Capacity Development

Food and Agriculture Organization of the United Nations

International Plant Protection Convention

JUNE 2019

ENG

Guide for Establishing and Maintaining Pest Free Areas

Understanding the principal requirements for pest free areas, pest free places of production, pest free production sites and areas of low pest prevalence

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Required citation:
FAO. 2019. *Guide for establishing and maintaining pest free areas*. Rome. Published by FAO on behalf of the Secretariat of the International Plant Protection Convention (IPPC).

ISBN 978-92-5-131764-8

Abstract

The purpose of the guide is to support national plant protection organizations (NPPOs) who wish to establish and maintain pest free areas (PFA) including places and/or production sites (PFPP and PFPS) as well as areas of low pest prevalence (ALPP). To facilitate an understanding of the processes to establish and maintain PFAs and ALPPs, a diagram in the form of a decision tree was constructed that identifies and outlines five general phases of programme development as follows: initiation, feasibility, establishment, maintenance, and market access phases. The guide is then divided into corresponding Sections that describe what the key elements of each phase are, why these elements are important, what some of the common challenges and pitfalls are, and factors that may influence the success of the different phases such as budget stability, public outreach, availability of good survey and control tools, and open engagement with stakeholders and trading partners. By providing a deeper understanding of the factors that should be considered when establishing a PFA, PFPP, PFPS or ALPP the guide aims to overcome the challenges and maximize the impact of these efforts to the benefit of all parties. The guide concludes by providing a number of case studies from around the world that highlight successful PFA and ALPP programmes and how they deal with particular key issues. This guide contains current experience and the most advanced phytosanitary procedures in the implementation of PFA and ALPP, however, it is subjected to revision and updates as new developments in the international phytosanitary arena emerge.

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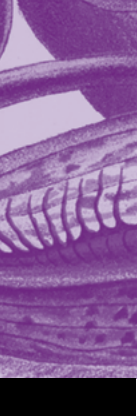


Acknowledgements

This document was created under the auspices of the Secretariat of the International Plant Protection Convention as a component of the IPPC National Phytosanitary Capacity Building Strategy, which was adopted by the fifth session of the Commission on Phytosanitary Measures (2010) of the IPPC. This work has been developed and peer-reviewed by selected experts all over the world under the coordination of the IPPC Secretariat with the oversight of the IPPC Implementation and Capacity Development Committee. With this multinational team, it is hoped that the guide is globally applicable.

Case studies

Acronyms

ALPP	Area of Low Pest Prevalence
APHIS	see USDA-APHIS
CE	Ceará (state of Brazil)
FTD	Fly Trap Day (average number of flies per trap per day)
GPS	Global Positioning System
IAEA	International Atomic Energy Agency
IPPC	International Plant Protection Convention
IPM	Integrated Pest Management
ISPM	International Standard for Phytosanitary Measures
MAT	Male Annihilation Technique
NAPPO	North American Plant Protection Organization
NPPO	National Plant Protection Organization
PFA	Pest Free Area
PFPP	Pest Free Place of Production
PFPS	Pest Free Production Site
PMP	Pest Management Practices
PPQ	Plant Protection and Quarantine unit of USDA-APHIS
PRA	Pest Risk Analysis
RN	Rio Grande do Norte (State of Brazil)
RPPO	Regional Plant Protection Organization
SAGARPA	Secretaria de Agricultura, Ganaderia, Desarrollo Rural, Pesca y Alimentacion, Mexico
SENASA	Servicio Nacional de Sanidad Agropecuaria, Honduras
	Servicio Nacional de Sanidad y Calidad Agroalimentaria, Argentina
SENASICA	Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria, Mexico
SIT	Sterile Insect Technique
SPS Agreement	WTO Agreement on the Application of Sanitary and Phytosanitary Measures
USDA	United States Department of Agriculture
USDA-APHIS	USDA Animal and Plant Health Inspection Service
WTO	World Trade Organization

Definitions

Additional declaration
A statement that is required by an importing country to be entered on a phytosanitary certificate and which provides specific additional information on a consignment in relation to regulated pests or regulated articles [FAO, 1990; revised ICPM, 2005; CPM, 2016]

Area
An officially defined country, part of a country or all or parts of several countries [FAO, 1990; revised ISPM 2, 1995; CEPM, 1999; based on the World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures (WTO, 1994)]

