at central locations to conduct destruction and recycling of metal containers (e.g., at local foundries).
- *Preventive* measures to minimize risk are far more achievable than post-spray control or management measures: e.g., it is far better risk control to use a pesticide with a short re-entry interval in a livestock area, as reentry intervals are likely to be extremely difficult to enforce.
- Given the limited level of control at the field level that USAID can exert in most foreseeable funding scenarios for desert locust control, restrictions and recommendations at the AI level cannot be overly complex or nuanced.

9.3 AUTHORIZED AIs AND MANDATORY AI-SPECIFIC RESTRICTIONS.

Table 13 below lists the pesticide active ingredients (AIs) for which USAID assistance to procurement, use, or both of pesticides containing these active ingredients (AIs) is allowed by this PEA, along with mandatory restrictions imposed on the entire pesticide class and/or on specific AIs.

TABLE 13: AUTHORIZED AIs FOR DESERT LOCUST CONTROL AND MANDATORY RESTRICTIONS.

AI	USAID assistance to procurement and/or use allowed?	Mandatory Class and AI specific restrictions.
PRG Priority 1: Biological/Mycoinsecticide		
Metarhizium	*Yes*	Note: this is the only AI permitted within 8m of surface waters. No pre-harvest or planting intervals. Reentry interval exists; entering the spray area before the re-entry interval generally has low risk but may stain clothing and result in allergic reaction.

TABLE 13: AUTHORIZED AIs FOR DESERT LOCUST CONTROL AND MANDATORY RESTRICTIONS.		
AI	**USAID assistance to procurement and/or use allowed?**	**Mandatory Class and AI specific restrictions.**
PRG Priority 2: Insect Growth Regulators (Benzolyurea)		IGRs may not be applied within 8m of surface waters. May be applied within 8m--50m of surface waters by ground. Aerial application must be >50m from surface waters. Farmers of sprayed crops must be informed of appropriate pre-harvest intervals. Entering the spray area before re-entry interval requires PPE.(3) Messaging for re-entry must match the product label.
Diflubenzuron	*Yes*	All restrictions for IGS apply, as above.
Teflubenzuron	*Yes*	All restrictions for IGS apply, as above.
Triflumuron	*Yes*	All restrictions for IGS apply, as above.
PRG Priority 3: Neurotoxic Pesticides		
Class: Phenyl pyrazoles		
Fipronil	*N—see 7.3.5 for reasons (1)*	
Class: Pyrethroids		All Pyrethroids: worker health monitoring system required, including availability of treatment Pyrethroids may not be used where bees are actively foraging or where apiaries cannot be protected or moved, Pyrethroids may not be used within 50m of surface waters (2) Farmers of sprayed crops must be informed of appropriate pre-harvest intervals. ULV-compatible product formulations and equipment must be used. Entering the spray area before re-entry interval requires PPE.(3) Messaging for re-entry must match the product label.
Deltamethrin	*Yes*	All restrictions for pyrethroids apply as above.
Lambda-Cyhalothrin	*Yes*	All restrictions for pyrethroids apply as above.
Class: Carbamates		

TABLE 13: AUTHORIZED AIs FOR DESERT LOCUST CONTROL AND MANDATORY RESTRICTIONS.		
AI	**USAID assistance to procurement and/or use allowed?**	**Mandatory Class and AI specific restrictions.**
Bendiocarb	*Yes*	Bendiocarb cannot be used in areas where animals or humans may be harvesting or foraging on vegetation. Bendiocarb cannot be used in areas where birds are actively foraging or roosting or areas known for bird breeding or nesting. Bendiocarb may not be used where bees are actively foraging or where apiaries cannot be protected or moved, Worker health monitoring systems required, including availability of treatment Bendiocarb may not be used within 50m of surface waters (2) Farmers of sprayed crops must be informed of appropriate pre-harvest intervals. Entering the spray area before re-entry interval requires PPE.(3) Messaging for re-entry must match the product label. Human flagging for aerial applications is prohibited except where flaggers are protected in an enclosed cab.
Class: Organophosphates (OPs)		All OPs: worker health monitoring system required, including availability of treatment OPs may not be used where bees are actively foraging or where apiaries cannot be protected or moved, OPs may not be used within 50m of surface waters .(2) Farmers of sprayed crops must be informed of appropriate pre-harvest intervals. ULV products and equipment must be used. Entering the spray area before re-entry interval requires PPE.(3) Messaging for re-entry must match the product label.
Malathion	*Yes*	All restrictions for OPs apply, as above.
Fenitrothion	*Yes*	All restrictions for OPs apply, as above. In addition, Fenitrothion products used on rangeland and pasture require a 7 day waiting period for grazing or 14 days for feeding fodder to livestock. Where rangeland is unrestricted for grazing by livestock, fenitrothion shall not be applied by aerial or barrier treatment. Fenitrothion may not be used in areas where birds are actively foraging or areas known for breeding.
Chlorpyrifos	*NO—see 7.3.5*	

TABLE 13: AUTHORIZED AIs FOR DESERT LOCUST CONTROL AND MANDATORY RESTRICTIONS.		
AI	**USAID assistance to procurement and/or use allowed?**	**Mandatory Class and AI specific restrictions.**
	for reasons (1)	

Notes:

(1) except that USAID funds may be used to provide PPE, training, and monitoring for use of these AIs when their use is part of an existing country control plan, and not enabled by USAID funding.

(2) Surface waters may include any standing waters or intertidal water below the mean high water mark such as rivers, lakes, agricultural ponds, reservoirs, aquaculture systems, where benthic invertebrates and fish species may be present. Buffer zones, as noted in specific restrictions, are important for reducing drift, runoff, and drainage into aquatic systems.

(3) all products with these AIs have re-entry periods without PPE, typically of 12h to 24h. Entering sprayed areas treated with Metarhizium *generally has low risk but may stain clothing and result in allergic reaction. Shoes, socks, coveralls, and chemically resistant gloves must be used for entering spray areas for all other AIs, including IGRs. Some AIs may require additional protection such as eyewear, hats, aprons, and respirators.*

9.4 REQUIREMENTS REGARDING USAID ASSISTANCE TO PROCUREMENT AND/OR USE OF PESTICIDES FOR LOCUST CONTROL ACTIVITIES UNDER THIS PEA.

USAID assistance to procurement and/or use of pesticides for desert locust control activities under this PEA:

1. Is limited to ONLY those pesticides containing the active ingredients (AIs) listed as allowed in Table 13. For pesticide products containing more than one AI, all AIs must be approved, and specific uses and conditions for all AIs apply. Labelling instructions related to repeated applications must also be followed for the specific product used with special notation of restrictions of multiple applications of the same AI, same class of AIs, or similar class of AIs to avoid additive and synergistic toxicity complications (e.g., additive or possible synergism of carbamate and organophosphate pesticide mixtures) (Laetz, et al. 2009).
2. Is limited to the uses, geographies, and actions included by this PEA (See section 2)
3. Must be in accordance with the partner country pesticide registration[43] for the intended use.
4. Is conditioned on adherence to the AI-specific conditions enumerated in the table above, and implementation of the AI selection decision tree presented below (Figure 4), which requires a credible site characterization process.
5. Must be conditioned on a credible commitment by the implementer to implement in a manner consistent with, and report on adherence to:
    a. safety and environmental precautions per FAO *Desert Locust Guidelines*, Chapter 6 "Safety and Environmental Precautions."

[43] Emergency use approvals satisfy this requirement

b. effective and efficient equipment and techniques to carry out desert locust control, per FAO *Desert Locust Guidelines*, Chapter 4 "Control." [44]

c. product manufacturer's label instructions, which require, *inter alia*, appropriate safer practices for: transporting, storing, mixing and loading and applying pesticides both by air and on the ground, safe cleaning and maintenance of pesticide equipment and PPE; and disposition of pesticide containers and unused pesticides.

6. Must be conditioned on the requirements that:

   a. All personnel engaged in aerial application of pesticides will be properly trained, certified and registered with relevant agencies.

   b. All personnel engaged in ground applications will be properly trained and certified or supervised and monitored by fully trained and certified and registered pesticide applicators.

   c. All individuals using pesticides must be knowledgeable or receive additional training specific to the products/AIs being used regarding occupational, human and environmental pesticide risks, routes of exposure and measures necessary to mitigate these risks, including recognizing symptoms of pesticide poisoning and first aid measures and guidelines for emergency situations.

   d. All individuals using pesticides must be provided with PPE consistent with the requirements established by the product label and use of the PPE must be monitored and enforced. **Exception: where this requirement cannot be reliably met to a rigorous standard, only assistance to procurement and/or use of *Metarhizium* and the Insect Growth Regulators listed in Table 13 are allowed.**

   e. At risk communities must be properly informed, mobilized and organized to avoid risk of short and long-term exposure to hazardous pesticides. This must address first aid, pre-harvest intervals, re-entry periods, moving out of the spray path, and not harvesting sprayed locust.

   f. All pesticide procurement, use, training, and monitoring must be systematically documented.

   g. Environment, Health and Safety (EHS) monitoring must be included as an integral part of operations and extend a reasonable period post-campaign.

7. Must include funding that enables fulfillment in full of the conditions established in 5 and 6 above, or conditionality and monitoring to assure that these necessary complementary actions are otherwise funded and implemented . This includes, but is not limited to, surveillance, PPE, appropriate applicator and handler training, field supervision, and EHS monitoring commensurate and sufficient to the spray operations being supported.

8. Must be recognizably consistent with the "Understanding of Effective, Responsible Practice for Desert Locust Response and Control" as presented in Annex C and summarized in section 3.3.

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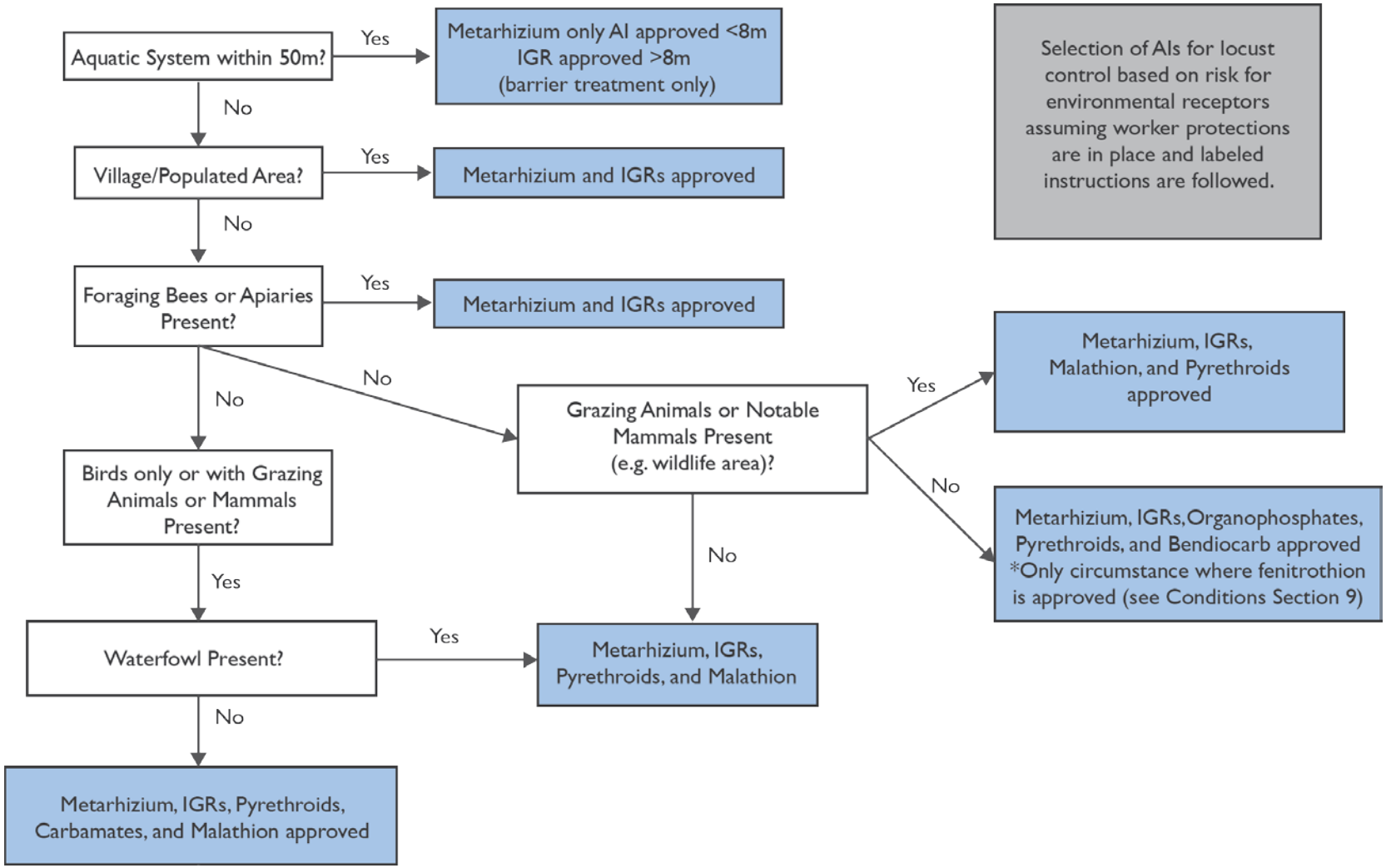
[44] Note available SOPs for Desert Locust Ground Control (http://www.fao.org/ag/locusts/common/ecg/359/en/SOPControlE.pdf) and Desert Locust Aerial Survey and Control (http://www.fao.org/ag/locusts/common/ecg/359/en/SOPAerialE.pdf) provide concise, field-focused guides to effective, efficient control techniques, but do not include all EHS elements per Chapter 6 of the *Desert Locust Guidelines.* The FAO's *Guidelines on Good Practice for Ground Application of Pesticides (http://www.fao.org/3/y2767e/y2767e00.htm#4) and Guidelines on Good Practice for Aerial Application of Pesticides (http://www.fao.org/3/y2766e/y2766e00.htm) provide useful elaboration on certain points of proper operations and safe use practices.*

NOTE: It is very unlikely that community-led spray campaigns can meet the safer use requirements enumerated above. Therefore, USAID support to community-led spray campaigns is not authorized under this PEA.

Figure 4: Mandatory AI Selection Decision Tree for AIs Permitted for Desert Locust Control



10 RECOMMENDATIONS REGARDING DESERT LOCUST PREPARATION AND RESPONSE PROGRAMING

This section goes beyond the authorized pesticides and required safer use conditions enumerated in Section 9 to offer recommendations regarding USAID engagement in desert locust preparation and response programming, with a focus on environment, health and safety (EHS), as well as sustainability more generally. Per the limited mandate of the PEA team and constraints attached to the funding for the PEA, it is deliberately brief.

- A significant challenge to desert locust response and control is maintaining preparedness during recession periods. Donor and country institutional and technical capabilities—both for surveillance and control—tend to atrophy over time. This leads to significant difficulty in mounting early control interventions, resulting in higher quantities of more toxic pesticides being applied as wider-area actions become necessary. There may be opportunities to better maintain preparedness by supporting common structures to effectively surveille and respond to the increasing problems of trans-boundary pests more generally.
- It is essential that potential future USAID support to desert locust response—particularly outside the FAO-led/intermediated emergency context—engage the correct actors, leverage partner country strengths and address gaps. The country briefings compiled for this PEA (Annex A) and those that will be required for any future amendments for geographic scope (see process in Annex B) map partner country actors, coordination mechanisms, capabilities and gaps and provide a roadmap for engagement.
- There is significant need and scope for further research and evaluation of desert locust control pesticides and control techniques. Many of the priorities identified by the 2014 FAO Pesticide Referee Group (PRG) report remain unaddressed, and the PRG itself is convened infrequently. USAID support to appropriate research and the PRG process has potential to make a significant difference to the EHS impacts of future campaigns.

PEA ANNEXES

A. Country Information
B. Process for amending this PEA for additional geographic scope
C. Understanding of Effective, Responsible Practice for Locust Response and Control
D. Review of the 2014 FAO PRG Report
E. Comparison of FAO SOPs for Locust Control to US RUP supervision/application requirements
F. Consultations Held
G. References
H. Preparer Biographies

ANNEX A. COUNTRY INFORMATION

ETHIOPIA DESERT LOCUST RESPONSE FIELD INFORMATION

1. Locust Vulnerability Information

Ethiopia is facing the worst desert locust outbreak in over 25 years, with the largest infestations occurring in the regional states of Oromia, Amhara, Tigray, Dire Dawa, Afar, the Southern Nations, Nationalities, and Peoples' Region (SNNPR), and Somali. Lowland pastoral and agro-pastoral areas have been the most affected. According to the FAO and the Ministry of Agriculture (MoA), households reliant on cropping activities and crop production, especially vulnerable populations, are at greater risk. Crop areas in Northern and Southeastern Tigray, northeastern Amhara, Eastern Oromia, and Southern and Eastern SNNPR have all been affected by locust swarms. Pastoralists and agro-pastoralists in Afar and Somali, have encountered damage to livestock fodder and crop losses. Despite the effects experienced, pastoralists remain able to search for fodder for their livestock from areas not affected or infested by the outbreak.

The FAO global Desert Locust Information Services (DLIS) provides relevant information on the desert locust situation in Ethiopia. FAO and its desert locust control partners use the eLocust3m application on mobile phones, for forecasts, early warning, regular updates, and alerts regarding desert locusts. The eLocust3m application is also used by partners to record and transmit desert locust data in real time to the National Locust Center, and ultimately to the DLIS. This DLIS system collects and analyzes these data on weather, vegetation, locust presence, geolocation, and time of surveillance/survey to produce situational updates and forecasts on, for example, the prevalence of locusts, stage of the locust, and forecasted population.

For information on livelihoods, partners use the desert locust impact assessments developed by FAO. Partners produce reports, field notes, World Food Programme (WFP) weekly price monitoring, etc., as new sources of information. Based on stakeholder consultations, the eLocust3m is the main source of information for desert locust control operations, while the Famine Early Warning System Network (FEWSNET) is the primary source of information for the livelihood-focused response initiatives. Respondents indicated that the information from eLocust3m is easy to use and provides required data.

2. Locust Surveillance & Response Responsibilities and Coordination Structures

A. Surveillance and Response Responsibilities

The major federal institutions engaged in the desert locust control operation in Ethiopia are the MoA and its regional offices in Afar, Somali, Amhara, Oromia, Tigray, SNNPR, and Dire Dawa regions. This institutional arrangement is weakened by a lack of capacity and resources at government offices. In addition to the MoA, the Environment, Forest, and Climate Change Commission (EFCCC) and the Ministry of Health (MoH) have responsibility for locust control, although there is poor coordination between these entities.

In addition, the FAO and the Desert Locust Control Organization for East Africa (DLCO-EA) are major actors operating in locust control operations in Ethiopia. FAO is working closely with the government to control the desert locust outbreak through the provision of an assortment of spraying, protective, and surveillance equipment, including leasing aircrafts, procuring vehicles, and providing PPE to scale up operations.

Furthermore, FAO supports a livelihoods recovery program by supporting livestock nutrition, agricultural inputs, and cash transfers. DLCO-EA is involved throughout the desert locust control campaign, in aerial surveillance and locust control, capacity building of plant protection experts, collecting information, analyzing the current situation, providing forecasts; and supporting research and development of alternative control agents and equipment.

Oher donor agencies engaged in the desert locust control operation include USAID, MasterCard Foundation, Bill Gates Foundation, Germany, Sweden, Switzerland, DFID of the UK, Norway, and Russia, all of whom provide financial support to the control and response operations. There are no non-governmental organizations (NGOs) working directly on the desert locust control operations, but many support livelihoods activities for the local communities as an adaptation and resilience mechanism. Possibly because the outbreak is time and condition-specific (and thus might not be considered feasible business nor feasible social responsibility), there are no private entities engaged in locust control efforts. At the community level, locust scouting is performed by grassroots community groups such as extension agents, farmer scouts, development groups, kebele administration, and faith-based associations. These groups further participate in the monitoring and surveillance of locusts, help mobilize the community during IPM operations, support the control team in fetching water for pesticides mixing and equipment washing, and assist in raising the awareness of the community during pesticide application.

B. Decision-making Regarding Pesticide Deployment

The MoA administers the entire operational process from pesticide procurement through use. All pesticides used in locust control are unavailable outside of government custody. The government employs Ethiolathion 95% ULV formulations (Malathion 95%). Diazinon and biopesticides (e.g., Metarhizium) —both procured on the international market—are also administered, but to a more limited extent. Diazinon is occasionally recommended/approved for use for locust control, but only under certain conditions and based upon expert opinion. There have been no constraints documented during procurement, as there is a national protocol at the MoA. Furthermore, as the MoA administers transportation through its four vehicles, there is currently no significant challenge beyond the low number of vehicles.

C. Coordination Structures

There is no formal structure established to coordinate among government institutions and donors, NGOs, and other institutions. The MoA is leading the control and response work, FAO is supporting in various ways, and donor agencies are channeling funds through FAO and MoA. Structurally, it is the mandate of the Federal government to coordinate the regional, zonal, and district agricultural offices. Although there is no well-structured coordination platform, the coordination thus far between FAO and MoA has been effective. As stakeholders become more diverse and increase in number, the need could arise to establish a multi-stakeholder coordination platform. All control operation decisions are made based on MoA expert opinions. The MoA experts discuss emerging issues based on the decision-making protocol which is defined among the stakeholders/actors and decide based on scientific and local contexts. A more complete elaboration of the coordination challenges between MoA, MoH, and EFCCC is provided in Section 5D below.

Pesticide Regulatory System & Safer Use Capacity

A. Legal/Regulatory Framework

The right of citizens to live in a clean and healthy environment is enshrined under the federal constitution (issued in 1995). The national Environmental Policy (proclaimed in 1997) clearly discusses issues related to environmental protection, environmental safety, and actors' responsibilities. Other policies include Proclamations on Environmental Pollution Control, Environmental Protection Organs Establishment proclamation, Environmental Impact Assessment (EIA) and Procedural Guidelines for EIA. The Environmental Impacts Assessment Guidelines (2002) establish the need for community consideration and participation in any investments made on the land and the entire environment.

Other important components relevant to Ethiopia's pesticide regulatory framework include:

- The Registration and Control of Pesticides Proclamation 674/2009: Established a national system for pesticides registration and regulation. It contains restrictions, prohibition, and entitlements, as well as pesticides registration and trading protocols. It is implemented by the Plant Health and Pesticides Regulatory Directorate, which registers pesticides if they qualify country and international protocols. However, the proclamation is not supported by a directive or policy direction.
- The Ethiopian Public Health Proclamation (No. 200/2000): Mandated to the Ministry of Health has the aim of promoting a healthy environment for the future generation (among others), including discussions on waste handling and disposal and communicable diseases.
- The Hazardous Waste Management and Disposal Control Proclamation No 1090/2018: Decreed with the objective of creating a system for the environmentally sound management and disposal of hazardous waste and preventing the damage to the human or animal health, the environment, biodiversity and property due to the mismanagement of hazardous waste.

In addition, Ethiopia has ratified numerous key international declarations, including those related to chemicals management:

- The Rotterdam Convention (Prior Informed Consent to promote shared responsibility and cooperative efforts among parties in the international trade of certain banned or severely restricted hazardous chemicals and severely hazardous pesticides formulations);
- The Basel Convention (ensuring environmentally safe transfer, disposal of hazardous wastes, and limiting "Toxic trade" in hazardous wastes),
- The Stockholm Convention (to protect human health and the environment from persistent organic pollutants) and,
- The Bamako Convention (the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa).

The pesticides currently approved for locust control operations in Ethiopia are limited to Ethiolathion 95% ULV and chlorpyriphos 24% ULV. Diazinon is occasionally recommended/approved for use for locust control, but only under certain conditions and based upon expert opinion.

B. Capacity for Pesticide Safer Use

Respondents at all levels reported that the use of pesticides remains the best choice for locust control when it occurs at large scale. All are aware that the use of environmentally safe products which reduce harm to non-targets is important. They stressed that spray teams should have been well trained on how to handle the pesticides and provided with the required PPE, but because of the COVID-19 pandemic and lack of funding, there were constraints. People living in the sprayed areas and their livestock are alerted to avoid sprayed areas. The FAO has been employing a standard guideline prepared previously to organize locust control operations, specifically dealing on aerial control campaigns. The surveying teams are employing aircrafts and making use of the procedures established in FAO guideline. The FAO has also developed two SOPs for Desert Locust (Ground Survey and Ground Control). The objectives of these SOPs are to guide for effective and safe ground survey operations, and to give concise instructions for field staff for good insecticide application in order to help them to avoid dangerous, ineffective or wasteful control operations. All actors have been trained on these guidelines, and the MOA, FAO and DLCO-EA are strictly advising all those involved in locust control works to use these guidelines.

Response efforts include risk prevention efforts—particularly targeting at-risk/high risk communities—in alignment with the FAO's established desert locust control procedures and consisting of on-site missions and training events. The numerous NGOs operating in many of the affected areas have been key contributors to this on-location support. The desert locust control operation implementers are working with the government and trying to bring on board other NGOs to further assist. There are experienced experts in the country at both the national and regional levels, though they are limited in number. These experts can deliver training and awareness-raising activities.

Pesticide applicators have been strongly advised to deliver warnings in all areas in which they are spraying about the associated risks in an effort to avoid non-target damage and harm. Community awareness activities have been undertaken by experts, community scouts, farmers associations, faith-based associations, and extension workers.

Pesticide application is based on predefined procedures, following the MoA pesticides application protocols where solely trained applicators, equipped with appropriate PPE, are authorized to undertake spray operations. Trained applicators are available from the MoA for locust control, though in some instances regional plant protection experts trained as pesticides applicators have been used. Private trained pesticides applicators have not been part of the migratory pest control response (e.g., there are in-country pesticide applicators, trained by Crop Life and based in offices in a number of regions across Ethiopia, but they do not have training specific to the desert locust response). In limited instances, pesticide spraying has been undertaken by farmers with very limited training, and inadequate PPE. Though there have not been reports of damage, contamination, or poisoning thus far, application by improperly trained or equipped individuals needs to be avoided, and the associated risks better controlled.

Before applying any pesticides, the MoA undertakes consultations with the local community, and conducts surveys to check for presence of sensitive ecosystems such as preserved and protected areas, water bodies, and other sensitive facilities. Government experts, transport drivers and staff, and applicators are trained on and execute the management and operations protocols. For migratory pests like locust, the operations are highly controlled and the government (along with its partners) is mandated to work on the use, management, and operation of pesticides, application equipment, and PPE.

C. Availability and Management of Pesticide Storage Facilities

Pesticides are procured through the MoA procedures and stored at the national/central warehouse in Addis Ababa (owned by the MoA), Agriculture Offices at the regional level as well as small stores based at the woreda-level. Transportation is only possible using the four MoA-owned and managed box trucks, which are solely assigned and reserved for pesticide transportation. No transportation is allowed beyond these trucks, and no storage is possible other than MoA administered stores.

D. Pesticide Disposal Options and Level of Effective Oversight

There is no pesticide disposal system in Ethiopia. The only option is to send the obsolete pesticides, contaminated equipment and PPE to the manufacturer or distributor for disposal in incinerators, mostly in Europe. According to the respondents at all stages, there are currently no desert locust control pesticide stocks, but if unplanned procurement is undertaken outbreaks such as the current one, there is a tendency to procure large quantities of pesticides with potential for unused pesticides remaining following the outbreak. In-country experts are well aware of this prospective issue and they reported that they are making plans with this in mind in an effort to avoid unnecessary stocking. The interviewees know that there are electric incinerators established by MoH and cement factories but there have not been discussions regarding use of those options. (It is not clear that these incinerators would be viable for safe incineration of recommended pesticides.) With regards to contaminated PPE, the sprayers are said to have been advised to collect and store them in a separate place. Advice was provided to store contaminated containers at designated locations, but no advice provided as of preparation of this report regarding the ultimate disposal.

4. Other Key Response Capacities

Surveillance has been conducted by community scouts, kebele administration, development groups, faith-based associations at the kebele level, and the government extension agents who conduct confirmatory surveys. Woreda plant protection experts undertake surveys, based on the information from Kebele groups. The work by kebele level groups on surveillance of locust outbreaks was very important, but less has been done in this regard. This activity has recently been supported by USAID. Bio-pesticides are being tested, but to a very limited extent. Other IPM methods such as mechanical prevention and control have been widely tried but have not been effective during upsurges.

5. Strengths, Gaps, and Constraints to Effective Locust Control

The following table discusses the existing resources, their functionality, and the deficits. The MoA and its partners are committed to deploy these resources, but all reported that the resources are not sufficient:

TABLE 14: LOCUST CONTROL RESOURCES

SN	Resource type	Quantity and Provided by	Current condition Functioning, needs maintenance, not functional; quantity available meets quantity needed
1	Aircraft	4 leased by MoA 2 leased by FAO 2 available at DLCO-EA	All functional. The 2 DLCO-EA owned aircraft are outdated and need to be replaced.
2	Vehicles	107 available at MoA 10 provided by FAO – +30 are coming	All functional, but there is a high deficit relative to need; it is estimated that at least 50 additional vehicles are needed.

TABLE 14: LOCUST CONTROL RESOURCES			
SN	**Resource type**	**Quantity and Provided by**	**Current condition** **Functioning, needs maintenance, not functional; quantity available meets quantity needed**
3	Sprayer backpacks/ motorized sprayers	280 available at MoA 20 newly provided by FAO	The 280 sprayers at MoA require maintenance. Beyond that, and the 20 sprayers provided, there is still a deficit of available sprayers relative to those needed.
4	Vehicle mounted sprayers	2 available at MoA 20 newly provided by FAO	The new sprayers are functional, but the 2 at MoA are not functional, There is a high deficit of available sprayers relative to need.
5	Skilled manpower at government offices	There are experts at Federal, Regional, Zonal and Woreda level government offices, but there is a big shortage.	The existing experts need additional training. There is a need to establish an independent "Desert Locust Control Unit" within government offices
6	FAO and DLCO-EA have experts	FAO and DLCO-EA have entomologists who are well trained and experienced in migratory birds control including desert locust	All are working entirely on the control operations

A. Control Equipment and Adequacy of Assets

Pesticide sprayers, protective cloths, and aircraft fuel are generally lacking and need to be mobilized. There is a critical shortage of PPE in all sites, and this challenges the application of pesticides. Otherwise, all applications are undertaken with clear guidelines. In some instances, farmers, without proper care, have been seen spraying pesticides without the knowledge of the responsible organization, which carries environmental and social consequences. To reduce this, the government is trying to raise the awareness of the local community, and local government experts are advising the farmers.

Stakeholders consulted indicated that their primary recommendation to improve desert locust control operations is the establishment of a "Desert Locust Control Unit" at the MoA, that extends down to regional bureaus. Another recommendation raised by stakeholders is to support the DLCO-EA to acquire modern aircraft. The existing aircrafts are WWII models and are not efficient or effective, as the flight cost is double that for more modern aircraft. Respondents indicated that USAID/BHA is best positioned to provide support to the locust control operations through:

- Provision of vehicles and PPE for locust survey works,
- Procuring approved pesticides and spray equipment including aircrafts for DLCO-EA and MoA, as well as vehicles for the MoA,
- Support the works to establish a locust control facility/unit at the MoA,
- Support the human and material capacity building efforts, and
- Support to strengthen the information flow network, surveillance, and survey efforts.

B. Surveillance

In terms of monitoring and enforcement of desert locust control operations, the major problem is data acquisition. Unidentified desert hoppers evolved to adults have swarmed prior to identification due to topographic barriers, skilled manpower, resource limitations, and related issues. Furthermore, the COVID-19 pandemic and its severe impact has limited travel to undertake survey operations and meet with stakeholders. Finally, monitoring—a cornerstone of desert locust management—is challenged by a lack of trained manpower, staff turnover, and a shortage of monitoring equipment.

C. Logistics Management Capability

The major challenges in safely procuring, storing, transporting, and using pesticides include:

- Lack of PPE and application equipment such as sprayers of any type;
- Lack of aircraft for aerial spraying (when there is demand);
- Resource limitation affecting ability to meet costs for control operations and sanitation;
- Low community-level awareness;
- Lack of knowledge and skill on proper handling and use of pesticide at local levels;
- Ability to conduct community awareness campaigns due to the COVID-19 pandemic; and
- Absence of a disposal system for pesticide contaminated containers, PPE, etc.,

D. Effectiveness of Coordination Structures and Organizations

There is weak coordination between MoA and MoH, and essentially no communication in terms of desert locust control. There is a clear need for establishment of communication and coordination mechanisms because desert locust control operations demand the coordination of different actors to ensure effective control and to safeguard environmental health and safety. MoA is responsible for mobilizing, communicating with, and monitoring at-risk communities, while EFCCC is tasked with creating a system for the environmentally sound management and disposal of hazardous waste, and preventing the damage to human or animal health, the environment, biodiversity, and property due to the mismanagement of hazardous waste (Proclamation No. 1090/2018). The MoH is supposed to be at the forefront of monitoring and addressing incidents and emergencies that may result from spray campaigns, but its efforts are very limited and mainly focus on medical waste management. Overall, the coordination between these entities is lacking.

E. Application

The major challenges in terms of the use of pesticides in the field include:

- A shortage of electrical pumps or siphons to transfer pesticides from large containers (e.g., drums) into sprayers;
- A lack of PPE, which is frequently damaged since operations are done in bush areas;
- While applicators are trained, there are still knowledge gaps and shortages of cleaning materials, like gasoline or other organic solvents. There is low awareness at the community level. There is also an insufficient number of trained applicators.

- Contaminated containers and materials are supposed to be properly stored in designated locations, but there is no standard system of disposal. There is also a lack of skill and knowledge regarding disposal.
- Failure to follow an early detection and reaction strategy.
- Poor communication of information from the field.

F. Pesticide Market Availability and Quality

Pesticides for desert locust control are procured by the government from Adami Tulu Pesticides Formulation plant, and abroad. Although there are application equipment and PPE suppliers in the local market, procurement for desert locust control pesticides is only done through the government. The Adami Tulu Pesticides Formulation Plants formulates Ethiolathion 95% ULV (Malathion 95%).

Particular Environmental or Human Health Concerns Presented by Spraying for Locust Control, Particularly Wide-area Spraying

A. Exceptional or Specific Ecosystem and Agricultural/Pastoral System Vulnerabilities

There is a general threat to ecosystems, agricultural, and pastoral systems from locust control operations, but care is being taken to avoid any environmental damages. The pesticides used for desert locust control are not specific to desert locusts. Therefore, when sprayed, they can kill non-target organisms which are part of the ecosystem, which could disturb the natural ecosystem. Local communities have been advised to avoid any travel by livestock and people (especially children) to areas where pesticides have been sprayed. In general, the application of pesticides gives due consideration to community needs through consultations with the local community. Protected areas are known, and before pesticide application, proper care is given to avoid harm, such as to pollinators, birds, and honeybee colonies, which are beneficial and present in most affected areas; for example, in Southwestern Ethiopia application is prohibited because of the large number of bee colonies. Any pesticide spraying considers the application timing, application location and all issues are well addressed and any relevant organizations such as the protected areas where wildlife are living. However, there is no working coordination with the Ministry of Environment and with the Ethiopian Wildlife Conservation Authority. During selection of pesticides the team, based on the national and international requirements, has tried to avoid highly hazardous chemicals, and due care is being considered to avoid any severe impacts.

B. Locusts for Human Consumption

Locusts are not traditionally eaten in Ethiopia. They are highly fatty and could be potential sources of feed (specifically for chicken) with the proper strategies and systems in place. Currently there is no system to use locust as feed, but it is recommended to design a system for chicken feed.

C. Adverse Impacts of Control Efforts in Past Outbreaks

According to the stakeholder consultations, there are no reported cases of human health and environmental impacts in Ethiopia as a result of desert locust control operations. The MoA has a well-articulated code of conduct for dealing with migratory pests such as the locust. The administration of pesticides is highly controlled in that transportation is only employed by the MoA trucks assigned for this purpose, spraying is undertaken only by trained technicians, and supply and procurements of pesticides have been very limited. There is the higher need to duly consider enforcing the code of conduct to avoid overstocking.

There has not yet been a Cost-Benefit Analysis of pesticide use for locust control operation, but the FAO is recruiting an expert to conduct this analysis, along with the environmental impact assessment. The expert will also work on the environmental, health, and safety issues related to desert locust control operations. Though no specific analysis has been made by the locust response team, there have been various efforts made by different organizations on identifying the impacts of losses on food security. A livelihoods response plan has been developed and will soon be implemented; this plan includes key criteria regarding how best to focus resource mobilization initiatives with the donor community aiming to reverse effects of the desert locust outbreak on livelihoods.

D. Public/Community Sensitivities or Concerns Regarding Control Efforts

There are particular public and community sensitives or concerns during desert locust control efforts, for the general population and for minority or disadvantaged groups specifically. General population concerns include:

- All areas impacted by locusts face loss of income, shortage of food, increased prices for food items, loss of assets. These factors could lead to widespread food insecurity if the outbreak continues or spreads.
- Unless due care is taken, the locust control measures through use of chemicals could also pose human and livestock health risks, especially those exposed to pesticides management.
- There are risks related to the COVID-19 pandemic. Experts at all levels reported that all visitors from federal, regional, zonal, and woreda levels are highly advised to take due care and respect instructions given by health officials. Not following these guidelines could create community-level risk.

Minority or disadvantaged groups face specific threats from locust control operations, including:

- More severe impacts due to their economic and social status, leading to delays in obtaining information and limited access to health facilities,
- Disadvantaged groups are further from infrastructure, including access to health facilities,
- Any irresponsible travel to local communities will likely lead to the spread of COVID-19, and there is a high need to respect MoH guidelines.

E. Storage and Management of Pesticides

Pesticides are highly controlled for migratory pest operations, and there are no leftover pesticides thus far. The experts do know the impacts of over-stocking and intend to plan for appropriate procurement based information at hand. An expert is now in place (assigned by the FAO) to work on monitoring systems in place to avoid any health and environmental risks. As mentioned in Section 3D, obsolete pesticides are often stored in poorly constructed stores, without proper controls. There are no disposal facilities in the country; the MoH (Ministry of Health) has incinerators in seven major towns, but there has been no communication or discussion between the MoA and MOH.

KENYA DESERT LOCUST RESPONSE FIELD INFORMATION

Locust Vulnerability Information

The first swarms of immature desert locust arrived in Kenya between 28 December 2019 and 20 January 2020. These swarms came in through North-Eastern counties, reportedly initially infesting Wajir,

Mandera, Garissa, Marsabit, Isiolo, Tana River, and Samburu. As additional swarms arrived, the invasion spread to Turkana, Baringo, Embu, Tharaka Nithi, Machakos, Kitui, Meru, and Elgeyo Marakwet counties. Selected other counties have also received low numbers of swarms. The highest prevalence of swarms was experienced in Wajir, Mandera, Garissa, Marsabit, Isiolo, and Samburu counties, which informed the decision to intensify aerial control in these areas.

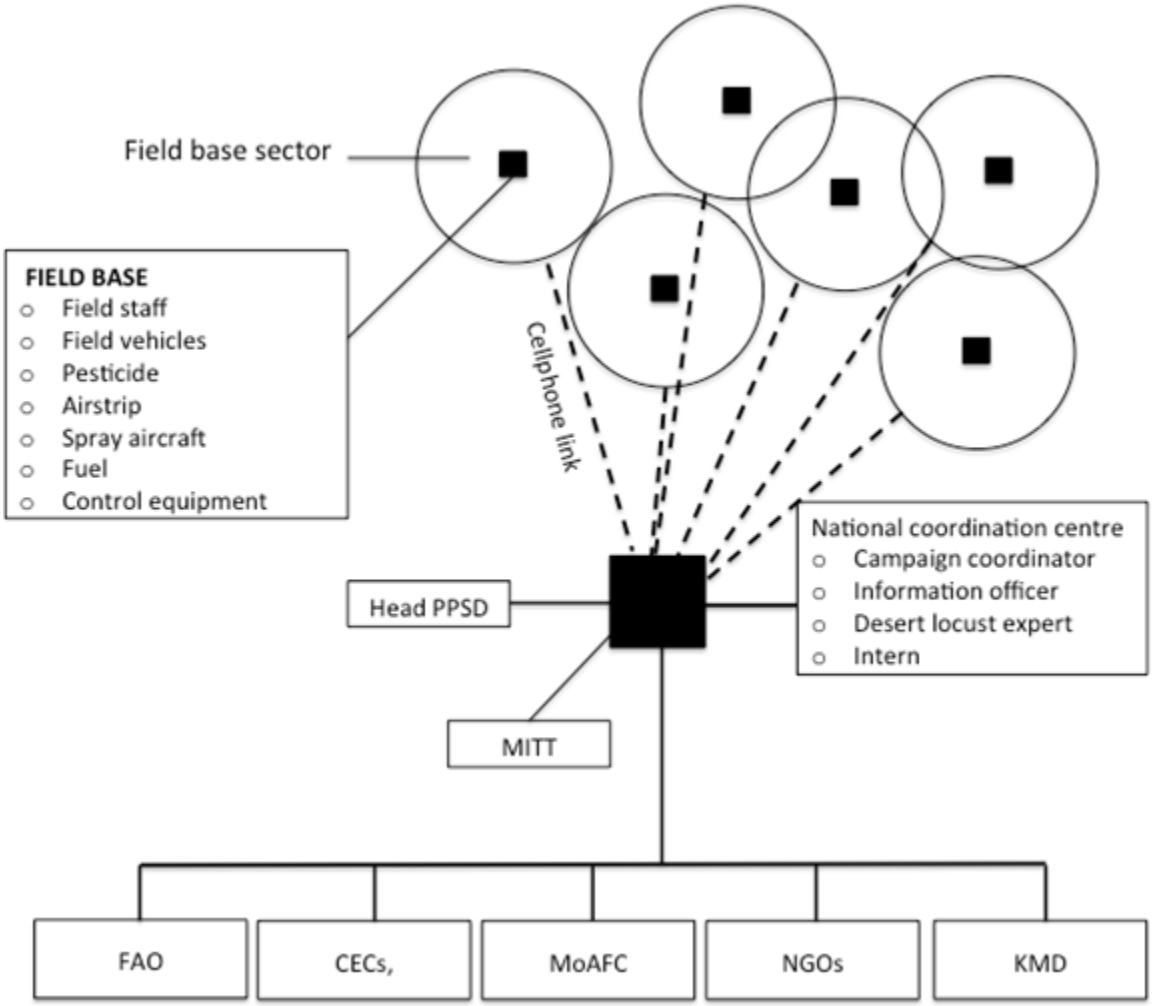
Ecologically, these counties lie in Kenya's arid-semi-arid lands (ASALs), predominantly inhabited by pastoralist and agro-pastoralist communities. Generally, Kenya's ASALs are home to seven million people and more than 50% of the country's livestock population. These rangeland areas are unsuitable for rain-fed cultivation due to the arid climatic conditions.

From late December 2019 to early February 2020, the majority of cultivated crops had reached physiological maturity and infestation did not affect the general yield. However, the swarms that fed upon pastures on which area livestock depend, considerably affected livestock production. A fast recovery of vegetation as a result of rains experienced in the area helped mitigate some of the area's vulnerability to the locusts.