Area of low pest prevalence
An area, whether all of a country, part of a country, or all or parts of several countries, as identified by the competent authorities, in which a specific pest is present at low levels and which is subject to effective surveillance or control measures [IPPC, 1997; revised CPM, 2015]

Biological control agent
A natural enemy, antagonist or competitor, or other organism, used for pest control [ISPM 3, 1995; revised ISPM 3, 2005]

Buffer zone
An area surrounding or adjacent to an area officially delimited for phytosanitary purposes in order to minimize the probability of spread of the target pest into or out of the delimited area, and subject to phytosanitary or other control measures, if appropriate [ISPM 10, 1999; revised ISPM 22, 2005; CPM, 2007]

Commodity
A type of plant, plant product, or other article being moved for trade or other purpose [FAO, 1990; revised ICPM, 2001]

Consignment
A quantity of plants, plant products or other articles being moved from one country to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of one or more commodities or lots) [FAO, 1990; revised ICPM, 2001]

Containment
Application of phytosanitary measures in and around an infested area to prevent spread of a pest [FAO, 1995]

Contaminating pest
A pest that is carried by a commodity, packaging, conveyance or container, or present in a storage place and that, in the case of plants and plant products, does not infest them [CEPM, 1996; revised CEPM, 1999; CPM, 2018]

Contamination
Presence of a contaminating pest or unintended presence of a regulated article in or on a commodity, packaging, conveyance, container or storage place [CEPM, 1997; revised ICPM, 1999; CPM, 2018]

Control (of a **pest**)
Suppression, containment or eradication of a pest population [FAO, 1995]

Corrective action plan (in an **area**)
Documented plan of phytosanitary actions to be implemented in an area officially delimited for phytosanitary purposes if a pest is detected or a tolerance level is exceeded or in the case of faulty implementation of officially established procedures [CPM, 2009]

Delimiting survey
Survey conducted to establish the boundaries of an area considered to be infested by or free from a pest [FAO, 1990]

Detention
Keeping a consignment in official custody or confinement, as a phytosanitary measure [FAO, 1990; revised FAO, 1995; CEPM, 1999; ICPM, 2005]

Ecosystem
A dynamic complex of plant, animal and micro-organism communities and their abiotic environment interacting as a functional unit [ISPM 3, 1995; revised ICPM, 2005]

Efficacy (of a **treatment**)
A defined, measurable, and reproducible effect by a prescribed treatment [ISPM 18, 2003]

Endangered area
An area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss [ISPM 2, 1995]

Entry (of a **consignment**)
Movement through a point of entry into an area [FAO, 1995]

Entry (of a **pest**)
Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled [ISPM 2, 1995]

Equivalence (of **phytosanitary measures**)
The situation where, for a specified pest risk, different phytosanitary measures achieve a contracting party's appropriate level of protection [FAO, 1995; revised CEPM, 1999; based on the World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures (WTO, 1994); [ISPM 24, 2005]

Eradication
Application of phytosanitary measures to eliminate a pest from an area [FAO, 1990; revised FAO, 1995; formerly "eradicate"]

Establishment (of a **pest**)
Perpetuation, for the foreseeable future, of a pest within an area after entry [FAO, 1990; revised ISPM 2, 1995; IPPC, 1997; formerly "established"]

Exclusion (of a **pest**)
Application of phytosanitary measures to prevent the entry or establishment of a pest into an area [CPM, 2018]

Free from (of a **consignment, field** or **place of production**)
Without pests (or a specific pest) in numbers or quantities that can be detected by the application of phytosanitary procedures [FAO, 1990; revised FAO, 1995; CEPM, 1999]

Fruits and vegetables (as a **commodity class**)
Fresh parts of plants intended for consumption or processing and not for planting [FAO, 1990; revised ICPM, 2001]

Fumigation
Treatment with a chemical agent that reaches the commodity wholly or primarily in a gaseous state [FAO, 1990; revised FAO, 1995]

Grain (as a **commodity class**)
Seeds (in the botanical sense) for processing or consumption, but not for planting [FAO, 1990; revised ICPM, 2001; CPM, 2016]

Growing medium
Any material in which plant roots are growing or intended for that purpose [FAO, 1990]

Growing season
Period or periods of the year when plants actively grow in an area, place of production or production site [FAO, 1990; revised ICPM, 2003]

Host range
Species capable, under natural conditions, of sustaining a specific pest or other organism [FAO, 1990; revised ISPM 3, 2005]