Locust Surveillance and Response Responsibilities and Coordination Structures

Kenya is a member of the Desert Locust Control Organization for Eastern Africa (DLCO-EA). DLCO-EA has the mandate to strengthen national and regional capacities for better management of emergency locust control and preventive interventions in Kenya, Djibouti, Eritrea, Ethiopia, Somalia and Sudan. DLCO-EA achieves this by raising awareness among communities in frontline locust-prone countries about the biology, threat, and means of controlling the pest. However, Kenya has not benefited much from the activities of DLCO-EA. Until this invasion, there was generally no structure to coordinate control and surveillance in Kenya. Management of desert locust is structured as shown in Figure 5, below.

Figure 5: Organogram Showing Desert Locust Control Structure in Kenya



Definition of acronyms, FAO = Food and Agricultural Organization of the United Nations; CECs = County Executive Committee; MoALFC = Ministry of Agriculture, Livestock, Fisheries and Co-operative Development; NGOs = Non-Governmental Organizations; KMD = Kenya Meteorological Department; and PPSD = Plant Protection Services Division;

1. The Multi-Institutional Technical Team (MITT) operates as a key decision-making organ; MITT is composed of numerous stakeholders, including: International Centre of Insect Physiology and Ecology (ICIPE), Centre for Agriculture and Biosciences (CABI), University of Nairobi, Entomological Society of Kenya (ESK), MoALFC, Kenya Forestry Services, Kenya Wildlife Society (KWS).
2. Next to MITT is the Director of PPSD, who briefs the Permanent Secretary (PS) and Chief Secretary (CS) of the MoALFC on locust control.
3. The National Coordination Centre collects and collates information received from the field bases for follow up.
4. At the ground level, control efforts are coordinated at field bases led by base managers. Base managers work with field officers and surveillance scouts to collect and submit desert locust information from the ground using eLocust3m. The base manager, together with field officers, relays

collected information to the command center and contributes to determining necessary control measures and actions.

5. The donors and PPSD, as well as FAO, facilitate or support government operations, where necessary.

Pesticide Regulatory System and Safer Use Capacity

Legal/Regulatory Framework and the Pest Control Products Board (PCPB)

Registration of insecticides is regulated by the Pest Control Products Board (PCPB). The PCPB is a statutory organization of the Government of Kenya established under the Pest Control Products Act of 1982 to regulate the import and export, manufacture, distribution and use of pest control products in the country. Occasionally, PCPB staff visit agro-chemical stores to ensure all products in the market are registered in Kenya (Opiyo). During such visits, PCPB staff are usually accompanied by the police, and arrests are made where illegal materials are found.

Current desert locust control needs have informed the decision to import more insecticides since many of the insecticides required were not available in the country. However, before authority was given to import these products, PCPB emphasized that the quality of proposed products must meet the required standards. By December 2019, the following pest control products were registered for control of locusts in Kenya: Fipronil 12.5g/L (ULV), Imidacloprid 10g/L (ULV), Cyanaphos 500g/L (ULV), Chlorpyrifos 240g/L (ULV), Chlorpyrifos 480g/L or 40.8% m/m (EC), Cypermethrin 50g/L (EC) and Teflubenzuron 50g/L (a benzoyl urea) (ULV).

In addition to the aforementioned products registered in Kenya, there are other pest control products with evidence of approval for control of desert locust in other countries. They include Deltamethrin 25g/L, Fenitrothion 400g/L, Acetamiprid 100g/L and Emamectin Benzoate 20g/L. The government, through the PCPB, subjects such products to its own approval process. However, these products can be imported through extension of their approvals in cases of emergency.[45]

All these products are manufactured by foreign companies and distributed by local agents or merchants. In order to filter out unscrupulous agents and merchants, the board requires the following:

1. All potential suppliers are to provide the PCPB with building licenses as a proof of their registration with the board. PCPB promised to verify the premises licenses provided by the suppliers.
2. Dealers who are not manufacturers or appointed local agents were asked to provide letters of appointment to distribute issued by the manufacturer or agent of that particular product.
3. The crop protection division of the MoALFC was to be guided by the summary tables provided by the PCPB in making procurement determinations (regarding both product and supplier).
4. Suppliers were to provide information to prove the point of origin of the product.
5. To prevent illegal suppliers and dealers, samples were to be collected from pesticides supplied for analysis, at the supplier's cost, and the outcome of the analysis used to inform the payment decision.

[45] See, e.g., "temporary registrations" at http://www.pcpb.go.ke/temporary-registrations/. PCPB states that "Temporary registration is granted where some additional scientific technical information is to be provided before the product is elevated to full registration status or for products to be sold for the emergency control of infestations that are seriously detrimental to public health, domestic animals, crops or natural resources."

6. In order to monitor types and quantities of products in use, crop protection divisions in affected counties in Kenya were tasked to provide feedback on the product.

Storage of Product, Distribution to the Control Bases, and Application

All procured or donated chemical insecticides are stored in the Plant Protection Services Division's (PPSD's) main storage area in Nairobi. Insecticides are sent out to the bases depending on operation demand as communicated by the base managers. The insecticides are transported in government trucks to the required bases. Unfortunately, the drivers are not trained to handle any pesticide accident or hazards during transportation. Among the six control bases, only four have rooms designated to serve as stores. In the two bases where there are no formal stores, insecticides are left in open tents. In bases where formal stores exist, storekeepers maintain records of insecticides received and distributed. Each store is guarded by two security officers.

In the bases, insecticide products are used in both aerial and ground applications. Professional pilots that have previously participated in desert locust control in other countries undertake aerial operations. They include pilots from DLCO-EA, Farmland Aviation in Kenya, and Orsmond Aviation of South Africa.

In contrast to professional aerial operations, ground operations are challenged because applicators received only two days of training, offered in February by PPSD staff under the guidance of an FAO international expert from Morocco. The country has not experienced a serious desert locust invasion in over 70 years. There is a need to have professionally trained sprayers undertake future controls. Though there are spraying teams trained to handle insecticides in Kenya, they were not included in this campaign due to logistical challenges.

In the early stages of operation, many applicators did not understand the difference between ULV and EC formulations. As a consequence, they ended up using ULV formulations in backpack motorized and knapsack sprayers.

Ground operation teams are usually well protected before they begin operation. They are regularly supplied with PPE; in total, 700 pieces of overalls, gloves, goggles and masks have been supplied. Applicators have been provided with both cotton and disposable overalls. In locations where disposable overalls are used, the base manager ensures that they are burnt using a small fire after the operation.

Currently, the government is preoccupied with pesticide procurement and corresponding desert locust control, with limited attention given to disposal of excess products or empty containers. Respondents indicated that all empty containers are kept in the storage in respective bases awaiting cleaning and crushing, once/if drum cleaners and crushers are procured. Plans are underway to procure three (3) crushers that will be installed in Kabete (Nairobi), Isiolo, and Lodwar.

Other Key Response Capacities

The Kenyan government had not prepared measures for desert locust control prior to the FAO's transmission of the invasion alert. In preparation of the impending desert locust invasion, the DLCO-EA team organized a meeting with the PPSD field team in December 2019 to plan on how to manage desert locust in Kenya. After the second meeting in January 2020, both PPSD and DLCO-EA formed a training team of five officers that trained Wajir, Mandera, Garissa, Samburu and Isiolo county teams on: identification of DL; biology and behavior; surveillance; and control. There were usually about 40 trainees in every county training session.

Strengths, Gaps, and Constraints to Effective Locust Control

Control Equipment / Assets Adequacy

Desert locusts are an important phytophagous pest affecting field crops and pasture. Because of the transboundary nature of desert locust movement, its control is the responsibility of the central government. Kenya. being a member of DLCO-EA, has benefited from preventive control done by DLCO-EA in the recession zone (Ethiopia, Eritrea and Djibouti). Preventive control efforts have been successful for the last 70 years except in 2007/2008 when four mature swarms entered Kenya through Mandera. Riding on the success of desert locust preventive control, the Kenyan government has focused on other pests like the fall armyworm, stem borers and *Quelea*. The current desert locust invasion surprised everyone.

- Aerial spray: Currently, there are four aircraft involved in the aerial control. DLCO-EA led the aerial campaign in Kenya but was overstretched and could only dispatch two aircraft. The government released one military aircraft to support the aerial campaign. The government contracted three additional aircraft mounted with Micronair™ atomizers for ULV application to support the aerial campaign. Two aircraft have since been withdrawn from the control operation, the military aircraft and one from DLCO-EA. The DLCO-EA aircraft was redeployed to support control of *Quelea* in Tanzania.
- Ground spray: The government, through PPSD, only possessed two Land Rovers mounted with sprayers and thus equipped to undertake ground control. In addition to a limited number of sprayer-mounted vehicles, the government possessed an inadequate number of handheld and knapsack sprayers. The procurement of poor-quality handheld and motorized backpack sprayers further complicated efforts to deploy effective ground spraying.

Surveillance (monitoring and timely reporting) adequacy – system and equipment

Surveillance of swarms (immature and mature desert) and hoppers in Kenya has been inadequate. Unlike countries in the recession region, Kenya has not been a member of the FAO Commission for Controlling the Desert Locust in the Central Region (CRC) , and thus has not benefited from regular training and supply of equipment funded by the FAO. However, no one should be blamed for this inadequacy since the last such invasion was observed more than 70 years ago. The limited desert locust surveillance and reporting was done by county teams jointly trained by PPSD and DLCO-EA staff. Apart from supporting training, DLCO-EA did not take part in surveillance since they only have one tablet equipped with eLocust3 in Kenya. DLCO-EA primarily uses this eLocust3[46] tablet for training and occasional surveys. Kenya is a member of International Red Locust Control Organization for Central and Southern Africa (IRLCO-CSA). IRLCO-CSA sent one helicopter to support surveillance.

Driven in part by insufficient technical capacity, surveillance and reporting from December through February were generally inadequate. During this period, there were several inconsistent desert locust data from different counties as information was coming in the form of short messaging services (SMS), WhatsApp messages and through phone calls. In many cases, this resulted in selection of the wrong control targets. However, this changed in March, when a new version of eLocust3m (i.e., eLocust3 for

[46] eLocust3 is based on a robust tablet, which can withstand sun glare, dust and high temperatures, and specially programmed software. The device has a built in GPS and battery, enabling the operator to move away from the vehicle and still record and transmit data.

smartphones) was introduced and field scouts were trained on its application. Since the initial training on proper use of eLocust3m, surveillance has intensified, particularly during April and May, coinciding with the maturity of 1st generation adults (copulating and oviposition) and the emergence of 2nd generation hoppers. Data entered in eLocust3m is submitted directly to the PlantVillage server and used to make desert locust control decisions. PlantVillage is a publicly supported and publicly developed application that uses a digital assistant to help farmers diagnose crop disease in the field without an internet connection. Developed at Penn State University, the app uses Google's TensorFlow machine learning tool and a database of images collected by crop disease experts across the world.

Additional surveillance data could be extracted from the EarthRanger database operated by the NGO, 51 Degrees. 51 Degrees is located in LEWA conservancy and has rangers distributed in all wildlife conservancies in Kenya. Using radio calls, these wildlife rangers have been submitting desert locust data since 28th December 2019 when the first immature swarms came into the country. Currently, FAO, through an aerial control coordinator, is exploring the possibilities of integrating desert locust data from EarthRanger into eLocust platforms.

Logistics Management Capability

DL control in Kenya is organized in bases for the ease of coordination. In total, there are six bases into which the affected counties are clustered. The bases include Masinga, Isiolo, Marsabit, Lodwar, Wajir and Garissa. In addition to six bases, there is a central command based in Kilimo house. A base manager heads each base and liaises with county-level focal persons--typically county agricultural or crop protection officers--operating from the base in that county. The base manager collects and collates information from these county focal persons and relays it to the National Coordination Centre. Trained county teams collect and relay information to the focal persons. The lead logistician, in consultation with base managers, makes decisions on actions to be taken.

Effectiveness

Control operations have not been effective in all counties. Some counties do not submit required desert locust data that are necessary to effectively plan control. In the process, they do support the movement of insecticides from points where they are not urgently needed to locations/bases where they are immediately needed. This management structure is less effective as it depends on the desert locust data from base managers.

Funding

Initial operations were supported by the central government, with funds drawn from the treasury. Other donors further supported desert locust control, channeling their funds through FAO. Some donors additionally provided equipment and insecticides. The bilateral, multilateral, and institutional donors supporting Kenya's response include: Bill & Melinda Gates, Netherlands, Germany, Russia, World Bank, China and India.

Road Network / Accessibility

Accessibility in this campaign can be divided into two categories: (1) between the counties (2) within the county.

1. All chemicals and equipment are delivered to a central location in Nairobi and distributed to the bases, depending on the needs. All the bases are accessible, though some are far from Nairobi. For example, Lodwar base is about 608 km from Nairobi and transport of chemicals to this base takes two days during the dry season. Similar long distances affect supply of insecticides to distant counties like Mandera, which is about 1,052 km away.
2. The road network within affected counties is poor and Isuzu DMX vehicles mounted with sprayers are unsuitable for this terrain, contrary to high performance 4x4 Toyota Land Cruisers. This has limited the ability to use of vehicle-mounted sprayers in control of hoppers.

The ground control teams relied heavily on knapsack and motorized backpack sprayers handled by National Youth Service recruits. This, however, did not proceed without challenges as it was not easy to supply the field teams with much needed water required to formulate EC insecticide. There are no boreholes and water bodies close to operation areas from which water could be drawn.

Communications and Adequacy; e.g., Notable Cell Network Gaps

The invaded areas are largely covered by the telephone network, though there are areas with poor network coverage. In such areas, information reaches the intended officers/recipients more slowly than desired Scouts and other field officers must use personal cell phones, they do not all possess smartphones, meaning they cannot all submit desert locust data using eLocust3m. In such areas, the control team relies mainly on the data sent by rangers through radio calls. Rangers send their data to the earth ranger platform housed in 51 Degrees' offices in LEWA conservancy.

Security

Security is a serious challenge in the general desert locust control campaign. Some counties are considered insecure and face threats from the Al-Shabaab (e.g., Mandera and Wajir) or inter-community conflict (e.g., Samburu, Turkana, and Baringo) driven by cattle rustling and scramble pastureland. These threats affect the transportation of insecticide by road as well as actual desert locust control operations. In Mandera and Wajir, the government deployed the military to undertake both ground and aerial operations.

Pesticide Market Availability and Quality

The government of Kenya relied on the list of insecticides provided by the FAO PRG. PCPB compared the PRG list against the insecticides registered in Kenya for use against desert locust and gave a special permit to allow the importation of insecticides in the PRG list that are not registered in Kenya.

Insecticide availability and supply is a business venture driven by local demands. Even though there are chemical industries in Kenya that can formulate and supply insecticides, none of them had desert locust control insecticide ready. Twiga and Osho chemicals were allowed to import technical products from China and India to formulate Fenitrothion and Deltamethrin, respectively. Other insecticides were either available locally or were brought into the country in the form of donations. See Table 15 for all insecticides and corresponding formulations as used in Kenya during the 2019/2020 desert locust invasion.

TABLE 15: LIST OF INSECTICIDES USED IN DESERT LOCUST CAMPAIGN IN KENYA (JAN MAY 2020)	
Trade name	**Active ingredient**
Adonis 12.5 ULV	Fipronil 12.5g/L
Atom 1.25 ULV	Deltamethrin 12.5 g/L
Atom 1.75 ULV	Deltamethrin 17.5 g/L
Cypermethrin 50g/L EC	Cypermethrin 50g/L
Dimilin 480 SC	Diflubenzuron 480g/L
Duduthrin 1.7 EC	Lambda-cyhalothrin 17.5g/L
Dursban 24 ULV	Chlorpyrifos 240g/L
Dursban 4 EC	Chlorpyrifos 480g/L or 40.8% m/m
Farsban 4 EC	Chlorpyrifos 480g/L
Malathion 96% w/w ULV	Malathion 96% w/w
Marshal 200 ULV	Carbosulfan 200g/L
Mursban 480 EC	Chlorpyrifos 480 g/L
Pentagon 5% EC	Lambda Cyhalothrin 50g/L
Sumithion ULV 96%	Fenitrothion 96%

There were concerns regarding the efficacy of Malathion during the month of January. Members of the local communities raised this when they observed low mortalities one day after aerial sprays and questioned the quality of this product (Batian, Tale). Application of this product was subsequently stopped, and remaining products withdrawn from the bases (Marangu). Later in April 2020, questions were raised about the efficacy of Deltamethrin 1.25g/L (Heath), when the majority of immature adults recovered and flew off 1-2 hours after of spraying (Heath, Ngera).

Particular Environmental or Human Health Concerns Presented by Spraying for Locust Control, Particularly Wide-area Spraying

Vulnerable Ecosystems

Swarming immature and mature DLs can roost in any area with vegetation they find suitable. Some such areas are located around human settlement, along water bodies or game reserves are considered to be ecologically sensitive. Similarly, hoppers can emerge or move closer to human settlement, game reserves or water bodies. Control measures need to consider such sensitive habitats. During training, the teams

were told to pay attention to such habitats and protect the environment. However, only pilots paid attention and avoided such sensitive habitats. In contrast, ground teams did not pay much attention to such habitats as they claimed that their spray is more targeted.

Agricultural or Pastoral Systems. Several swarms of immature DLs came in Kenya between 28th December 2019 and 20th January 2020 from Somalia and Ethiopia. These swarms came in when many of the crops had reached physiological maturity. These immature adults and later on emerging hoppers invaded pastoral lands and fed on the pasture. Pastoral systems are sensitive and pastoralists in these areas require sensitization by the field teams before ground or aerial sprays. In some areas communities, through local administration, were advised to withdraw their animals and hold them away for three days.

Locusts as Food (Entomophagy). Communities living in the counties facing locust invasion are mainly pastoralists and do not eat insects. However, the respondents could not confirm if this could change during food scarcity. This might be different in the neighboring Turkana county where the respondent indicated that they might eat desert locust if they were to invade during times of hardship.

Adverse Impacts of Control Efforts in the Past Outbreaks

The respondents gave accounts of some incidents that may be considered as adverse effects of this invasion and control operation. Whether true or false, this is their account.

- Respondents shared a belief, not backed with scientific evidence, that when immature and mature locusts roost closer to animal watering bodies and defecate in water, that water becomes toxic and infests cows.
- Some ground teams are seriously exposed to insecticide fumes since some applicators handle insecticides without proper gear (gloves, mask and gloves). Efforts have been made to correct this as base managers try to closely monitor operations.
- Cases where ULV was sprayed using knapsack sprayers resulting in the waste of insecticides.
- Effect on the non-targets. Two birds were reportedly poisoned after ground spraying. An investigation by the Marsabit county office could not confirm this incident.

Public/Community Sensitivities or Concerns Regarding Control Effort Including Minority or Disadvantaged Groups

- Concerns of the pastoral communities have always been considered in every operation. In some cases, sprays have been abandoned in areas where the locals feel that spray will affect their animals and health (Heath).
- Aerial sprays have in some cases been abandoned where targets are found to be closer to sensitive areas.
- In Laikipia, monitoring and control was stopped by a ranch owner. The owner claimed that ranch is a private property and cannot allow scouts into the ranch.

Management of Pesticides Stocks

Procured insecticides are delivered and stored in the government storage area in Nairobi. Stored insecticides are only released to the base upon request. Upon arrival in the bases, insecticides are stored in the designated storage areas in the bases. This is the first time the country is experiencing desert locust invasion in 70 years. With the donations of insecticides received, there is likely to be significant quantities of insecticides remaining. Remaining quantities will be safely stored in the government storage areas and redistributed to countries in the recession region, through triangulation.

Challenges to Monitoring and Enforcement of Locust Control Operations

- DL control requires regular surveillance in all the potential habitats particularly in counties previously infested. Scouts can be effective if they are in formal engagement. Unfortunately, current scouts are working as volunteers and are thus less committed.
- Kenya is not a member of any DLDL control commission and thus does not have a desert locust officer.
- Current monitoring and reporting are based on the use of eLocust3m app installed on android phones and tablets. However, not all potential scouts have smartphones, and this affects reporting.
- Counties have not been able to support monitoring through nomination and training of scouts.
- Control operations are hampered in some areas by the insecurity in the invaded areas.

SOMALIA DESERT LOCUST RESPONSE FIELD INFORMATION

Executive Summary

Somalia is among the countries most impacted by desert locust that is spreading rapidly across East Africa since December 2019. The country is facing the worst desert locust outbreak in over 25 years, declared a disaster on 18 November 2019 by the United States Government and a national emergency on 2 February 2020 by the Federal Government of Somalia (FGS). An estimated 445,000 acres of land have been infested by locust hoppers and breeding adults, which have damaged agricultural production areas and pasturelands, threatening food security and livelihoods in the country. Rural populations in Galmudug, Puntland, and Somaliland, including riverine farmers, agro-pastoralists, pastoralists, and internally displaced populations are the most affected.

On 27 February 2020, the FGS and the Food and Agriculture Organization of United Nations – Somalia (FAO Somalia) released the "Somalia Action Plan for Desert Locust Crisis" that outlined the response, priorities, and targets for desert locust control in Somalia. With funding from USAID/OFDA, FAO Somalia in close collaboration with the FGS and Federal Member State's (FMS) Ministry of Agriculture and Irrigation (MoA&I) has been conducting control operations to prevent the spread of the pests to the Southern grain basket. The control activities are being handled by ground control teams (equipped with knapsack, hand-held, and/or vehicle-mounted sprayers) using biopesticides (Novacrid[â]). Two helicopters were delivered to Somalia on May 14th, 2020, each with the ability to spray 1,000 hectares per day and have commenced spraying. Alongside these control operations, continuous surveillance activities are being carried out by the government, communities, and FAO partners to provide early warning and inform effective operations.

The control operations were managed centrally by the Federal MoA&I, but with close collaboration with the FMS, FAO Somalia, FAO partners, and donors. The federal Minister appointed a National Desert

Locust Control Taskforce with mandate to manage and coordinate all monitoring and control operations by providing necessary resources (including the selection of appropriate pesticide, coordination, and ensuring environmental health and safety). As of 15 May 2020, the FGS, with the direct support of FAO, has sprayed a total of 3,145 hectares. Puntland has reported the treatment of an additional 20,000 hectares. With current forecasts projecting that the desert locust will cause damage across 44 districts within 14 regions of Northern, Central, and Southern Somalia, the control operations will likely extend beyond the first half of 2020 to target hoppers and locusts hatched from eggs laid in May and June.

The Department of Plant Protection is mandated to regulate pesticide registration and use and has enacted several draft legislations on the same. However, this is poorly managed as the legislation is inadequate and the country lacks technical capacity and decision support mechanisms (e.g., laboratories) to monitor the use of pesticides. It was observed that the pesticides used in the control operations were not available in the local market, and they were thus imported and distributed by FAO Somalia. Specific measures were taken to reduce the environmental and human health risks, including the selection of biopesticides; proper training of the control teams and adequate biopesticides management i.e., handling, transportation and storage; systematic use of personal protective equipment; maintenance of buffer zones when spraying; collection and disposal of empty pesticide containers; and continuous monitoring of the efficacy of the operations and impacts on human health and environment. No cases of intoxication of humans or livestock, or incidents or emergencies resulting from the spray campaign, have been reported as of preparation of this report.

Locust Vulnerability Information

Somalia is facing the worst desert locust outbreak in over 25 years, declared a disaster pm 18 November 2019 by the United States Government (USG), and a national emergency on 2 February 2020 by the Federal Government of Somalia (FGS). An estimated 445,000 acres of land has been infested by locust hoppers and breeding adults (USAID 2020), which have damaged agricultural production areas and pasturelands threatening food security and livelihoods in the country.

So far, locust infestations have been confined to the rangeland and grassland areas in Galmudug, Puntland, and Somaliland (Figure 6). Locust breeding and egg-laying have been witnessed in these states and hatching occurred throughout the first half of April. The other states (Hirshabelle, Jubaland, and South West) are monitoring mature egg-laying locusts as well as the formation of new swarms; migratory swarms have been reported in parts of southern Somalia. Rural populations in Galmudug, Puntland, and Somaliland, including riverine farmers, agropastoralists, pastoralists, and internally displaced populations are the most affected.

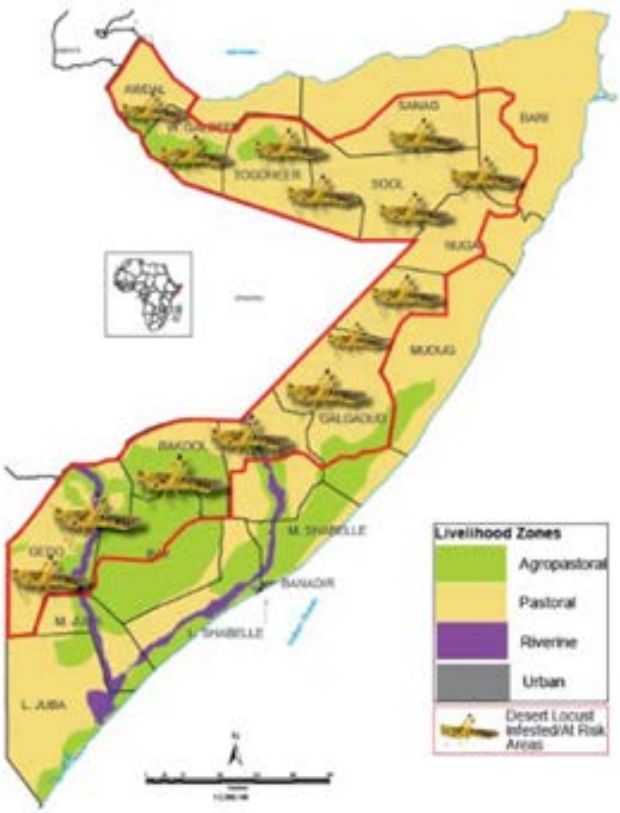


Figure 6: Areas Infested/Likely to be Infested by Desert Locust in Somalia

Source: FAO Somalia Action Plan: Desert Locust Appeal, April 2020

The situation is critical, with the second generation of mature adults laying eggs and a new generation of immature adults forming swarms. According to FAO,

the most likely scenario is that desert locust damage will be confined to a buffer zone along the Somalia-Ethiopia and Somalia-Kenya borders until September 2020; this includes 44 districts within 14 regions of Northern, Central, and Southern Somalia (FAO 2020b). These areas have already experienced or are likely to experience desert locust infestation and upsurge, with breeding sites either confirmed or suspected. These areas fall adjacent to an area where there has been significant desert locust infestation and no adequate control. These areas have also experienced average to above-average levels of rainfall and, given the wet conditions to ensure the availability of suitable vegetation favorable for desert locust breeding, the population could increase 400-fold by June 2020 (FAO 2020a). [2] Based on the current forecast, control operations will likely extend beyond the first half of 2020 to target hoppers and swarms of locusts hatched/developed from eggs laid in May and June.

As a frontline country, Somalia continues to collect and transmit desert locust information to FAO's Global Desert Locust Information Services (DLIS) and receives up to date information on desert locust breeding, outbreaks and impacts from several sources. These sources include

- eLocust3, which is used to collect and transmit DL, weather, and habitat observations during field surveys and is sent to the desert locust Information System (DLIS), which analyzes the information and issues regular bulletins and forecasts and keeps the country informed.
- FEWSNET, which provides regular warnings and analysis on the food security situation in Somalia. In the current locust outbreak, FEWSNET has produced food security outlook reports and alerts, and conducted analysis of the anticipated impacts of the desert locust upsurge and associated control measures.
- The FAO website provides good information on locust situation and control activities.
- USAID's SERVIR supports improved tracking; by combining field data and information from satellite imagery, SERVIR helps decision-makers make informed decisions to save lives and livelihoods in periods of disasters or plan better for unforeseen events such as locust invasion. However, field-level awareness of this source of information is low.

Even with these new tools and sources of information, and technical information and communication provided by FAO, the collection of field data for input into effective control activities remains weak given the current limited capacity of the Ministry at both federal and state levels. As such, continued efforts need to be undertaken to equip and train the national, state and local surveillance teams, especially during the recession period. FAO is strengthening the desert control units by providing technical assistance and, with the MoA&I, organizing international assistance in support of the desert locust control activities.

Locust Surveillance and Response Responsibilities and Coordination Structures

The desert locust emergency response in Somalia is a joint effort of the Federal and State's Ministry of Agriculture and Irrigation (MoA&I) and FAO Somalia, with funding from a number of donors, including USAID OFDA. DLCO-EA is also supporting response in the region. The country's desert locust control units operate from Hargeisa, Garowe, and Dhusamareb as part of the existing plant protection structures and do not have the required operational and financial autonomy. Working in close collaboration with the FMS Ministries, the Federal MoA&I is the lead agency responsible for organizing and coordinating the control campaign, and capacity building and resource mobilization for the desert control operations. It must be noted that currently, the Federal Government of Somalia (FGS) has Puntland, Galmudug, Jubaland, Hirshabelle, and South West as its Federal Member States (FMS), while Somaliland has no interest in being part of the Federation and considers itself an independent country. Table 16 summarizes the roles of the various actors involved in the desert locust control.

TABLE 16: ROLES OF ACTORS INVOLVED IN THE DESERT LOCUST CONTROL ACTIVITIES	
Actor/Institution	**Roles/Responsibilities**
MoA&I	Lead institution in the implementation, coordination, capacity building and resource mobilization for the desert locust control activities
Ministry of Agriculture, FMS	Leads direct implementation within the member states, surveillance and monitoring, sensitization and provision of the field surveillance and control teams.
FAO Somalia	Resourcing, coordination, technical assistance and capacity building, and resource mobilization for the desert locust control activities
Desert Locust Control Taskforce and Technical Committee	Overall technical support and coordination of the field activities, coordination of control and surveillance teams, reporting on control activities.
FAO Somalia partner NGOs	Supporting surveillance activities, collection of data on impacts of livelihoods and provision of livelihood support packages to households in affected areas
Field teams	Ground control, surveillance, community sensitizations and application of pesticides
Communities	Monitoring and reporting on desert locust situation and conduct mechanical control of the DL
USAID/BHA (formerly OFDA) and other donors	Financial support for the control activities

As the control operations were managed centrally, following the declaration of the desert locust emergency, the Federal Minister appointed a National Desert Locust Control Taskforce (including technical experts from the FGS and FMS (except Somaliland) chaired by the FGS Director of Plant Protection). The Taskforce was complemented by a Technical Committee that had the responsibility of managing control operations in the specific areas and that was composed of FAO Somalia experts and the Directors of Plant Protection in the affected states. In Somaliland, the Desert Locust Taskforce has membership in several Ministries, including Agriculture Development (chair), Livestock and Fisheries, and Environment. It also includes the FAO Somalia, World Food Program, representative NGOs from the Somaliland Food Cluster, and Somaliland National Disaster Preparedness and Food Reserve Authority (NADFOR). Figure 7 presents the key responsibilities of the Taskforce.

Figure 6: Responsibilities of the National Desert Control Taskforce

Coordinate desert control activities in collaboration with FAO Somalia;

Work closely with FMS to identify teams to undertake field operations, participate in training on control practices and supervise field control activities;

Facilitate field surveillance activities, community mobilization, and guidance to field teams;

Ensure field compliance with FAO's desert locust guidelines, including adherence to environmental health and safety measures; and

Conduct field reporting of the desert locust operations.

Source: Ministry of Agriculture and Irrigation, Somalia

As indicated earlier, the primary responsibility for the emergency response lies with the Federal Minister for Agriculture and Irrigation[47] who decides when and how teams and pesticides are deployed. Although no cost-benefit analysis of pesticide use was conducted by the government, following consultations with the National Desert Control Taskforce and FAO Somalia, the Minister selected biopesticides as the primary chemical to be used in the locust emergency response, reflecting national sensitivities regarding pesticide safety. The Taskforce works closely with FAO in coordination and provision of technical guidance to the desert locust control and surveillance activities, and mobilization of resources for the response. The respective State Ministries of Agriculture are providing technical teams to conduct control and surveillance, and community mobilization. They also provide storage facilities for pesticides and support logistics for the transport and distribution of pesticides in the field.

Note that the Puntland Federal Sate has made direct investments in procurement of pesticides containing malathion and has carried out control and surveillance activities alongside the FAO Somalia supported activities. the Puntland Federal Sate only applied malathion at a few locations in its territory. (FAO Somalia has noted that the equipment procured under USAID funding will not be used for malathion.)

FAO Somalia supports the government-led response, likewise, procuring pesticides, equipment, and facilitating field logistics. It simultaneously supports the development of governmental and stakeholder capacity to safely and effectively carry out control operations in 2020 and beyond. The capacity for ground control has been strengthened with the purchase of land cruisers and vehicle-mounted sprayers. Two (2) helicopters have been hired by FAO Somalia and mobilized to carry out aerial surveillance and locust control operations. The multilateral assistance provided through FAO has been funded by the following donors: United States Government, Germany, European Commission, United Kingdom, Denmark, Netherlands, Switzerland, Sweden, Canada, and Belgium. In Somaliland, desert locust operations are also supported by World Vision in Odweyne region in Somaliland.

Surveillance efforts are being conducted by the Ministry, which works closely with the FAO Desert Locust information services, including both the Food Security and Nutrition Analysis Unit (FSNAU) and the Somalia Water and Land Information Management (SWALIM) project teams. Several FAO partner NGOs are also engaged in the surveillance efforts that are feeding into FAO desert locust early warning system; local partners and community members are providing information on desert locust sightings in area rangelands and pasturelands. For example, in Adado (Galmudug State), local community members have formed the Desert Locust Control Committee which is engaged in the community mobilization in the surveillance and mechanical control (using noise and smoke) of the migratory swarms in their area.

[47] In Somaliland, the primary responsibility lies with the Minister for Agriculture Development.

Consultations indicated that there has been limited private sector involvement in locust response in Somalia.

The brand of biopesticide deployed for desert control operations are Novacridâ and were imported and supplied to the Ministry by FAO Somalia. So far, 2 tons of biopesticides were delivered to Somalia (out of 4 tons procured) and a further 8 tons are being processed. From FAO Somalia, the biopesticides are shipped to logistics bases in Mogadishu and Hargeisa from which they are distributed to field stores (owned by the Ministry) where the locust control team can access them. (The procurement of malathion for its limited use by the Federal State of Puntland is not included in these statistics.)

The control activities are being handled by ground control teams (knapsack and hand-held, and vehicle-mounted sprayers) using biopesticides. As of May 15th, 2020, the Government, with the direct support of FAO, has sprayed a total of 3,145 hectares. Puntland has reported the treatment of an additional 20,000 hectares (FAO 2020c). According to FAO Somalia, the plan is to scale up the surveillance, monitoring, and control, and enhance the local capacity to carry out the desert locust operations. Operations are expected to increase with the new season of breeding; the surveillance and control teams will be increased. Two helicopters delivered to support survey operations will be deployed to ensure identification of remote breeding areas and continued spraying. Alongside these activities, livelihood support packages, including livelihood inputs and services for farming households and rangeland cubes[48] to supplement scarce feed resources in locust affected pastoral areas are being delivered.

Coordination structures were established both at the national and regional level and a National Action Plan for Desert Locust Control developed. However, the country did not have a contingency plan to address desert locust control effectively and did not have emergency funds for control operations. At the national level, the Taskforce was the coordinating structure for the formal and informal actors engaged in the emergency response. The stakeholders observed that the Taskforce and Technical committees met regularly (once a week) and there was excellent coordination between the FGS and FMS (and even Somaliland). Regionally, cooperation in desert locust control efforts exists between the member states of the Regional Commission for Desert Locust Control, with member states meeting regularly to monitor the desert locust situation and promote overall coordination across the different countries. FAO continues to provide the Ministries of Agriculture in the region with technical assistance to support improved policies, control strategies, and information on desert locust management.

Pesticide Regulatory System and Safer Use Capacity

The Department of Plant Protection in the MoA&I is, among other functions (Figure 8), mandated to manage the implementation and enforcement of the regulations governing pesticide registration and use. However, in practice this is poorly managed as the legislation is inadequate and the country lacks technical capacity and decision support mechanisms (e.g., laboratories) to effectively monitor the quality and use of the pesticides. Nevertheless, several draft legislations, including a draft Plant Protection and Quarantine Law, 2019 and draft Agricultural Chemicals Control Law, 2019 were discussed at the cabinet level, but are yet to discussed and passed by the Parliament. Somaliland has enacted an Environmental Management Act that contains Articles on the Standards of Pesticides and Toxic Substances and the Application for Registration of Pesticides and Toxic Substances, as well as the establishment of the Somaliland Environmental Management Authority.

[48] Rangeland cubes are compressed animal feed supplement designed for ruminant livestock.

Figure 7: The Functions of Plant Protection Department

1. Monitor pests and diseases through survey and control of migratory pests;
2. Implement agro-chemical regulations;
3. Provide measures to reduce post-harvest and storage losses;
4. Provide technical support to farmers and extension staff on the management of crop pests and diseases; and
5. Facilitate safeguarding of plant health by regulating importation and export of plants and plant products by the issuance of phytosanitary certificates and import permits to control the sale, use, and disposal of agricultural pesticides and fertilizers.

Source: Ministry of Agriculture and Irrigation, Somalia

Both Malathion and Novacrid were not available in the local market, and they were thus imported and distributed by FAO Somalia. There are many companies engaged in the importation of pesticides and fertilizer. Though pesticide imports have increased and there is a substantial increase in the use of chemicals, there is no list of registered or approved pesticides for crop use or locust control. Nevertheless, some imported agrochemicals, originating primarily from China, India, Jordan, Pakistan, and Kenya, were available to procure from large agrochemical dealers in Mogadishu and other larger towns, as well as retail shops in rural areas. These actors have limited training in the use and application of pesticides, and with limited quality control and regulation of imports of pesticides, fake and counterfeit pesticides were available in the market. Somaliland has published its list of registered or approved pesticides for use in the region, though enforcement and control are issues of concern.

FAO Somalia provided an adequate number of application agents/sprayers, quantities of pesticides, and provided technical advice, and assistance and PPE. Safe pesticide management is a core component of control activities and FAO has developed *Desert Control Guidelines: Safety and Environmental Precautions* for use by organizations and institutions engaged in desert locust survey and control. The control and surveillance teams were trained on various themes linked to locust control, including desert locust control operations, safe pesticide handling, proper storage and disposal of used pesticide containers and PPE, and environmental monitoring. Based on FAO's technical advice, the used pesticide containers and contaminated equipment and PPE are burned and buried in safe areas under the oversight of the Taskforce.

Other Key Response Capacities

Somalia is a frontline country in desert locust control and even with limited capacities, it has made commitments and has staff (in the Department of Plant Protection) engaged in locust control. As a member of the Regional Commission for Desert Locust Control, it continues to participate in the high-level desert locust emergency consultative meetings. During the outbreak, the Ministry extension staff and surveillance teams conducted sensitization of the communities, who also participated in early detection and reporting of the locusts and their mechanical control.

Research activities related to desert locust have not been conducted thus far. Nevertheless, the country continues to monitor locust situation and continues transmitting data to DLIS. In Puntland, the Department of Environment within the Ministry of Agriculture has conducted environmental impact assessments of the desert locust operations.

Strengths, Gaps, and Constraints to Effective Locust Control

As indicated earlier, the country's desert locust control units operate from Hargeisa, Garowe, and Dhusamareb. Control campaigns and their operations are in breeding areas in Galmudug, Puntland, and Somaliland given the relative access and presence of hopper bands, as well as supporting government authorities. The control units are supported by FAO and are equipped with 5 eLocust3 tablets (2 in Somaliland, 2 in Puntland, and 1 in Galmudug). In each of the regions, surveillance by teams from the Ministry, partner NGOs, and communities. The information from eLocust3 is used to assess the current situation and forecast its development and, once verified by staff from the MoA&I, the information is then passed to FAO's DLIS.

The distribution, storage, use, and disposal of pesticides is managed by the Taskforce with technical support from FAO, and following the FAO's *DL Guidelines* on safety and environmental precautions (FAO (Valk, H. van der; Everts, J.W.) 2003). While the procurement of pesticides and logistics for field transportation was facilitated by FAO, the storage was provided by the MoA&I and the FMS. Some of the storage facilities were not adequately designed, but as the pesticides were dispatched for field use within a relatively short period of time, potential environmental and social risks were considered to be low. Furthermore, the central storage facilities were managed by FAO and were designed and managed appropriately. The transportation teams were trained and sensitized on safe and proper transport of the acquired pesticides and were likewise provided with appropriate PPE. Proper inventory was kept in the stores with proper stock movement checklists and forms tracking pesticide movements in and out of the stores, first in / first out inventory management of the stocks and use of proper equipment in the stores.

In the field, the teams adhered to safe application of the pesticides and disposal of empty/used containers and contaminated PPE. The containers and PPE were not given to the community, but crushed, burned, and buried on site. The public was also informed about the possible environmental and health effects of the pesticides before and after locust control operations by the surveillance and control teams. While the communities conducted mechanical control of locusts, they were not involved in the spraying operations. During the spray operations, the teams monitored the operations, collecting data on the spray activities, including location, pesticide data, and weather situation during the spraying, using FAO's spray monitoring forms. In addition, they observed whether the pesticide and the spraying were effective. It is anticipated that a dedicated operational monitoring and post-campaign assessment will be conducted.

According to the control teams, the instances of pesticides contamination were minimal, and the teams reported that they adhered to the necessary safety procedures. For example, the use of protective clothing was strictly adhered to and efforts were made to build awareness concerning environmental and health hazards. No incidents or emergencies resulting from the spray campaign have been reported thus far. As the operations were ongoing, it was difficult to get the estimate of remaining pesticide stocks that will need to be disposed of at the end of the control operations. However, considering that FAO had the capacity to transfer certain amounts of pesticide from one country to another in the region, the risk of accumulation of a large amount of pesticides that would later become obsolete in the country has been considered low.

There were several challenges the pest control campaign and its operators faced. Due to the insufficiency of human, material, and financial resources, the country lacks adequately resourced autonomous national desert locust control units and the means to start a campaign. It also lacks plant inspectorate services and has no enforcement at major ports, among local storage facilities, and at local markets. With limited staffing and poor training of the existing staff, the operations are associated with reduced survey and control efficacy and safety. (as compared to the ideal) It must be noted that the desert locust breeding areas are located in the vast and remote areas within the infested regions. Insecurity, conflicts, and access constraints have prevented technical experts from conducting comprehensive surveillance activities in these areas. Further, movement of personnel, equipment, and logistics are hindered by the current movement restrictions resulting from the COVID–19 pandemic.

There are also institutional challenges to effective response and coordination. At both the federal and state levels, there has been limited involvement of the Ministry of Health in monitoring health impacts on populations; overall, health systems across Somalia are weak with limited coverage of rural areas, and the existing capacities have been focused on managing the response to the COVID–19 pandemic. The institutional set up for the Ministries at federal and state levels are different. For example, because the environmental agencies in Puntland and in the Federal Government are located within ministries and departments directly implicated in the locust control effort, they have been involved. Otherwise, the government environmental agencies are located outside of the institutions implementing locust control and could not readily engage. In Puntland, because its environmental agency is located in the Directorate implementing locust control activities, agency staff conducted environmental impact assessments. In Somaliland, the Ministry of Environment representative is a member of the National Desert Locust Taskforce and plans to participate in monitoring the impacts on the environment.

Even with the above gaps, Somalia has a small team of personnel competent in plant protection. It must be noted that Somalia's FMS are not equal in terms of existence, capacities, and power status. For example, the self-governing and well-established regions of Somaliland and Puntland have well established Ministries with infrastructure, human resources, and budgets and are therefore able to make a larger contribution and take more responsibilities in the emergency response. The country has also developed draft legislation to regulate and control the importation and use of pesticides.