Import permit
Official document authorizing importation of a commodity in accordance with specified phytosanitary import requirements [FAO, 1990; revised FAO, 1995; ICPM, 2005]

Incidence (of a **pest**)
Proportion or number of units in which a pest is present in a sample, consignment, field or other defined population [CPM, 2009]

Incursion
An isolated population of a pest recently detected in an area, not known to be established, but expected to survive for the immediate future [ICPM, 2003]

Infestation (of a **commodity**)
Presence in a commodity of a living pest of the plant or plant product concerned. Infestation includes infection [CEPM, 1997; revised CEPM, 1999]

Inspection
Official visual examination of plants, plant products or other regulated articles to determine if pests are present or to determine compliance with phytosanitary regulations [FAO, 1990; revised FAO, 1995; formerly "inspect"]

Inspector
Person authorized by a national plant protection organization to discharge its functions [FAO, 1990]

Integrity (of a **consignment**)
Composition of a consignment as described by its phytosanitary certificate or other officially acceptable document, maintained without loss, addition or substitution [CPM, 2007]

Intended use
Declared purpose for which plants, plant products or other articles are imported, produced or used [ISPM 16, 2002; revised CPM, 2009]

Interception (of a **consignment**)
The refusal or controlled entry of an imported consignment due to failure to comply with phytosanitary regulations [FAO, 1990; revised FAO, 1995]

Interception (of a **pest**)
The detection of a pest during inspection or testing of an imported consignment [FAO, 1990; revised CEPM, 1996]

International Plant Protection Convention
International Plant Protection Convention, as deposited with FAO in Rome in 1951 and as subsequently amended [FAO, 1990]

International Standard for Phytosanitary Measures
An international standard adopted by the Conference of FAO, the Interim Commission on Phytosanitary Measures or the Commission on Phytosanitary Measures, established under the IPPC [CEPM, 1996; revised CEPM, 1999]

International standards
International standards established in accordance with Article X paragraphs 1 and 2 of the IPPC [IPPC, 1997]

Introduction (of a **pest**)
The entry of a pest resulting in its establishment [FAO, 1990; revised ISPM 2, 1995; IPPC, 1997]

Inundative release
The release of large numbers of mass-produced biological control agents or beneficial organisms with the expectation of achieving a rapid effect [ISPM 3, 1995; revised ISPM 3, 2005]

Lot
A number of units of a single commodity, identifiable by its homogeneity of composition, origin etc., forming part of a consignment [FAO, 1990]

Monitoring
An official ongoing process to verify phytosanitary situations [CEPM, 1996]

Monitoring survey
Ongoing survey to verify the characteristics of a pest population [ISPM 4, 1995]

National plant protection organization
Official service established by a government to discharge the functions specified by the IPPC [FAO, 1990; formerly "plant protection organization (national)"]

Non-quarantine pest
Pest that is not a quarantine pest for an area [FAO, 1995]

Official
Established, authorized or performed by a national plant protection organization [FAO, 1990]

Official control
The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests [ICPM, 2001]

Outbreak
A recently detected pest population, including an incursion, or a sudden significant increase of an established pest population in an area [FAO, 1995; revised ICPM, 2003]

Packaging
Material used in supporting, protecting or carrying a commodity [ISPM 20, 2004]

Pathogen
Microorganism causing disease [ISPM 3, 1995]

Pathway
Any means that allows the entry or spread of a pest [FAO, 1990; revised FAO, 1995]

Pest
Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products. Note: In the IPPC, "plant pest" is sometimes used for the term "pest" [FAO, 1990; revised ISPM 2, 1995; IPPC, 1997; CPM, 2012]

Pest free area
An area in which a specific pest is absent as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained [ISPM 2, 1995; revised CPM, 2015]

Pest free place of production
Place of production in which a specific pest is absent as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period [ISPM 10, 1999; revised CPM, 2015]

Pest free production site
A production site in which a specific pest is absent, as demonstrated by scientific evidence, and in which, where appropriate, this condition is being officially maintained for a defined period [ISPM 10, 1999; revised CPM, 2015]

Pest record
A document providing information concerning the presence or absence of a specific pest at a particular location at a certain time, within an area (usually a country) under described circumstances [CEPM, 1997]

Pest risk (for **quarantine pests**)
The probability of introduction and spread of a pest and the magnitude of the associated potential economic consequences [ISPM 2, 2007]

Pest risk (for **regulated non-quarantine pests**)
The probability that a pest in plants for planting affects the intended use of those plants with an economically unacceptable impact [ISPM 2, 2007]