Key areas of needed support include strengthening the current response, as well as the national capacity and preparedness before the start of the *Gu* rains. A Desert Locust Contingency Plan that outlines actions to accelerate control efforts, including strengthening ground control and introducing aerial spraying in areas where large swarms exceed the capacity of ground control. Also, as the county starts undertaking aerial spraying, support will be needed in conducting a detailed environment, health, and safety impact assessment. In addition to the direct support to the rapid response, interventions are also needed to support the livelihoods of farmers and pastoralists to ensure that they have the cash to meet their immediate food needs and inputs to restart production. In terms of coordinating the response, there is a need to support the regional partnerships and collaboration, support rapid surge support, and strengthen national-level coordination of the emergency response.

As preventive control activities during calm (recession) periods remains an issue of high concern in Somalia, Somalia will need support in strengthening its desert locust control system, including strengthening its Desert Locust Control Centers, increasing staffing (including the number of certified Desert Locust Information Officers (DLIOs) and field scouts) and surveillance vehicles and equipment, expanding pesticide storage capacities, among other resource needs for desert locust surveillance and control. As the country rebuilds key institutions, Somalia will need to become a party to the key charter for international standards for phytosanitary standards, including World Trade Organization's Sanitary and Phytosanitary Agreement and International Plant Protection Conventions, as well as developing required legislations, infrastructure, and human capacities to comply with these conventions and standards.

Particular Environmental or Human Health Concerns Presented by Spraying for Locust Control, Particularly Wide-area Spraying

A key component of the desert locust operation is an assessment of the effectiveness and safety of the operations, and specific measures to reduce human and environmental risks. To start with, the environmental and human health risks in Somalia were managed by the selection of highly specific biopesticides, rather than the use of chemical pesticides that present more widespread concerns. (Only in Puntland has a chemical pesticide, malathion been used, in a limited manner.) Besides, as the initial

operations only involved the use of knapsack/hand spraying and vehicle-mounted sprayers, they were less widespread than aerial spraying.[49] Other measures to reduce the human and environmental risks included:

- Training of the desert control teams on the field operations as well as the use of equipment, management and safe disposal of biopesticide containers and contaminated PPEs and related facilities;
- Adequate pesticide management (i.e., handling, transportation and storage);
- Community engagement and mobilization, and feedback to the teams;
- The systematic use of PPE by the teams engaged in spraying;
- Maintenance of buffer zones when spraying water sources and livestock grazing areas;
- Collection and disposal of empty pesticide containers by burning and burying in safe areas;
- Continuous monitoring of the efficacy of the operations and impacts on human health and environment.

As for the consumption of desert locust, though considered halal (permitted to be consumed), the consumption of desert locust is very limited. Further, during community mobilizations, populations were sensitized beforehand against the consumption of locust in the sprayed areas. No cases of intoxication of humans or livestock have been reported thus far.

[49] So far, 2 helicopters were mobilized and are supporting surveillance operations and conducting aerial spraying.

ANNEX B. PROCESS FOR AMENDING THIS PEA FOR ADDITIONAL GEOGRAPHIC SCOPE

As noted in Section 2, this PEA:

- anticipates amendment to add additional countries/geographies beyond Ethiopia, Somalia and Kenya, as needs may arise under the current East Africa outbreak or future outbreaks.
- It is applicable to potential future support to desert locust control by USAID operating units other than BHA, subject (1) to the approval of the cognizant mission director/Washington equivalent; the BHA BEO, and the cognizant BEO for the subject mission/operating unit/activity; and (2) that any necessary amendment for geographic scope is carried out.

This Annex describes the process and requirements for an amendment to add a new country/geography, as follows:

1. Contact the regional environmental advisor (REA), regional BEO, and BHA Bureau Environmental Officer to advise them of the need and intent to amend, and so that they may confirm, revise and/or clarify the content of this Annex.
2. Via a combination of desk research, expert knowledge, and consultations with key actors, develop country information with the format and scope presented in Annex A. This will constitute one section of the amendment.
3. Review and confirm, with assistance and guidance from the BEO and REA as may be indicated, that no country conditions exist that would exclude any AIs from the approved list. Document this analysis as Section 2 of the amendment.
4. If the amendment is for a specific activity, describe this activity, its consistency with the elements of effective desert locust control practice enumerated in Section 3.3, and how the actors engaged and actions supported map to the key stakeholders, coordination mechanisms, and strengths and gaps enumerated in the country information developed under #2, above
5. Package an amendment, using an appropriately modified form of the approval sheet for this PEA. The signatures of the cognizant mission director/Washington equivalent; the DCHA BEO, and the cognizant BEO for the subject mission/operating unit/activity will be required.

ANNEX C. UNDERSTANDING OF EFFECTIVE, RESPONSIBLE PRACTICE FOR DESERT LOCUST RESPONSE AND CONTROL

Experience with desert locust response and control over the past several decades has resulted in a widely held understanding of the essential elements of effective practice, of which pesticidal control actions—both aerial and ground-based[50]—are one aspect. This Annex is the basis for the summary presentation of this topic in Section 3.3. It is a synthesis of relevant FAO resources,[51] selected other resources,[52] and stakeholder consultations conducted for this PEA, summarizes this understanding.

WHAT WORKS: THE KEY ELEMENTS OF EFFECTIVE, RESPONSIBLE PRACTICE FOR DESERT LOCUST RESPONSE AND CONTROL

1. Surveillance-based Prevention: Preventing Upsurges with Surveillance Informed by Forecasting for Quick, Targeted Control Actions. Ongoing desert locust surveillance, forecasting and reporting is undertaken on-ongoing basis**.** FAO and partners undertake the following activities:

- Establishing and staffing early warning systems responsible for collating, managing and analyzing data received from field teams to provide information to decision makers in a timely manner on a regular basis
- Utilize satellite imagery, weather monitoring, and remote sensing to identify Desert Locust breeding areas for immediate survey and control operations.
- Establishing international, national, regional and local reporting networks and including on the ground input from local extension, landowners, farmers and general population in monitoring and reporting
- Developing, introducing and utilizing innovative technologies and tools for early detection based on (1) processing of survey data with geographical information systems (GIS), (2) survey and application techniques using global positioning systems (GPS).
- Monitoring weather, wind trajectories, ecological conditions and the locust situation.
- Monitoring vegetation, rainfall and soil moisture in potential seasonal breeding areas to delimit areas which are suitable for breeding in a specific season (using aerial and ground survey, satellite imagery, weather reports and information from local inhabitants).
- Mapping potential habitats via satellite imagery, soil moisture monitoring, soil type maps, and weather monitoring.

2. Preparedness for Adequate Response if Upsurge Prevention Measures Fail. FAO conducts a host of activities in order to be prepared for control of desert locust. These include:

- **Maintaining an organizational network.** FAO maintains an organizational network at headquarters and regional level and dedicates resources to prevention and control of locust outbreaks, upsurge and plagues. These networks collaborate with the National Locust Control Units (NLCUs) and partner governments.

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[50] See *FAO Desert Locust Guidelines,* Chapter 4 "Control" for description of common control actions. (Description in 3.4, on-links provided.)

[51] Specifically, the FAO Desert Locust Guidelines, FAO SOPs, FAO Technical Series, FAO Post Campaign Evaluation Reports, FAO Contingency Planning Guide, FAO Practical Guidelines on Pesticide Risk Reduction for Locust Control for Caucuses and Central Asia, FAO brochures, mainly Human Health and Environmental Safety in Desert Locust Control Operations

[52] Principally the 1989 USAID PEA

- **Maintaining FAO engagement.** Locusts and Transboundary Plant Pests and Diseases Group (AGPMM) at FAO headquarters in Rome and FAO committees, commissions and regional organizations provide ongoing support for preventing and managing locust emergencies.
- **Ongoing capacity building, training, developing guidelines and manuals, awareness building and communications**. FAO targets its capacity development support at individual, organization and policy level. It brings together participants from different countries, Ministries, research institutions, civil society organizations for activities such as workshops and training. In East Africa FAO conducts training on desert locust control and surveillance as part of an action plan to boost government capacity to conduct desert locust control campaigns. FAO engages experts and specialists and publishes numerous materials, manuals, brochures, informational bulletins, and guidelines including guidelines on protection of human health and environment during locust campaigns. In partner countries FAO is establishing, developing, staffing and building capacity of coordination and decision-making institutions and mechanisms, providing expert advice and engaging experts and leaders.
- **Ongoing locust control research and introduction of new technologies.** Ongoing development of technologies and solutions for better detection and control are being explored and continuously introduced. FAO is promoting biological control agents and is looking into use of biological options in addition to *Metarhizium* such as microsporidian *Nosema locustae* and the hymenopteran egg parasitoids *Scelio spp.* that are still under development.
- **Selection of appropriate insecticide and application methods**. FAO established the Pesticide Referee Group (PRG) as an independent body of experts that advises FAO on the efficacy and environmental impact of pesticides. The resulting advice systematically lists pesticides suitable for locust control from the scientific point of view and supports pesticide selection decisions. PRG evaluates data on pesticide testing for efficacy and impact on non-target organisms and assists with pre-selection of least toxic pesticides that minimize pesticide exposures of people and the environment.
- **Contingency planning.** FAO provides partner countries with guidelines, technical support and advice for contingency planning.
- **Preparing for contingencies.** To be prepared for contingencies partner countries are working on:
    - Maintaining the necessary level of resources including infrastructure (roads, communications, warehouses), machinery and equipment (planes, cars, sprayers), and access to inventories (pesticides, PPE)
    - Building capacity in safe pesticide handling including logistics (transporting, storing, handling), applications (mixing, applying, clean up) and management (monitoring operators, recording pesticide use)
    - Establishing SOPs for mobilization in case of emergency
    - Establishing incident (e.g., accidents, spills, theft) reporting procedures
    - Establishing public announcement systems and channels of communication for mobilizing communities for awareness building about measures for avoiding exposure to pesticides, communicating procedures in case of medical emergency, recruitment and engagement of community members for conducting surveillance activities, promoting non-chemical control method, locust harvesting prior to spray campaign, announcement of spray operations, not consuming locust after spraying, observing pre-harvest intervals and withholding periods and all other relevant communications

- Aligning formal and informal public health networks to address potential adverse impacts of pesticides to be used during locust control campaigns, including training communities in recognizing symptoms of pesticide poisoning, administering first aid, maintaining stocks of necessary medical supplies (e.g., atropine) and conducting follow on epidemiological monitoring
- Building capacity government and non-government environmental management networks to monitor, sample, test and biomonitor impacts of pesticides on water, sediment, soil and biota
- Building capacity to manage hazardous and non-hazardous waste, including left over pesticide stocks and disposal and recycling of pesticide containers.

3. **Response:** Implement effective, efficient and safe controls.

- **Activating contingency plans.** In response to upsurge warning FAO and partner countries coordinate activities and communicate with stakeholders for engagement and mobilizing funds and resources while maintaining ongoing surveillance and forecasting of locust movements.
- **Establishing collaboration and communication channels with national governments and stakeholders and mobilizing resources.** Locust survey and control are primarily the responsibility of national Ministries of Agriculture in affected countries. FAO is working with the governments of affected countries at the national and sub-national levels, as well as with partners and stakeholders in the region to mobilize international funding to support the deployment of experts and procure equipment (FAO 2020d).
- **Establishing supply chains and managing procurement and logistics.** An integral part of the campaign is managing the supply chain and making available appropriate well-calibrated, well-functioning spray/delivery equipment, particularly ULV, and appropriate PPE and ordering as needed pesticides in appropriate amounts and quality**.**
- **Engaging communities.** Mobilizing communities and establishing communications channels for ground surveying, monitoring and reporting, implementation of non-chemical pest control measures, awareness raising of local populations, including on moving out of areas of aerial applications, withholding and re-entry periods for humans and livestock, pre-harvest intervals, not consuming sprayed locust, and no reuse of empty containers.
- **Mitigating potential adverse impacts of pesticides.** Implementation of campaign with consideration for human and environmental safety requires adoption of appropriate behaviors and specific measures during control operations including:
    - Systematic use PPE by staff involved in control operations and pesticide management;
    - Well-trained staff carrying out control operations in accordance with best practices, following pesticide label instructions and using properly calibrated sprayers
    - Use of updated and efficient techniques (such as barrier treatments and ULV) as well as less environmentally hazardous pesticides, in particular alternatives to conventional pesticides (i.e., IGRs and biopesticides), and formulations (such ready-to-use ones);
    - Site characterization to ascertain appropriate pesticides and exclusion zones
    - Planning and managing operations to achieve optimal effective results with minimal rates and duration of exposure to non-target organisms and smallest possible area coverage
    - Respect of protected areas and buffer zones;
    - Managing pesticide drift;

- Following FAO's *DL Guidelines*, SOPs and best practices for safe storing, transporting, handling, mixing and applying pesticides aerially and on the ground
- Ensuring safe disposal and/or recycling of pesticide containers and other campaign generated waste (FAO n.d., e)
- Training all staff responsible for using pesticides in pesticide poisoning symptoms, first aid and emergency procedures
- Conducting baseline and ongoing health checks for all personnel handling pesticides

- **Monitoring pesticide use, mitigation measures and impacts.** Pesticide control actions must be carefully monitored for safety including oversight for transport, storage, mixing, handling, and safe cleaning of pesticide equipment and containers. Both aerial and ground applications need to be monitored for safety, quality and efficacy of control actions.
- **Maintaining records of pesticide use.** A consistent record of pesticide use needs to be kept particularly when using aircraft. It may not be possible to fill in everything on every occasion, but as much as possible should be completed each time. Date, the type of target, the aircraft and the insecticide used are important details. A similar record should be kept for block hopper band ground control. With individual hopper band spraying, a daily record should be kept of the number of bands treated and the insecticide used (NRI 1990).
- **Establishing disposal and waste management procedures.** Sound procedures for cleaning pesticide contaminated equipment and properly disposing of empty containers by drums crushing, recycling or return to manufacturers and ensuring proper disposal of leftover pesticides is required to prevent contamination.
- **Engaging public health authorities.** Authorities responsible for public health can support medical checkups for staff, establishing health emergency procedures and a reporting hotline, training in first aid, ensuring health clinic preparedness for emergencies including recognition of potential symptoms, AChE testing capability and ensuring availability of atropine at clinics where organophosphates are used.
- **Conducting post campaign assessments.** Much can be learned from conducting human health and environmental impact assessments after the campaign based on records of volumes and locations of pesticide use, testing for pesticide residues in soil and water and conducting epidemiological studies and biomonitoring programs designed to monitor chemical exposure levels to identify specific chemicals and communities of concern and making results of research clear and visible.

All of the above together make possible control campaigns that deliver the right amounts of the right pesticides and at the right time, consistent with a strategy focused on early control, and with adverse impacts to Environment, Health and Safety minimized and monitored.

WHAT DOESN'T WORK: KNOWN FAILURE MODES AND CRITICAL GAPS LEADING TO INEFFECTIVE CONTROL AND/OR ELEVATED EHS RISKS.

1. Failing to Prevent an Upsurge.

- **Predictive systems and forecasts have limits.** There is a consensus that being proactive and preventive and not reactive and curative is a determining factor in the fight against desert locust., Monitoring locust breeding areas can be difficult as many of the areas impacted by locusts are located in remote areas or are in areas inaccessible due to border disputes and lack of security. However, it should be noted that current satellite imaging technology allows for the

identification of areas which may have a high probability of supporting significant locust breeding and possible gregarization.

- **Detection lapses can unfold despite FAO efforts.** As occurred in 2018, an outbreak in remote deserts of Oman went undetected despite advanced models and forecasts. Once locust swarms formed, there was limited capability to control them. Technologies cannot replace scouting in remote locations, but poor access and security issues make human scouting difficult. Once an outbreak has passed a certain threshold, it becomes very difficult to stop by spraying the swarms.
- **Warnings not heeded in a timely manner.** Reportedly, most of the sub-region's second-generation leaders do not have first-hand memory and experience with desert locust, and therefore there was a delayed reaction to FAO warnings. FAO 2004-2005 campaign evaluation reports suggested establishing more clear categories for emergencies.
- **Engaging grassroots stakeholders in predictive monitoring was limited.** Farmers and nomads that are closest to locations where outbreaks occur are commonly not engaged in predictive monitoring. Monitoring without effective scouting on the ground has only limited value as demonstrated by this upsurge. Farmers need access to surveillance technology to enable them to monitor pests and forecast potential outbreaks and infestations that can be tracked and managed effectively. Monitoring and prevention feedback loops with on-the-ground monitoring were not established and tested in advance.

2. Inadequate Preparedness. Ability to mobilize quickly is hindered by poor preparedness and capacity:

Insufficient planning for contingency. Some countries did not carry out routine pest inspections, did not develop locust control contingency plans and did not establish invasive insect species task forces, councils, committees and advisory groups to provide expertise and guidance on how to prepare for and tackle insect invasions when these happen (Ngumbi 2020).

As was noted by evaluators after previous campaigns, there is a general tendency to allow survey and control capacity in locust-affected countries to deteriorate during the locust recession period. In addition, some countries and areas have experience and others are not well prepared as they have not traditionally faced upsurge of locust. Contingency plans that are prepared may be too general and lack detail for mobilization and operating procedures.

Some countries have no permanent locust control units that monitor weather and environmental conditions and carry out regular surveys when conditions are right for breeding. Inventories of critical equipment are low and there is limited human resources capacity to respond to outbreaks and especially to an upsurge.

- **Limited consultative process.** Reportedly, in some instances leading decision makers did not sufficiently encourage proactive engagement of knowledgeable experts in planning and control.
- **Limited capacity and resources.** According to FAO post campaign evaluation reports, in many instances, the existing strategy of preventive control does not function well for reasons of limited capacity and resources such as:
    - Lack of basic infrastructure including roads, communications, storage facilities, running water and electricity hindered access to some important breeding areas, mobilization and implementation.
    - Insufficient or inappropriate pesticide stocks and application equipment including planes, sprayers, cars, etc.

- Although FAO encourages only properly trained and equipped teams to undertake control operations and not communities or farmers, given the limited number of trained specialists, issues are encountered due to inexperience of the field survey teams and campaign organizers, or lack of understanding of ultra-low volume spraying.

3. Implementation Constraints.

- **External constraints.** Rainy season, working in remote locations with poor access to communications, utilities, infrastructure and services, and sometimes under conditions of poor security makes implementation very challenging.
- **COVID-related emergency.** Social isolation measures and teleworking requirements of UN agencies are posing challenges and creating delays. Travel bans and airport closures create some limits in placing experts. Disruptions in supply chains cause delays for the manufacture of pesticides and supply of equipment (FAO 2020d).
- **Potential organizational constraints.** FAO has a complex central, regional and local organizational structures and recommends delegation of unified command authority to ECLO. However, FAO also speaks of responsibility of local governments to implement the campaign. Considering reports of delayed response, It is not clear whether preparedness and implementation of the campaign suffers from lack of clarity of delineations of authority and responsibility among various implementing partners. Situations where those with authority are unable or will not take on the responsibility and/or those with responsibility don't feel that they have the authority to act can create organizational confusion and difficulties.
- **Limiting engagement of stakeholders in decision making.** Several reports noted that solutions are sought only at official Ministry officials level. Lack of input and participation from stakeholders and beneficiaries in decision making results in lack of local ownership. Although participatory procedures are very difficult in emergency situations, beneficiaries are also excluded during planning. To develop solutions, strategic cross-sectoral engagement of stakeholders and beneficiaries including farmers and nomads.
- **Falling behind.** Resources are being allocated to rebuild or create planning, coordination and decision-making mechanisms and to implement training to augment capacity, but as the upsurge is already in progress, there is limited real time opportunity.
- **Inadequate supplies of least toxic pesticides and appropriate equipment.** Numerous constraints may prevent availability of least toxic pesticide necessary for the campaign including registration status of appropriate pesticide, low stocks, high costs and/or supply chain logistics constraints.
- **Misapplication of pesticides.** Using untrained and inexperienced staff can result in mishandling and misapplication of pesticides, increased pesticide usage and higher application costs, and a waste of product and can lead to increased occupational, consumer, and bystander risks, as well as environmental risks including environmental contamination and adverse impacts to non-target organisms.
- **Not mapping ecologically sensitive areas.** Ecologically sensitive areas may be adversely impacted by spraying or drifts if not properly identified. All areas in the country that are ecologically and agronomically important or particularly sensitive to insecticides should be identified and mapped. For those sensitive areas where control operations may take place, locust management options should be evaluated, based on the type of organisms at risk and the likely locust targets that could appear in the area (FAO 2019). Indiscriminate application of pesticides without mapping ecologically sensitive systems, not maintaining buffers, not managing

drifts, repeat applications of toxic pesticides over large areas can adversely impact non-target organisms and contaminate the environment.

- **Limited experience and lack of conditions conducive for use of biopesticides.** The application of Metarhizium requires specific capability with respect to storage of the spores, mixing of the spray formulation, monitoring of efficacy and cleaning of equipment. While not overly complicated, the FAO's Pesticide Referee Group (PRG) recommends that spray teams applying Metarhizium are specially trained and supervised to ensure optimal efficacy of this biopesticide. The PRG review of environmental impact of spraying biopesticides formulated with mineral oils was limited.
- **Limited occupational risk mitigation capacity.** Limited capacity of hazard mitigation and monitoring systems make the requirements for safer use of pesticides difficult to implement. These limitations may include shortage of PPE, inadequate time for training, shortage of well-trained staff, lack of needed least toxic pesticide products and means and conditions for their safe handling, application and end of the day clean up.
- **Limited capacity for mitigation of risk to bystanders and consumers.** Potential risk to communities can result from exposure due to proximity of residences to agricultural fields if early warning is not provided to communities to vacate and move their livestock before aerial spraying is conducted. If communities are not forewarned, sprayed locust may be gathered and consumed. Potential risk to consumers may also result if sprayed crops are harvested without maintaining pre-harvest intervals or animal products are consumed without maintaining withholding intervals.
- **Limited capacity for monitoring all risk mitigation activities.** Demands and pressures of the campaign may make it difficult to monitor operations and end of the day clean ups, efficacy of treatment, implementation of environmental and health mitigation measures as well as to accurately monitor amounts of pesticide use and locations and areas of pesticide coverage.
- **Limited capacity for community engagement, mobilization, awareness building, information dissemination.** Community engagement, keeping communities informed and establishing channels of communication for community cooperation and feedback is important for many aspects of locust monitoring and control, but can be complex, labor intensive and time consuming. The mobile ground teams whose job it is to keep tabs on locust populations have to reach some of the world's remotest, hottest and sometimes (for environmental and security reasons) most hostile places (Team Makao 2020). Thus it was previously suggested that engaging farmers and nomads in scouting and establishing channels of communications and hotlines for reporting findings can help with locust monitoring. Community informational networks can help disseminate early warning to communities, act as channels for awareness about hazards and safe behaviors.
- **Not coordinating closely with health authorities.** Health authorities can be instrumental in mitigation of pesticide health risks by building awareness among spray operators and the general public about pesticide health risks, pesticide poisoning symptoms and first aid measures, maintaining used pesticide safety data sheets, developing and communicating emergency response procedures to the health clinics and the general public, and stocking health clinics with necessary medical supplies.
- **Limited capacity and resources for conducting health monitoring.** Health authorities can also be instrumental in conducting health checkups and baseline evaluations, and monitoring staff and where necessary general public insecticide exposure. However, health authorities may also have limited capacity and resources to address short and long-term adverse impacts on

human health and conduct testing and biomonitoring and conduct post campaign epidemiological studies.

- **Limited capacity and resources for conducting environmental monitoring.** There may be limited capacity of the environmental management authorities to ensure that ecologically sensitive areas, such as wildlife habitats, or bee foraging areas are not sprayed with toxic pesticides and limited capacity to monitor ecological impacts of pesticide use on the environment and non-target organisms during and post campaign.
- **Lacking capacity for waste management and disposal of excess pesticides.** National governments often lack the capacity to properly dispose of pesticide contaminated items and unused pesticides. Methods such as burning, burying, chemical treatments and landfilling, without adequate knowledge, supervision and experience of experts and appropriate facilities should not be undertaken. The consequences of improper disposal can be hazardous and expensive. Expert advice is needed to comply with strict international guidelines for disposal.

4. Overlooked Recommendations from Previous Campaign Reports. The Desert Locust plague of 1986-89 and the subsequent upsurges in the 1990s demonstrate its continuing capacity to threaten agriculture and food security over large parts of Africa, the Near East and southwest Asia. The FAO post campaign evaluation reports pointed out that in many instances, the existing preventive controls did not function well, but had limited information about campaign implementation and post campaign monitoring. Some highlights from these reports included:

- **Not following through with PRG recommendations.** The last PRG meeting report is from 2014 and information about efficacy of pesticides has not been presented since. The prior 2004 and the 2014 PRG reports recommended further exploring and testing use of Spinoteram and Chlorantranilprole, as well as combination of fenitrothion and esfenvalerate. As additional data and information about pesticides effectiveness is submitted it is important to conduct additional research.
- **Not providing clarity on how resources are being spent**. Large funds are being spent on satellite imagery, remote sensing, platforms and IT technology to improve prevention capacity that avoid plague development. However, the core business of locust control still depends on organization and logistics of controlling swarms. During upsurges it is very common for FAO and affected countries to request funds for buying pesticides and survey and application equipment however it is not always indicated how the requested funds will be used (Vreysen, Robinson and Hendrichs 2007).
- **Environmental and health impacts of former campaigns not articulated.** FAO's *DL Guidelines* articulate human health and environmental mitigation measures and FAO conducted numerous post campaign environmental studies. However, information about environmental and human health impacts of previous locust campaigns are not articulated to the general public.
- **Economic evaluation of Desert Locust management interventions not conducted.** Suggestion to evaluate proposed Desert Locust control measures for cost effectiveness and resource allocation, were not explored (Hardeweg 2001) (FAO 1997). An example of such study would be comparing the total expenditure on locust control by all parties to the overall benefits likely to be generated through the control campaign—by estimating the value of damage to agriculture that could have occurred in the absence of control and cost of providing food aid to affected communities (Millist and Abdalla 2011).

ANNEX D. REVIEW OF THE 2014 FAO PRG REPORT

This Annex reviews the 2014 FAO Pesticide Referee Group (PRG) report with particular respect to how the report addresses environment, health, and safety (EHS) concerns. Based on this review, it concludes that EHS concerns were considered robustly and are reflected in pesticides listed by the PRG for locust control (see Conclusions section, at end.) The review is informed both by a close review of the report and by consultations with PRG participants.

1. Background: the FAO Pesticide Referee Group (PRG) and its Listed Pesticides

"The PRG is an independent body of experts that advises FAO on the efficacy as well as the health and environmental risks of insecticides used in locust control.[53] The PRG reviews insecticide efficacy trial reports and establishes recommended dose rates against the desert locust and other species of locusts; evaluates environmental impact studies and classifies insecticides with recommended rates as to their environmental and health risks; reviews operational use of insecticides in locust control and possible constraints; and identifies gaps in knowledge and recommends further studies to be conducted. The PRG advises on other matters pertaining to locust control as requested by FAO.

The resulting advice systematically lists insecticides suitable for locust control from the scientific point of view. The PRG has no legal status. All uses of insecticides discussed in this report are fully subject to national legislation, regulation and registration" (Pesticide Referee Group 2014).

This said, pesticides listed by the PRG for locust control are the *de facto* international standard, and for this reason this PEA assesses the PRG locust list as the universe of desert locust control pesticides, for which USAID may potentially provide assistance to procurement and/or use.

2. 2014 PRG and its Report

The last PRG meeting took place in December 2014 in Tunisia.[54] For the 2014 PRG meeting, the FAO made a total of 54 studies on biological efficacy or environmental impact available to the PRG for analysis. Although human health and safety in locust control is addressed in the 2014 report (as documented below), the report does not mention that the evaluated studies also emphasized on human health and safety. The studies reviewed by the PRG are documented in the report came from various locust control organizations, plant protection services and research institutions in locust affected countries as well as from scientific journals. The PRG was concerned about the lack of efficacy studies submitted by the pesticide industry, in particular of new insecticides which may be suitable for locust control. As a result, the PRG suggested that FAO re-engage with the pesticide industry.

The 2014 PRG report discusses the following topics in relation to human health and environmental risks associated with desert locust pesticide campaigns:

- The 2003 *FAO Desert Locust Guidelines on Safety and Environmental Precautions*
- Human health risks;
- Environmental evaluation;

[53] The 2014 PRG had 5 members. For the purpose of this PEA two members of the 2014 PRG were consulted.
[54] Prior to this meeting, there had not been a PRG meeting for a decade. According to stakeholder consultations, the next PRG meeting is planned to take place in the near future.

- Insecticide selection, including use order priority;
- Insecticide procurement and stock management;
- Insecticide formulation quality;
- Training and Monitoring of Control Staff; and
- Waiting periods

Each is discussed below.

2003 FAO Desert Locust Guidelines on Safety and Environmental Precautions. The FAO's 2003 *Desert Locust Guidelines* on Safety and Environmental Precautions address major environmental and human health risks related to desert locust control and provide guidance on risk reduction, campaign preparation, campaign execution, and campaign follow-up (FAO (Valk, H. van der; Everts, J.W.) 2003).

Overall, the PRG approved of FAO's comprehensive 2003 *DL Guidelines*. Though, the PRG found that many of the issues discussed in the 2003 *DL Guidelines* may need to be reviewed and updated. According to consultations with a member of the 2014 PRG meeting, topics to be updated included training, health and safety, testing of workers handling pesticides and campaign follow-up. In addition, technical manuals became dated and needed updating.

To date, there is no newer version of the *DL Guidelines* available. However, FAO now regularly posts updated desert locust campaign guidance as well as technical details on LocustWatch (FAO 2020e).

Human Health Risks. In the 2014 report, the PRG re-evaluated and classified locust insecticides, according to the World Health Organization (WHO) Recommended Classification of Pesticides by Hazard· for acute oral and dermal toxicity and the United Nations' Globally Harmonized System of Classification and Labelling of Chemicals (GHS) for other health hazards such as acute toxicity, skin sensitization, carcinogenicity, respiratory and reproductive toxicity (WHO 2019), (United Nations 2013). The main source for the toxicity endpoints used in this re-evaluation was the European Union Pesticides Database (European Commission n.d., c).

The PRG noted that ideally insecticides are classified according to their formulations as they often contain co-formulants which could cause adverse health effects. However, since formulation data is not always available, classifications can be done based on the AI alone (Pesticide Referee Group 2014).

The PRG recommended the FAO conduct additional studies on occupational exposure to insecticides in locust control to obtain more precise estimates of health risks. Various existing occupational exposure models used in pesticide registration in Europe and North America are likely not appropriate for the application practices, equipment and UL formulations encountered in locust control. The PRG suggested that such studies should focus on, but not necessarily be limited to, the handling of insecticides during loading of spray equipment (Pesticide Referee Group 2014).

The PRG evaluated preliminary results of the monitoring of blood cholinesterase inhibition in locust control personnel, which had been conducted in various countries. It noted the large variability in the results of these monitoring exercises, some suggesting over-exposure of staff while others appear to indicate only limited acute health risks. The PRG recommended that the health monitoring data collected so far be evaluated in detail, including the extensive dataset available in Australia. Results of this evaluation could be used to identify key factors affecting exposure to insecticides (Pesticide Referee Group 2014).

The PRG underlined the great importance of regular health monitoring of desert locust control staff. Desert locust control organizations should ensure that medical examinations of all staff are done before, during and after control campaigns, irrespective of the types of insecticides used (Pesticide Referee Group 2014).

Environmental Evaluations. The 2014 PRG report evaluated the potential environmental impact of the insecticides that pass their efficacy assessment. Insecticides are classified as posing low, medium or high risk to the main classes of non-target organisms that may be exposed by locust control operations (FAO (Valk, H. van der; Everts, J.W.) 2003).

According to the 2014 PRG report, the selection and use of pesticides for locust control should be aligned with international guidance on the use of pesticides and toxic chemicals including the FAO's 2013 International Code of Conduct on Pesticide Management (FAO n.d., b), the Strategic Approach to International Chemicals Management (SAICM), the Rotterdam and Stockholm Conventions and the Sustainable Development Goals (SDGs) (Pesticide Referee Group 2014).

The PRG aligned their risk classification as much as possible with recognized international classifications such as those agreed on by the European Food Safety Authority (EFSA) or the International Organization of Biological and Integrated Control (IOBC).

The evaluation of environmental data in the 2014 session of the PRG resulted in the reclassification of deltamethrin and lambda-cyhalothrin. Both compounds were reclassified to "highly toxic" for bees. No other change in environmental risk classification was made in the 2014 report. However, the PRG recommended that, whenever possible, countries conduct their own, locally specific, environmental risk assessments (Pesticide Referee Group 2014).

The PRG noted that for ecological reasons, barrier treatments should be favored over blanket treatments. To function as true refugia, at least half of the inter-barrier areas need to be completely uncontaminated by the insecticide (Pesticide Referee Group 2014).

Insecticide Selection, including Use Order Priority. The PRG report explains that the choice of a particular insecticide and type of application depends on the particular circumstances and topography of the areas concerned. The PRG refers to the FAO *Desert Locust Guidelines* on Control and on Safety and Environmental Precautions (FAO (Dobson, H.M.) 2003), (FAO (Valk, H. van der; Everts, J.W.) 2003), which provide more detailed guidance on selecting the appropriate insecticide for desert locust control (Pesticide Referee Group 2014).

The PRG noted that locust control campaigns in the past had heavily relied on organophosphate insecticides, likely due to availability and relatively low purchase cost. However, in consideration of international concerns about the use of insecticides and the absence of new products evaluated for locust control, the PRG stressed that emphasis should be given to the least toxic compounds already evaluated in relation to human health and environmental impact, provided they are effective against the locust target requiring control (Pesticide Referee Group 2014).

Therefore, the PRG considered *Metarhizium acridum* to be the first priority control option, with second priority given to IGRs, and third priority to neurotoxic insecticides as a last resort when rapid control is needed to protect agricultural crops in the immediate environment of a locust population (Pesticide Referee Group 2014).

TABLE 17: PRG PRIORITY LIST OF INSECTICIDES TO BE USED AGAINST LOCUSTS		
Priority	Insecticide	Remarks
Priority 1	*Metarhizium acridum*	The mycoinsecticide has been shown to be effective in numerous trials and limited operational use. While the speed of action is slow compared with neurotoxic insecticides, it has the beneficial effect of being very low risk to non-target organisms, including birds and reptiles which ingest the treated locusts. Due to low ecotoxicity, there are no problems associated with the disposal of stocks once they are no longer viable for field use.
Priority 2	**Insect Growth Regulators (IGRs):** Diflubenzuron Teflubenzuron Triflumuron	Very low human toxicity. These compounds are considerably less hazardous to use compared with neurotoxic insecticides, although there are some adverse effects on certain non-target organisms, especially aquatic arthropods. IGRs are particularly recommended for applications aimed at locust hoppers. They are slower acting compared to the insecticides listed in Priority 3.
Priority 3	*The neurotoxic insecticides currently approved for use in locust control are listed in relation to their human toxicity (lowest to highest toxicity), but adjusted in relation to the concentration of the spray and dose applied per hectare.*	
	Phenyl pyrazoles: Fipronil (barrier)	Low acute human toxicity This insecticide applied in a UL formulation (<10g/l) has been shown to be effective at doses of < 1.0 gram a.i./ha against hoppers. Low to medium toxicity for aquatic organisms and terrestrial vertebrates, high toxicity to terrestrial non-target arthropods.
	Pyrethroids: Deltamethrin Lambda-cyhalothrin	Deltamethrin: Low human toxicity. This insecticide used in a UL formulation (< 30g/l) has been shown to be very effective against adults and hoppers at 12.5 – 17.5g/ha. Low toxicity to fish, medium to high toxicity to aquatic and terrestrial non-target arthropods, low toxicity to terrestrial vertebrates. Lambda-cyhalothrin: Moderate human toxicity. This insecticide has shown similar activity to deltamethrin in a UL formulation (< 50g/l) and applied at 20g/ha against adults and hoppers. Low toxicity to fish, medium to high toxicity to aquatic and terrestrial non-target arthropods, low toxicity to terrestrial vertebrates.

TABLE 17: PRG PRIORITY LIST OF INSECTICIDES TO BE USED AGAINST LOCUSTS		
Priority	Insecticide	Remarks
	Carbamates: Bendiocarb	Moderate human toxicity. Although this insecticide has not been used much in operational control programs, studies have shown it is effective against locusts in formulations containing 200g/l at 100g a.i./ha against adults and hoppers. Low to medium toxicity to aquatic organisms and terrestrial vertebrates, medium to high toxicity to terrestrial non-target arthropods.
	Organophosphates: Malathion Fenitrothion Chlorpyrifos	These insecticides may be used as a last resort when rapid control is needed to protect agricultural crops in the immediate environment of a locust population. Malathion: slight acute human toxicity but may cause skin sensitization. Available in a UL formulation (925g/l) and has been used extensively against (adult) locusts at ~925g/ha). Low to medium toxicity to aquatic organisms, low toxicity to terrestrial vertebrates, high toxicity to terrestrial non-target arthropods. Fenitrothion: Moderate human toxicity. This insecticide has been extensively used at 400g/ha against adults and hoppers. Low to medium toxicity to aquatic organisms and terrestrial vertebrates, high toxicity to terrestrial non-target arthropods. Chlorpyrifos: Moderate human toxicity. This insecticide has been extensively used at 240g/ha against adults and hoppers. Medium to high toxicity to aquatic organisms, low to medium toxicity to terrestrial vertebrates, high toxicity to terrestrial non-target arthropods.

Source: Appears as Table 7 in the 2014 PRG Report to the FAO

Insecticide Procurement and Stock Management. The PRG reported that since the 2003/2004 desert locust outbreak significant progress had been made in managing pesticide stocks. For example, The Pesticide Stock Management System (PSMS) has been deployed in all desert locust affected countries. Despite all efforts, the PRG pointed out that new obsolete pesticide stocks have been created in most desert locust affected countries, and that new funds will need to be secured to dispose of these obsolete pesticides safely. In the interests of sustainability, the PRG noted that countries should take responsibility for preventing obsolete pesticide stocks and also for disposal of those stocks when they are created. While the 2014 PRG report does not provide any further recommendations on safe handling of pesticides during transport, storage and disposal, these topics are addressed in more detail in the 2003 *DL Guidelines*.

Insecticide Formulation and Container Quality. The PRG discussed problems encountered with the compatibility of certain ULV formulations of IGRs with spray equipment, leading to severe damage to aircraft spray tanks. It underlined that most aircraft spray tanks are intended for high volume, water-based pesticides and may not resist solvents in more concentrated UL formulations. The PRG therefore recommended that in the procurement of UL formulations the supplier should indicate all solvents in

the formulation and should certify that they do not affect the spray equipment used in locust control (Pesticide Referee Group 2014).

The PRG took note of recent field reports indicating that the metal drums in which UL formulations had been supplied had not always been of sufficient quality, which has led to breakage, insecticide loss, and environmental contamination. As a result, FAO reviewed the technical requirements of pesticide drums for locust control and recommends reinforced steel drums meeting international standards (Pesticide Referee Group 2014).

Training and Monitoring of Control Staff. The PRG discussed the great importance of training and capacity building of all staff to ensure that locust control is effective and does not pose undue risks to human health and the environment. The PRG recommended that countries and FAO maintain their emphasis on, and where possible further strengthen, training in good locust control practices. The PRG also urged that FAO and the concerned national and regional institutions ensure that training contents are updated on a regular basis to address the latest techniques and equipment.

Waiting Periods. The PRG discussed the lack of appropriate livestock withholding periods, re-entry periods for persons, and pre-harvest intervals, for locust control with UL insecticides. Locust control often takes place in grazing areas and crop areas. However, with the exception of Australia, many pesticide registration authorities in locust affected countries have not established such waiting periods. According to the PRG, pesticide manufacturers often do not indicate waiting periods on the labels of locust control insecticides. However, the FAO Safety and Environmental *DL Guidelines* recommend that a minimum time interval needs to be respected before humans or livestock re-enter the treated area, or before treated crops are harvested (FAO (Valk, H. van der; Everts, J.W.) 2003).

3. Conclusion

Review of the 2014 PRG report as well as stakeholder interviews with members of the 2014 PRG revealed that the pesticides published in the PRG list are the result of a deliberative process that, alongside efficacy, overall considered EHS rigorously and robustly.

After careful evaluation of EHS risks, the 2014 PRG report noted that emphasis should be given to the least toxic compounds already evaluated in relation to human health and environmental impact, provided they are effective against the locust target that has to be controlled (Pesticide Referee Group 2014). Successful, early intervention permits use of more selective, generally safer pesticides in lower volumes.

FAO recommends that pesticides classified by the WHO classification by hazards as class Ia and Ib products (extremely and highly hazardous) are not used for locust control. As a result, insecticides that have passed PRG evaluation are mostly class U (least toxic) and class II (moderately hazardous) with the exception of Malathion, Bendiocarb and Chlorpyrifos, which are class III (slightly hazardous) (FAO (Valk, H. van der; Everts, J.W.) 2003).

ANNEX E. COMPARISON OF FAO'S *DL GUIDELINES* AND SOPs TO US RUP SUPERVISION/APPLICATION REQUIREMENTS

This Annex characterizes the extent to which FAO's relevant *Desert Locust Guidelines (DL Guidelines*) and SOPs are equivalent to the requirements for RUP application and for aerial pesticide application in the US, as well as the extent to which FAO's relevant *DL Guidelines* and SOPs address the potential risks/adverse impacts of aerial and ground spray operations and pesticide transport, handling, storage and disposal.