Pest risk analysis (agreed interpretation)
The process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it [ISPM 2, 1995; revised IPPC, 1997; ISPM 2, 2007]

Pest risk management (for **quarantine pests**)
Evaluation and selection of options to reduce the risk of introduction and spread of a pest [ISPM 2, 1995; revised ISPM 11, 2001]

Pest risk management (for **regulated non-quarantine pests**)
Evaluation and selection of options to reduce the risk that a pest in plants for planting causes an economically unacceptable impact on the intended use of those plants [ICPM, 2005]

Pest status (in an **area**)
Presence or absence, at the present time, of a pest in an area, including where appropriate its distribution, as officially determined using expert judgement on the basis of current and historical pest records and other information [CEPM, 1997; revised ICPM, 1998]

Phytosanitary action
An official operation, such as inspection, testing, surveillance or treatment, undertaken to implement phytosanitary measures [ICPM, 2001; revised ICPM, 2005]

Phytosanitary certificate
An official paper document or its official electronic equivalent, consistent with the model certificates of the IPPC, attesting that a consignment meets phytosanitary import requirements [FAO, 1990; revised CPM, 2012]

Phytosanitary certification
Use of phytosanitary procedures leading to the issue of a phytosanitary certificate [FAO, 1990]

Phytosanitary import requirements
Specific phytosanitary measures established by an importing country concerning consignments moving into that country [ICPM, 2005]

Phytosanitary legislation
Basic laws granting legal authority to a national plant protection organization from which phytosanitary regulations may be drafted [FAO, 1990; revised FAO, 1995]

Phytosanitary measure (agreed interpretation)
Any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests [ISPM 4, 1995; revised IPPC, 1997; ICPM, 2002]

Phytosanitary procedure
Any official method for implementing phytosanitary measures including the performance of inspections, tests, surveillance or treatments in connection with regulated pests [FAO, 1990; revised FAO, 1995; CEPM, 1999; ICPM, 2001; ICPM, 2005]

Phytosanitary regulation
Official rule to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests, including establishment of procedures for phytosanitary certification [FAO, 1990; revised ISPM 4, 1995; CEPM, 1999; ICPM, 2001]

Phytosanitary security (of a **consignment)**
Maintenance of the integrity of a consignment and prevention of its infestation and contamination by regulated pests, through the application of appropriate phytosanitary measures [CPM, 2009]

Place of production
Any premises or collection of fields operated as a single production or farming unit. [FAO, 1990; revised CEPM, 1999; CPM, 2015]

Plant products
Unmanufactured material of plant origin (including grain) and those manufactured products that, by their nature or that of their processing, may create a risk for the introduction and spread of pests [FAO, 1990; revised IPPC, 1997; formerly "plant product"]

Plants
Living plants and parts thereof, including seeds and germplasm [FAO, 1990; revised IPPC, 1997]

Point of entry
Airport, seaport, land border point or any other location officially designated for the importation of consignments, or the entrance of persons [FAO, 1995; revised CPM, 2015]

Production site
A defined part of a place of production, that is managed as a separate unit for phytosanitary purposes [CPM, 2015]

Prohibition
A phytosanitary regulation forbidding the importation or movement of specified pests or commodities [FAO, 1990; revised FAO, 1995]

Quarantine
Official confinement of regulated articles, pests or beneficial organisms for inspection, testing, treatment, observation or research [FAO, 1990; revised ISPM 3, 1995; CEPM, 1999; CPM, 2018]

Quarantine area
An area within which a quarantine pest is present and is being officially controlled [FAO, 1990; revised FAO, 1995]

Quarantine pest
A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled [FAO, 1990; revised FAO, 1995; IPPC 1997]

Refusal
Forbidding entry of a consignment or other regulated article when it fails to comply with phytosanitary regulations [FAO, 1990; revised FAO, 1995]

Regional plant protection organization
An intergovernmental organization with the functions laid down by Article IX of the IPPC [FAO, 1990; revised FAO, 1995; CEPM, 1999; formerly "plant protection organization (regional)"]

Regulated article
Any plant, plant product, storage place, packaging, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved [FAO, 1990; revised FAO, 1995; IPPC, 1997]

Regulated non-quarantine pest
A non-quarantine pest whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of the importing contracting party [IPPC, 1997]

Regulated pest
A quarantine pest or a regulated non-quarantine pest [IPPC, 1997]