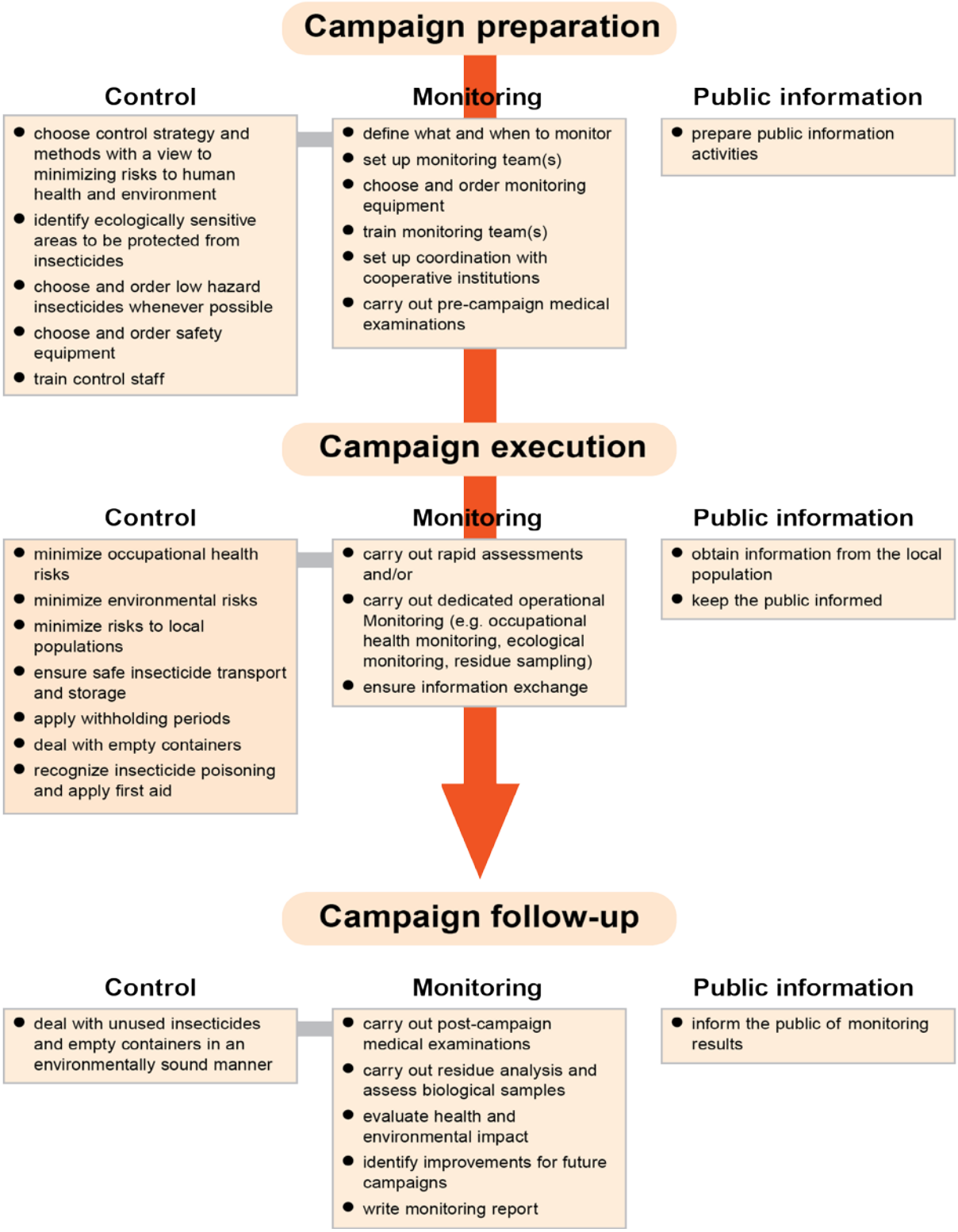
Extent to which FAO's Relevant *DL Guidelines* And Standard Operating Procedures (SOPs) Are Equivalent to the Requirements for RUP Application and for Aerial Pesticide Application in the US

FAO's *DL Guidelines* and SOPs for Desert Locust Control as Related to EHS

The FAO's *Desert Locust Guidelines Chapter 6, Safety and Environmental Precautions*, focus on reduction of environmental and human health risks from insecticide use during locust control. Chapter 4 of these Guidelines, Control, focuses on safe, effective and efficient equipment and techniques to carry out locust control. The FAO's SOPs for Desert Locust Aerial Survey and Control and Desert Locust Ground Control specify implementation of key elements of both Guideline Chapters in more specific terms, with particular respect to pesticide handling, mixing, loading, application, cleanup and spray equipment calibration. Both these Chapters of the *DL Guidelines* and the SOPs were reviewed.

The FAO *DL Guidelines* provide a comprehensive decision tree to illustrate the safer use processes that need to be followed before, during and after the spray campaign (see Figure 9).

Figure 8: EHS Measures by Desert Locust Campaign Stages



Source: FAO Desert Locust Guidelines - Safety and Environmental Precautions

US Requirements for RUP Application and for Aerial Pesticide Application

In the US, federal law requires any person who applies or supervises the use of RUPs to be certified as a private or commercial applicator[55] in accordance with US EPA regulations, and state, territorial and tribal laws (US EPA n.d., e).US EPA has oversight of state, territory, tribal and federal agency certification programs to ensure they meet certain standards. US EPA regulations (40 CFR Part 171) establish minimum standards of competency for pesticide applicators that apply or supervise the use of RUPs.

TABLE 18: US EPA STANDARDS FOR CERTIFICATION OF PRIVATE AND COMMERCIAL PESTICIDE APPLICATORS

Requirements	US EPA Standards for Certification of Private Applicators	US EPA Standards for Certification of Commercial Applicators
Practical knowledge of:	• Pest problems and control practices associated with agricultural operations; • proper storage, use, handling, and disposal of pesticides and containers; and • legal responsibility;	• Core pesticide use and safety and at least one specific category (type/site) of application. • Pesticide label and labeling comprehension. • Safety, including pesticide hazards, first aid, personal protective equipment and emergency response. • Pesticides in the environment. • Pest identification and management. • Pesticide formulations. • Pesticide application equipment and application techniques. • Laws and regulations.

[55] A private applicator is defined as someone who applies pesticides for the production of an agricultural commodity on land that they or their employer owns or rents. A commercial applicator is anyone that does not meet the description of a private applicator (US EPA n.d., e)

TABLE 18: US EPA STANDARDS FOR CERTIFICATION OF PRIVATE AND COMMERCIAL PESTICIDE APPLICATORS		
Requirements	**US EPA Standards for Certification of Private Applicators**	**US EPA Standards for Certification of Commercial Applicators**
Ability to:	● read and understand pesticide labels and labeling; ● apply pesticides according to labeling instructions and warnings; ● and recognize: ○ common pests and damage caused by them; ○ local environmental situations to be considered during application to avoid contamination; and ○ poisoning symptoms and procedures to follow in case of a pesticide accident.	
Certified by a state, territory, or tribe by:	● Passing a written or oral test. ● Attending a training course. ● Another system approved by USEPA.	● Passing a written test. ● Passing a performance-based test. ● Another system approved by USEPA. ● Applicators must be recertified periodically to maintain certification. This generally requires continuing education courses every 3-5 years.

Source: US EPA website: Pesticide Worker Safety – Federal Certification Standards for Pesticide Applicators

In 2017, the US EPA finalized stricter requirements for RUP applicators. All States were required to submit their new compliance plans to USEPA by March 4, 2020. Upon submission, US EPA has two years to review and approve the State plans.

The main changes in the revised US EPA standards for RUP applicators are:

- Enhanced applicator competency standards to ensure that RUPs are used safely.
- Nation-wide minimum age for certified applicators and persons working under their direct supervision.
- Maximum recertification interval of 5 years for commercial and private applicators.
- Specialized certifications for people using specific application methods (fumigation and aerial).
- Protection for non-certified applicators by requiring training before they can use RUPs (under the direct supervision of a certified applicator). Non-certified applicators have to complete the training outlined in the rule, complete Worker Protection Standard handler training, or complete a program approved by the state.
- Streamlined requirements for states, tribes, and federal agencies to administer their own certification programs, while granting flexibility to tailor programs to the needs of each state, tribe, or federal agency.

While US states administer their own applicator certification programs, a number of states utilize the National Pesticide Applicator Certification Core Exam, which is the *de facto* national standard. To assess the content of US RUP and aerial application requirements, this PEA reviewed the two standard manuals developed for the National Pesticide Applicator Certification Core Exam. Each is described below.

National Pesticide Applicator Certification Core Manual. The 2014 National Pesticide Applicator Certification Core Manual was developed jointly by the U.S. Environmental Protection Agency and the Pest Management Regulatory Agency of Canada, and serves as a study guide for those preparing to take the National Pesticide Applicator Certification Core Exam.

The National Pesticide Applicator Certification Core Manual provides guidance on the following topics:

- Pest management
  - Pest management methods, integrated pest management
- Federal pesticide laws
- Pesticide labeling
- Pesticide formulations
- Pesticide hazards and first-aid
  - Toxicity, exposure and hazards, symptom recognition and first aid for pesticide poisoning
- Personal protective equipment
- Pesticides in the environment

    - Pesticide characteristics, how pesticides move in the environment, pesticide drift, water contamination, pesticide effects to sensitive areas and non-target organisms.
- Transportation, storage, and security
- Emergency or incident response
    - Emergency response planning and training on pesticide spill remediation
- Planning the pesticide application
    - Selecting pesticides, pesticide labels, conducting a compatibility test, safe mixing and loading practices, cleaning up after use and disposing of pesticides, application procedures and equipment cleaning procedures
- Pesticide application procedures
    - Application methods, safety systems, proper use of pesticide application equipment usage, and equipment calibration
- Professional conduct
    - Pesticide security and supervision, and public communication

National Pesticide Applicator Certification Aerial Applicators Manual. The Pesticide Applicator Certification Aerial Applicators Manual focuses on how to apply pesticides properly and safely from an aircraft.

The manual focuses on how to apply pesticides properly and safely from an aircraft and discusses the following topics:

- Laws and regulations for the aerial applicator pilot
- Operation and application safety
- Preventing pesticide drift
- Aerial pesticide dispersal systems
- Calibrating aerial application equipment
- Making an aerial pesticide application

Comparison of FAO's SOP and U.S. RUP Application Requirements for ULV Aerial Spraying and Ground Fogging

The FAO's DL SOPs and *DL Guidelines* address pesticide handling, mixing, loading, application, cleanup, spray equipment calibration and PPE in a manner generally consistent with and equivalent in rigor to the US *de facto* national standards described above.

Beyond this, the FAO's *DL Guidelines* provide guidance related to campaign preparation and follow-up that is beyond the scope of US commercial and aerial applicator certifications. For example, the *DL Guidelines* stress that beyond the campaign itself, it is essential to be well prepared. If campaign preparation has been done well, the actual risk reduction activities that need to be carried out during

the control operations will be explicit. Similarly, the FAO's *DL Guidelines* underline that health and environmental risk reduction activities should not be considered completed when the locust has been eliminated. Essential campaign follow-up includes properly managing the unused insecticides and empty containers; analyzing residues and identifying and evaluating biological samples; post-campaign health checks of control staff; evaluating the monitoring results and identifying improvements for future campaigns; and writing a detailed report of the risk reduction activities and conclusions (FAO (Valk, H. van der; Everts, J.W.) 2003).

Further, FAO stresses the importance of thorough pre-campaign planning and training. Although not a requirement, FAO recommends that locust control staff be officially licensed or certified in the handling and application of insecticides, after having successfully completed the training. FAO currently does not suggest a minimum age for pesticide applicators.

Extent to Which FAO's SOPs for Locust Control Address the Potential Risks/Adverse Impacts of Aerial and Ground Spray Operations and Pesticide Transport, Handling, Storage and Disposal

According to the FAO's *DL Guidelines* for Safety and Environmental Precautions, environmental risk reduction has to be done on a case-by-case basis. It involves choosing the right insecticide for a given situation or environment, using the appropriate control strategy and method, and strictly applying environmental protection measures where possible. Table 19. below outlines the extent to which FAO's SOPs for locust control address the potential risks or adverse impacts of aerial and ground spray operations and pesticide transport, handling, storage and disposal.

	Risks and/or mitigation measures adequately identified and addressed by FAO Guidelines and SOPs
	Risks and/or mitigation measures inadequately identified and addressed by FAO Guidelines and SOPs

TABLE 19: EXTENT TO WHICH FAO'S RELEVANT DL GUIDELINES AND SOPs ADDRESS THE POTENTIAL RISKS/ADVERSE IMPACTS OF AERIAL AND GROUND SPRAY OPERATIONS AND PESTICIDE TRANSPORT, HANDLING, STORAGE AND DISPOSAL

Potential Risks/Adverse Impacts	Risks Identified in FAO DL SOPs and *DL Guidelines* for Safety and Environmental Precautions	Summary and Excerpts of Specified Mitigation Measures or SOP Elements that Mitigate these Risks.
Aerial and Ground Spray Operations		
Ecotoxicity, adverse impact on non-target	Almost all the insecticides that are at present used for desert locust control have broad-spectrum activity and are thus not	• Select appropriate insecticide for a given situation or environment

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Potential Risks/Adverse Impacts	Risks Identified in FAO DL SOPs and *DL Guidelines* for Safety and Environmental Precautions	Summary and Excerpts of Specified Mitigation Measures or SOP Elements that Mitigate these Risks.
organisms	entirely specific to locusts.* As a result, they may adversely affect other beneficial organisms in the environment. Many organisms that could be affected by locust control insecticides are important natural resources or perform ecological functions on which local populations depend. **Note: statement does not apply to Metarhizium, which came into use after the DL Guidelines were written*	o choose low toxicity insecticides; o do not spray sensitive organisms or ecosystems. • Use appropriate control strategy and method o use good application practices; o ensure proper calibration; o apply buffer zones; o if possible use barrier treatments. • Strictly apply environmental protection measures where possible. o If possible, do not treat the same area multiple times; o Do not use persistent pesticides. • Monitoring is essential for locust control campaigns • Control teams should always verify that no livestock or people are present in the area to be treated • The campaign organization should develop a list of areas that cannot be sprayed and/or contaminated
Water contamination	Local people may be exposed to pesticides during or after locust control operations through contaminated drinking water. Water can become contaminated because: • People were not told to close wells; • Error was made by pilot or spray operator; • Use of empty pesticide containers for storage of drinking water. Ecosystem impacts that can result from contamination of surface waters are insufficiently discussed in the *DL Guidelines*	
Pesticide residue consumption	Consumers can be exposed through entering sprayed fields, consuming contaminated crops, consuming animal products without maintaining withholding period or consuming pesticide treated locust. • People were not informed about pre-harvest intervals or did not respect pre-harvest interval • People were not instructed to keep livestock away from treated areas;	FAO Guidelines do not elaborate on the need for awareness building and informational campaigns to prevent people from consuming sprayed locusts. However, the Guidelines do mention that locusts killed by insecticides should never be consumed, since they may still contain toxic levels of insecticides. Additionally, the Guidelines emphasize the need to raise awareness about and maintain adherence to recommended pre-harvest intervals and

TABLE 19: EXTENT TO WHICH FAO'S RELEVANT DL GUIDELINES AND SOPs ADDRESS THE POTENTIAL RISKS/ADVERSE IMPACTS OF AERIAL AND GROUND SPRAY OPERATIONS AND PESTICIDE TRANSPORT, HANDLING, STORAGE AND DISPOSAL		
Potential Risks/Adverse Impacts	**Risks Identified in FAO DL SOPs and *DL Guidelines* for Safety and Environmental Precautions**	**Summary and Excerpts of Specified Mitigation Measures or SOP Elements that Mitigate these Risks.**
	• People were not informed or did not respect livestock withholding period; • People were not informed to avoid consuming animals killed by the treatments.	withholding periods. Specifically, the Guidelines state that: • When locusts are sold on the market for human consumption, one should always be sure that they were caught alive and not after insecticide treatments. However, it is unclear how this challenge is to be addressed • During campaign planning, contact should be sought with the Registration Authority to obtain safety information, such as pre-harvest intervals and withholding periods o The strictest withholding periods are generally those for the harvesting of crops for human consumption. At harvest, insecticide residues should not surpass the so-called maximum residue limits (MRLs). However, it is unclear from the guidelines how testing should be done. • Monitoring is an essential element of a locust control campaign o dedicated operational monitoring and in-depth monitoring look in more detail into insecticide residues. o Insecticide residues after treatments should be monitored to evaluate whether the withholding periods recommended by the insecticide manufacturers are valid under local conditions or to confirm that no contamination of protected areas occurs when suggested buffer zones are respected.
Spray/Handler	Field staff who are directly involved in	• FAO uses the WHO classification of

TABLE 19: EXTENT TO WHICH FAO'S RELEVANT DL GUIDELINES AND SOPs ADDRESS THE POTENTIAL RISKS/ADVERSE IMPACTS OF AERIAL AND GROUND SPRAY OPERATIONS AND PESTICIDE TRANSPORT, HANDLING, STORAGE AND DISPOSAL		
Potential Risks/Adverse Impacts	**Risks Identified in FAO DL SOPs and *DL Guidelines* for Safety and Environmental Precautions**	**Summary and Excerpts of Specified Mitigation Measures or SOP Elements that Mitigate these Risks.**
Team exposure	spraying operations generally run the highest risk of insecticide poisoning. However, almost all other field staff such as drivers, pilots, transporters, survey staff, flagmen and monitoring staff) are also at risk of insecticide poisoning, either by accidental exposure or during the normal course of their work	pesticides by hazard as a guideline on occupational and bystander risk • FAO recommends that class Ia and Ib products (extremely and highly hazardous) are not used for locust control, (The PRG list contains no such AIs.) • Dedicated operational monitoring are an essential element of a locust control campaign
Spray drift and environmental residuals	Aerial and large area treatments have a higher risk of uncontrolled drift.	• If no-spray areas lie downwind of the spray target, sufficient distance needs to be kept to ensure that insecticides do not drift into no-spray areas. • Start spraying at the downwind side and move upwind, to avoid walking/driving/flying through the treated area • Anyone that is not actively involved in the insecticide applications should stay upwind and at a safe distance • If necessary, beehives can be covered up temporarily to protect them from unexpected spray drift • The campaign organization should develop a list of areas that cannot be sprayed and/or contaminated
Improper formulation and application (driver of impacts above)	The Desert Locust Control Guidelines for Safety and Environmental Precautions provides a table with correct formulations for each pesticide as an annex.	Mixing of pesticides is not usually a problem as most of the insecticides used in desert locust control are ready-for-use ULV formulations. However, in some countries, concentrated ULV formulations are diluted in the field. • Staff carrying out the dilutions should be careful not to expose themselves to

TABLE 19: EXTENT TO WHICH FAO'S RELEVANT DL GUIDELINES AND SOPs ADDRESS THE POTENTIAL RISKS/ADVERSE IMPACTS OF AERIAL AND GROUND SPRAY OPERATIONS AND PESTICIDE TRANSPORT, HANDLING, STORAGE AND DISPOSAL		
Potential Risks/Adverse Impacts	**Risks Identified in FAO DL SOPs and *DL Guidelines* for Safety and Environmental Precautions**	**Summary and Excerpts of Specified Mitigation Measures or SOP Elements that Mitigate these Risks.**
		the concentrated insecticide; • Personnel carrying out the mixing/diluting operations should be well trained. While the FAO Guidelines do mention that appropriate PPE such as gloves, face shield, and impermeable apron as well as appropriate pumping/mixing equipment should be available, it is unclear from the Guidelines whether or not PPE is actually required.
Timing of application	DL spray targets to be treated the following morning are often identified during late afternoon.	• The timing of application and appropriate mitigation measures are only vaguely discussed in the FAO Guidelines and SOPs. o During campaign planning, contact should be sought with the Registration Authority to obtain safety information, such as pre-harvest intervals o Inhabitants can be warned the evening before spraying
Pesticide Transport, Handling, Storage and Disposal		
Environmental and Community Exposure	Despite local populations generally not being directly involved in desert locust control campaigns, they can still be exposed to insecticides in multiple ways: • Consumers can be exposed through contaminated water, crops, killed locust or other animals. • Bystanders can be exposed through overspraying, contaminated equipment, spills and entry into sprayed areas	• Select appropriate insecticide for a given situation or environment o choose low toxicity insecticides; o do not spray sensitive organisms or ecosystems. • Use appropriate control strategy and method o use good application practices; o ensure proper calibration; o apply buffer zones;

TABLE 19: EXTENT TO WHICH FAO'S RELEVANT DL GUIDELINES AND SOPs ADDRESS THE POTENTIAL RISKS/ADVERSE IMPACTS OF AERIAL AND GROUND SPRAY OPERATIONS AND PESTICIDE TRANSPORT, HANDLING, STORAGE AND DISPOSAL		
Potential Risks/Adverse Impacts	**Risks Identified in FAO DL SOPs and *DL Guidelines* for Safety and Environmental Precautions**	**Summary and Excerpts of Specified Mitigation Measures or SOP Elements that Mitigate these Risks.**
	• Inhabitants of nearby villages can be exposed to pesticides by improper storage, spillage, contaminated equipment, overspraying, entry into sprayed areas and the use of empty pesticide containers for other purposes. • Almost all the insecticides that are at present used for desert locust control have broad-spectrum activity and are thus not entirely specific to locusts. As a result, they may adversely affect other organisms in the environment	o if possible use barrier treatments. • Strictly apply environmental protection measures where possible. o If possible, do not treat the same area multiple times; o Do not use persistent pesticides. • Monitoring is essential for locust control campaigns • Control teams should always verify that no livestock or people are present in the area to be treated • The campaign organization should develop a list of areas that cannot be sprayed and/or contaminated
Reuse of pesticide containers	Empty insecticide drums, bags or other containers are a health risk to humans and the environment due to small amounts of insecticide remaining in containers even after cleaning. ULV formulations, in particular, are very difficult to clean out from containers. Oftentimes, empty containers are in great demand. Empty insecticide containers should never, under any circumstances, be reused for storage of drinking-water or food, not even after cleaning.	• If logistics have properly functioned during the campaign, empty and rinsed insecticide drums will have been returned to storage sites • After the campaign, containers should be collected in one location, where appropriate arrangements can be made. • From an environmental perspective it is best if the pesticide manufacturer will take back the drums for reconditioning. • If the drums are not taken back, a few empty drums of good quality should be kept for insecticide storage, to be used in case of spills or container damage. The rest should be crushed using a drum crusher. Crushed drums can be recycled in an industrial metal smelter or destroyed in a dedicated incineration plant. • Empty paper bags, used for insecticide dust formulations, may be burned if this

TABLE 19: EXTENT TO WHICH FAO'S RELEVANT DL GUIDELINES AND SOPs ADDRESS THE POTENTIAL RISKS/ADVERSE IMPACTS OF AERIAL AND GROUND SPRAY OPERATIONS AND PESTICIDE TRANSPORT, HANDLING, STORAGE AND DISPOSAL		
Potential Risks/Adverse Impacts	**Risks Identified in FAO DL SOPs and *DL Guidelines* for Safety and Environmental Precautions**	**Summary and Excerpts of Specified Mitigation Measures or SOP Elements that Mitigate these Risks.**
		is done far away from habitations. o Insecticide bags should never be burned or buried on site as this could create dangerous conditions for both humans and the environment.
Residual and obsolete stocks **Inadequate storage facilities and facilities management**	The size and the timeline of an upsurge is difficult to predict. Therefore, planning the quantity of insecticides needed can be challenging, particularly towards the end of the campaign. Options for insecticide supply logistics, range from a large national stock to a more flexible pesticide bank system. It should be noted that environmental risks increase with the amount of pesticides stored and/or disposed.	• If locust populations have to be controlled on a regular basis in the country, leftover pesticides can be stored for future use; • Leftover pesticides are best collected in only one, or a few, good pesticide storage facilities; • Containers that have been damaged during transport, and may therefore corrode or leak more rapidly, should be replaced; • With insecticides coming from different sources, a good storage administration system should be kept; • If small amounts of insecticides remain, but will probably not be used for locust control in the near future, they may sometimes be used against other pests. Note that this should only be allowed if the insecticide has been registered for use against such pests; • If large amounts of insecticides remain and are unlikely to be used over the next few years, the sale or donation of these products to neighboring countries that need them for locust control could be considered. This is highly preferable to the creation of obsolete stocks; • Desert Locust Guidelines No. 5 Campaign Organization and Execution,

TABLE 19: EXTENT TO WHICH FAO'S RELEVANT DL GUIDELINES AND SOPs ADDRESS THE POTENTIAL RISKS/ADVERSE IMPACTS OF AERIAL AND GROUND SPRAY OPERATIONS AND PESTICIDE TRANSPORT, HANDLING, STORAGE AND DISPOSAL		
Potential Risks/Adverse Impacts	**Risks Identified in FAO DL SOPs and *DL Guidelines* for Safety and Environmental Precautions**	**Summary and Excerpts of Specified Mitigation Measures or SOP Elements that Mitigate these Risks.**
		provides more details about these systems, as well as advice on how to estimate insecticide need

Source: FAO Desert Locust Guidelines – Chapter 6 Safety and Environmental Precaution

ANNEX F. CROSSWALK OF 22 CFR 216.3(1)(I) ANALYSIS FACTORS TO PEA CONTENT

As stated in the introduction to Section 7, "22 CFR 216.34(b)(1)(iii) requires that Environmental Assessments prepared under the pesticide procedures include an analysis of the 12 factors identified in 22 CFR 216.3(1)(i). This PEA fulfills this requirement. However, to maintain the outline for environmental assessments prescribed by 22 CFR 216.6(c) to the greatest extent practicable while avoiding redundancy this PEA does not include a stand-alone 12-factor analysis. Rather, the analysis is integrated throughout and a cross walk of the analysis factors to PEA content is provided in this Annex:

TABLE 20: HOW AND WHERE 22 CFR 216.3(1)(I) ANALYSIS FACTORS ARE ADDRESSED IN THE PEA

Evaluation Factor Specified in 22 CFR 216.3(1)(i)	How/where addressed
a) The US EPA registration status of the requested pesticide	7.3.1 with additional discussion in 7.3.3.
b) The basis for selection of the requested pesticide	The PEA reviews all pesticides listed by the 2014 FAO Pesticide Referee Group (PRG) for locust control. 2.1 explains that this list is the de facto international standard, and why it is desirable that USAID have the option to provide assistance to procurement and/or use of as much of the PRG list as is consistent with due regard for environmental and human health and safety.
c) The extent to which the proposed pesticide use is part of an integrated pest management program	As described in 3.3 and in Annex C, surveillance enables early intervention. Early intervention, in combination with the full PRG priority-of-use scheme (Annex D) and availability of a range of PRG-listed desert control AIs, makes possible minimizing quantity and toxicity of pesticides employed in locust control campaigns. (See also Section 8.)
d) The proposed method or methods of application, including availability of appropriate application and safety equipment	Aerial and ground-based application in principle per FAO *Guidelines and SOPs.* (FAO n.d., f) Availability of appropriate application and safety equipment is addressed in the field information provided for each country in Annex A.
e) Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use and measures available to minimize such hazards	Human and environmental hazards are summarized in a qualitative comparative analysis within each pesticide class in 7.3.3 "Analyses and discussion of comparative toxicology with weight-of-evidence risk summary." Available measures including but not limited to PPE, application practices, and pesticide selection are summarized in review of the FAO Guidelines and SOPs in 7.4.1 and Annex E. Measures required by the PEA are enumerated in Section 9.

TABLE 20: HOW AND WHERE 22 CFR 216.3(1)(I) ANALYSIS FACTORS ARE ADDRESSED IN THE PEA	
Evaluation Factor Specified in 22 CFR 216.3(1)(i)	**How/where addressed**
f) The effectiveness of the requested pesticide for the proposed use	Efficacy is established by the 2014 PRG process (Pesticide Referee Group 2014) with additional discussion for some PRG-listed AIs in 7.3.1 and 7.3.4 regarding efficacy established by, respectively, US EPA and Australian regulators for same/similar use.
g) Compatibility of the proposed pesticide with target and nontarget ecosystems	7.3.3 "Analyses and discussion of comparative toxicology with weight-of-evidence risk summary." Measures required by the PEA to mitigate ecosystem risks are enumerated in Section 9.
h) The conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils	Linked resources provided by section 6.
i) The availability and effectiveness of other pesticides or nonchemical control methods	Pesticides beyond those listed by the PRG for desert locust control were not assessed, as the PRG list is the de facto international standard (2.1, Annex D). Non-chemical controls have utility and application in early stages of infestation, but pesticidal controls are widely accepted as necessary once upsurges occur.
j) The requesting country's ability to regulate or control the distribution, storage, use and disposal of the requested pesticide	See field information provided for each country in Annex A.
k) The provisions made for training of users and applicators	In-principle, these are per FAO *Guidelines* and SOPs. Field reality for each country is briefed in Annex A.
l) The provisions made for monitoring the use and effectiveness of the pesticide	In-principle, these are per FAO *Guidelines* and SOPs. Field reality for each country is briefed in Annex A.

ANNEX G. CONSULTATIONS HELD

Over the course of developing the PEA, the Analysis team conducted consultations with key stakeholders to augment, confirm, and broaden information identified through the team's desk research. The stakeholder interviews fall into two categories (outlined in tables 21 and 22 below): US-based consultations were conducted by the ECOS core team and in-country consultations were conducted by local consultants. Please note that due to COVID, in-country consultations were also conducted mostly by phone.

TABLE 21: US BASED CONSULTATIONS HELD

ORGANIZATION	DATE CONSULTATION HELD (DD/MM/YYYY)
USAID OFDA (now BHA)	03/13/2020
USAID DCHA FFP	03/23/2020
Famine Early Warning Systems Network (FEWS NET)	03/24/2020
USAID DCHA FFP	03/24/2020
USAID DCHA FFP	03/27/2020
USAID Kenya	03/30/2020
FEWS NET Ethiopia	04/01/2020
FEWS NET Kenya	04/07/2020
USAID Contractor	04/10/2020
CABI Kenya	04/21/2020
Addis Ababa University, Ethiopia	04/21/2020
University of Eldoret, Kenya	04/22/2020
Egerton University, Kenya	04/27/2020
FAO Rome	05/15/82020
NASA SERVIR	TBD
Member of the FAO Pesticide Referee Group	TBD

TABLE 22: IN COUNTRY CONSULTATIONS HELD	
COUNTRY	POSITION / ORGANIZATION
Somalia	Director, Plant Protection, Ministry of Agriculture (MoA)
	FAO Somalia, Crop Protection
	FAO Somalia, Head of Operations
	Permanent Secretary, MoA - Hirshabelle State
	Director, Plant Protection, MoA Puntland State
	MoA, Plant Protection, MoA Puntland State
	MoA, Plant Protection, MoA Puntland State
	FAO Somalia - Field Manager, Puntland State
	Chairman, local community group
	Galmudug State - Adaado Media
	Director General, MoA, Jubaland State
	FAO Crop Protection Officer - Somalia Desert Locust
	MoA, Field Desert Locust Control Team, Galmudug
	MoA Director General - Galmudug
	Executive Officer, Juba Foundation (local NGO)
	Manager, Darusalam Seed Company - importers
	Director General, MOA&L South West State
	Member Desert Locust Taskforce - Galmudug
Somaliland	Field team member - desert locust control
	Director, Plant Protection, MoA
	FAO Crop Protection - Somaliland Desert Locust
	Plant Protection Directorate Director, MoA

TABLE 22: IN COUNTRY CONSULTATIONS HELD	
COUNTRY	POSITION / ORGANIZATION
Ethiopia	Plant Health and Regulatory Directorate, Director General, MoA
	Senior Expert, Regulatory, MoA
	FAO Ethiopia
	FAO Ethiopia
	Country Office Entomologist and IPM expert, FAO Ethiopia
	Sub Regional Office Entomologist Specialist, FAO Ethiopia
	Director, Desert Locust Control Organization for East Africa
	Hygiene and Environmental Health Directorate, Assistant Director, Ministry of Health
	Director for Hygiene and Environmental Health Directorate, Ministry of Health
	Solid and Hazardous Waste Compliance Monitoring, Directorate Director, Environment Forest and Climate Change Commission (EFCCC)
	Hazardous Waste Compliance Monitoring Expert, Environment Forest and Climate Change Commission (EFCCC)
Kenya	Director, Pest Control Products Board
	Administrative Secretary, State Department of Agriculture
	Director, Plant Protection Services Division, MoA
	National Desert Locust Control Coordinator
	Base Manager - Desert Locust Management Base - Isiolo
	Assistant FAO Representative (Programs)
	FAO Desert Locust Coordinator
	Local Entomologist
	Desert Locust Control Organization for East Africa - Aerial Operations, Operations Coordinator for DLCO-EA
	Desert Locust Control Organization for East Africa- Chief Information Officer

TABLE 22: IN COUNTRY CONSULTATIONS HELD	
COUNTRY	POSITION / ORGANIZATION
	Desert Locust Control Organization for East Africa - Desert Locust Control Research
	Desert Locust Control Organization for East Africa - Aircraft Engineer
	Director, Farmland Aviation
	Northern Rangelands Trust (NRT)
	Director, 51 degrees

ANNEX H. REFERENCES

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ANNEX I. PREPARER BIOGRAPHIES

Mark Stoughton, Ph.D. Team Leader and Pesticide Regulation and ESIA Specialist. Dr. Stoughton, a Principal at the Cadmus Group LLC (Cadmus), serves as senior ESIA specialist for USAID's Environmental Compliance Support Project, which was commissioned to develop this PEA. An expert in the use of environmental and social impact assessment (ESIA) processes to strengthen international development activities and programs, he is particularly concerned with the effectiveness of donor systems in highly decentralized or delegated project implementation environments.

Dr Stoughton was the program manager for USAID's Global Environmental Management Support Projects (GEMS I and II) over 2011–2019, which provided on-demand environmental compliance, management, and sound design support to USAID's Environmental Officers, individual agency operating units and their projects and programs worldwide. In this capacity, he had a key technical role in design and implementation of full-scale ESIAs, developing agency-wide ESIA resources, design and implementation of an extensive training series in ESIA follow-through in project implementation, and in advising USAID on how to assess the effectiveness of partner country ESIA systems. A senior technical consultant to CLEAA, the pan-African ESIA network, and to the multi-donor Partnership for Environmental Assessment in Africa (PEAA) over 2006–2012, he worked closely with donors and CLEAA to strengthen and target ESIA capacity-building at the regional level. A returned Peace Corps Volunteer (Ghana, 1990–92), his work is grounded in an awareness of the social, institutional and economic realities of the developing-country context.

Dr. Stoughton holds a doctorate in Technology and Policy (Area: Industrial Development and Environmental Policy) and a Master's degree in Civil and Environmental Engineering, both from the Massachusetts Institute of Technology.

Jesse Gibson. Research, Writing and Management Support. As a Research Analyst at The Cadmus Group, Mr. Gibson primarily supports USAID's Bureau for Development, Democracy, and Innovation's (DDI)—formerly Global Development Lab—Bureau Environmental Officer (BEO) in the review of environmental compliance and climate risk management documentation. This support extends to the development of training materials and SOPs, the maintenance of an environmental compliance tracker, and recommendations to partners on integrating environmental compliance considerations into their design process. Prior to Cadmus, Mr. Gibson worked in support and senior management roles at NGOs operating in the international development space. Jesse holds a Bachelor of Science in Foreign Service in Latin American and African Studies with a focus on poverty from Georgetown University, where he also received a certificate in International Development Studies.

James Jolley, PE. Consultation and EHS Specialist. Mr. Jolley, a Senior Environmental Engineer at Cadmus, has more than 30 years of experience in international environmental assessment and due diligence, pest management and anti-malaria programs, and water, wastewater, and stormwater management. Mr. Jolley has worked extensively in the field in sub-Saharan Africa, notably in East and Southern African, developing pest management plans and performing field evaluations of malaria vector control programs in Eastern Congo, Uganda, Mozambique, and Zimbabwe. Currently, Mr. Jolley is managing the ECOS field evaluations of USAID/PMI Indoor Residual Spraying (IRS) campaigns in Benin and Burkina Faso. He has also completed several additional environmental compliance projects in Uganda. Mr. Jolley served as the Provincial Water Engineer, in Garoua, Cameroon and Regional Representative with the U.S. Peace Corps from 1986-1988. Mr. Jolley has both a B.S. and an M.S. in Civil/Environmental Engineering.

Daniela Kaegi. Key Writing and Research Support and Team Coordinator. Ms. Kaegi joined The Cadmus Group in June 2019. In her role as a Senior Analyst, Ms. Kaegi mainly supports USAID's

Bureau for Humanitarian Assistance (BHA) – formerly DCHA - Bureau Environmental Officer (BEO) in the management and review of environmental compliance and climate risk management documentation. In this role, Ms. Kaegi is responsible for a portfolio of five East African countries. Backstopping support also includes the review and development of training materials, standard operating procedures, and guidance documents for USAID staff for capacity building in USAID DCHA environmental procedures and processes. Ms. Kaegi also has extensive project management and administrative experience in the government, legal and corporate sectors. Ms. Kaegi holds a bachelor's degree in Sociology from George Mason University and a master's degree in Public Policy with a specialization in environmental policy and international development from the University of Maryland. As a master's student, Ms. Kaegi worked as a short-term consultant for the Global Environment Facility (GEF), the Wildlife Trust of India (WTI) and the World Wildlife Fund (WWF).

Arianne Neigh, Ph.D. Toxicologist. Dr Neigh, a Senior Associate at Cadmus, is a senior technical advisor and policy analyst with 20 years of working experience in natural resource management, resilience, international development, risk assessment, and toxicology in municipal, federal, military, and private contexts. She has extensive experience in applying environmental safeguards and climate adaptation practices both domestically and across more than 30 countries, specializing in Africa. As a technical advisor to USAID, Dr. Neigh is working with the President's Malaria Initiative involving USAID, CDC, and partner country health authorities by providing expert review of health and safety measures for malaria prevention and control and assuring worker and beneficiary safety in indoor residual spray campaigns. Additionally, Dr. Neigh advises the USAID Office of HIV/AIDs on matters of warehouse pest control and health care waste. In the agricultural sector, she is leading the revisioning of the USAID/Africa approach to safer pesticide use and management as well as working directly with Missions to meet regulatory requirements for pesticide use, monitor safety practices, and improve integrated pest management. Dr. Neigh has completed a Science and Technology Policy Fellowship for the American Association for the Advancement of Science with USAID in the Bureau for Democracy Conflict and Humanitarian Assistance in Washington DC and also served as Interim Regional Environmental Advisor for USAID/Southern Africa Regional Mission. She holds a doctorate in Environmental Toxicology.

George Ong'amo, Ph.D. Partner Country Systems/Context Specialist—Kenya. Dr. Ong'amo is an entomologist with over a decade of experience in various pest control projects in East Africa. Since July 2019, Dr. Ong'amo has served as the Technical Lead on Desert Locust management at the Entomological Society of Kenya, he organizes meetings of eminent Kenyan entomologists to explore desert locust management operations since the threat of the present outbreak. He also represents the Society in the multi-institutional desert locust management technical team formed by the government. In addition, Dr. Ong'amo works as a Senior Lecturer at the School of Biological Sciences at the University of Nairobi, where he lectures courses in research methodology and experimental design and biostatistics. Dr. Ong'amo has a Master of Science in Zoology (Agricultural Entomology) and a PhD in Applied Entomology from Kenyatta University.

Stella Siegel, MBA. **Developing Areas Pesticide/IPM/Safer Use Technical Specialist**. Ms. Siegel, a Senior Associate at Cadmus, has over twenty-five years of experience working in international development. For the past fifteen years she has been working as a senior member of a team providing environmental compliance management support to USAID and advising organizations responding to USAID environmental regulatory reporting requirements . Stella specializes in developing required environmental compliance documentation including assessments, plans, and reports with focus on pesticide use safety and compliance with pesticide national and international regulations. She has conducted environmental impact assessments in crop and livestock production, construction, water and sanitation, enterprise development, and public health sectors. Stella has experience developing reports,

training materials, guides and manuals on issues of compliance with pesticide regulations and pesticide use safety. Her practical field experience includes both short-term field visits for conducting environmental monitoring, evaluations, and assessments and working and managing projects in developing countries long-term.

Goshu Worku. Partner Country Systems/Context Specialist—Ethiopia. Mr. Worku is an environmental engineer specializing in environmental management, environmental assessment, and climate change. In his previous experience as a Sr. Project Officer for Environmental Compliance on the ATA/USAID Feed the Future Commercial Farm Services Project and the Natural Resources Management and Environmental Advisor on the USAID Agricultural Growth Project – Livestock Market Development, has prepared amendments for, designed implementation strategies of, and monitored implementation for PERSUAPs. Mr. Worku is licensed by the Ethiopian Ministry of Environment and Ministry of Water Resources as an Environmental Impact Assessment Consultant, and he has received specialized trainings on environmental assessment and pesticides and pesticides management. He holds a Master of Science in Soil & Water Engineering from Haramaya University.

Mohamed Yussuf, Ph.D. Partner Country Systems/Context Specialist—Somalia. Dr. Yussuf is a senior Regional Livelihoods and Food Security Expert and brings about 10 years of professional experience in humanitarian and emergency programming and market systems; and about 7 years of experience as technical advisor and lead consultant in market systems, economic development livelihoods, food security, climate adaptation and resilience, agriculture, fisheries, early recovery and youth empowerment. Dr. Yussuf brings in diverse work experience in Arid and Semi-Arid lands (ASAL), Kenya. He has conducted vulnerability capacity assessments, socio economic assessments, climate resilience and adaptation, animal health assessments with linkage to livelihoods within the above-mentioned sectors. In addition, he has developed resilience plans, markets-for-poor approaches and markets access models in ASALs. Dr. Yussuf has delivered customised organisational, institutional, capacity building and markets management consulting solutions in Refugee and Post Refugee contexts in ASALs in Kenya, Somalia, South Sudan, Ethiopia and Uganda.

Dr. Yussuf holds a Master of Science in Veterinary Epidemiology and Economics from the University of Nairobi and a PhD in Veterinary Science from the University of Cambridge.

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FROM THE AMERICAN PEOPLE

Daniela Kaegi <dkaegi@usaid.gov>

Request for Clearance – Desert Locust Programmatic Environmental Assessment (3 Country East Africa)

Daniela Kaegi <dkaegi@usaid.gov> Wed, Nov 4, 2020 at 9:58 AM
Draft

On Mon, Nov 2, 2020 at 12:17 PM Taylor Garrett <tgarrett@usaid.gov> wrote:

Hi Gina and Dennis, thank you!

I too have reviewed and it looks good to me also. I clear!

Taylor.

Taylor Garrett
Acting Director, Office of Africa
USAID/Bureau for Humanitarian Assistance
Cell: 703 473 7193
Alt Cell: 202 431 6233
tgarrett@usaid.gov
Admin Assistant: Kim Jensen, kjensen@usaid.gov

On Mon, Nov 2, 2020 at 9:44 AM Gina Vorderstrasse <gvorderstrasse@usaid.gov> wrote:

Hi Taylor!

Yes, this looks good to me as well.

Best,
Gina

On Mon, Nov 2, 2020 at 5:37 AM Dennis Weller <dweller@usaid.gov> wrote:

Yes, Taylor--this looks good to me. It allows us to have a bit more flexibility in the range of pesticides that can be used for locust control in Ethiopia and in other heavily locust-infested EA countries.

Dennis Weller
USAID's Bureau for Humanitarian Assistance
Sudan Team Leader (acting) / East Africa Desert Locust group
Cell: 336-324-7835 email: dweller@usaid.gov

USAID
FROM THE AMERICAN PEOPLE

Daniela Kaegi <dkaegi@usaid.gov>

Request for Clearance – Desert Locust Programmatic Environmental Assessment (3 Country East Africa)

Yene Belayneh <ybelayneh@usaid.gov> Fri, Oct 30, 2020 at 11:35 AM
To: Erika Clesceri <eclesceri@usaid.gov>
Cc: Taylor Garrett <tgarrett@usaid.gov>, Michael Zeleke <mzeleke@usaid.gov>, Dennis Weller <dweller@usaid.gov>, Gina Vorderstrasse <gvorderstrasse@usaid.gov>, Emily Beggins <ebeggins@usaid.gov>, Shawntel Hines <shines@usaid.gov>, Patrick Robin <probin@usaid.gov>, Cara Christie <cchristie@usaid.gov>, Carolyn Troy <ctroy@usaid.gov>, Taylor Stager <tstager@usaid.gov>, Chequetta Washington <cwashington@usaid.gov>, William Thomas <withomas@usaid.gov>, "Hirsch, Brian(AFR/SD)" <bhirsch@usaid.gov>, Mark Stoughton <Mark.Stoughton@cadmusgroup.com>, Daniela Kaegi <dkaegi@usaid.gov>, Chris Pettit <cpettit@usaid.gov>

Dear Erika:

As always, thank you for your support. You and your team's yeoman's work in getting the PEA finalized is much appreciated. I clear the updated PEA.

thx,
Yene
[Quoted text hidden]
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Yeneneh Belayneh, Ph.D., Senior Technical Advisor, Pests and Pesticides, USAID/BHA/TPQ, RRB 8.7.100, 1300 Pennsylvania Avenue, NW Washington, D.C. 20523, USA ybelayneh@usaid.gov, Phone: 202-712-1859 (off), 703-362-5721 (mobile); Link to Pest Monitoring and Management Website: https://www.usaid.gov/what-we-do/working-crises-and-conflict/responding-times-crisis/how-we-do-it/humanitarian-sectors/agriculture-and-food-security/pest-and-pesticide-monitoring