Release (into the environment)
Intentional liberation of an organism into the environment [ISPM 3, 1995]

Seeds (as a **commodity class)**
Seeds (in the botanical sense) for planting [FAO, 1990; revised ICPM, 2001; CPM, 2016]

Spread (of a **pest)**
Expansion of the geographical distribution of a pest within an area [ISPM 2, 1995]

Sterile insect
An insect that, as a result of a specific treatment, is unable to reproduce [ISPM 3, 2005]

Sterile insect technique
Method of pest control using area-wide inundative release of sterile insects to reduce reproduction in a field population of the same species [ISPM 3, 2005]

Suppression
The application of phytosanitary measures in an infested area to reduce pest populations [FAO, 1995; revised CEPM, 1999]

Surveillance
An official process which collects and records data on pest presence or absence by survey, monitoring or other procedures [CEPM, 1996; revised CPM, 2015]

Survey
An official procedure conducted over a defined period of time to determine the characteristics of a pest population or to determine which species are present in an area [FAO, 1990; revised CEPM, 1996; CPM, 2015]

Systems approach
A pest risk management option that integrates different measures, at least two of which act independently, with cumulative effect [ISPM 14, 2002; revised ICPM, 2005; CPM, 2015]

Technically justified
Justified on the basis of conclusions reached by using an appropriate pest risk analysis or, where applicable, another comparable examination and evaluation of available scientific information [IPPC, 1997]

Test
Official examination of plants, plant products or other regulated articles, other than visual, to determine if pests are present, identify pests or determine compliance with specific phytosanitary requirements [FAO, 1990; revised CPM, 2018]

Tolerance level (of a **pest)**
Incidence of a pest specified as a threshold for action to control that pest or to prevent its spread or introduction [CPM, 2009]

Transience
Presence of a pest that is not expected to lead to establishment [ISPM 8, 1998]

Transparency
The principle of making available, at the international level, phytosanitary measures and their rationale [FAO, 1995; revised CEPM, 1999; based on the World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures (WTO, 1994)]

Treatment
Official procedure for the killing, inactivation or removal of pests, or for rendering pests infertile or for devitalization [FAO, 1990, revised FAO, 1995; ISPM 15, 2002; ISPM 18, 2003; ICPM, 2005]

Visual examination
Examination using the unaided eye, lens, stereoscope or other optical microscope [ISPM 23, 2005; revised CPM, 2018]

Note: These definitions are sourced from the *IPPC Glossary of phytosanitary terms* (ISPM 5). This list includes only the glossary terms that are used in this guide. The Glossary is updated annually based on decisions taken by the IPPC Commission on Phytosanitary Measures. The complete and updated glossary is maintained at: http://www.ippc.int/publications/glossary-phytosanitary-terms. The definitions are accurate as of November 2018.

Names of pests and host plants

Scientific name	Common name(s) used in this guide
Anastrepha fraterculus (Wiedmann)	South American fruit fly
Anastrepha grandis (Macquart)	South American cucurbit fruit fly
Anastrepha ludens (Loew)	Mexican fruit fly
Anastrepha obliqua (Macquart)	West Indian fruit fly
Bactrocera correcta Bezzi	guava fruit fly
Bactrocera dorsalis (Hendel)	oriental fruit fly
Cactoblastis cactorum Berg	cactus moth
Ceratitis capitata (Wiedmann)	Mediterranean fruit fly, medfly
Ceratitis rosa Karsch	Natal fruit fly
Cochliomyia hominivorax (Coquerel)	New World screwworm
Conotrachelus spp.	weevil
Copturus aguacatae Kissinger	avocado branch borer
Cucumis melo L.	melon
Cydia pomonella (L.)	codling moth
Delia antiqua (Meigen)	onion fly
Drosophila suzukii (Matsumura)	spotted wing drosophila (SWD)
Epiphyas postvittana (Walker)	light brown apple moth (LBAM)
Hylocereus undatus (Haworth)	dragon fruit, pitahaya
Lobesia botrana (Denis and Schiffermüller)	European grapevine moth (EGVM)
Lycorma deliculata (White)	spotted lanternfly
Mangifera indica L.	mango
Opuntia spp.	prickly pear
Persea americana Mell.	Hass avocado
Ralstonia solanacearum (Smith) Yabuuchi *et al.*	(causal agent of potato brown rot)
Rhagoletis cerasi L.	European cherry fruit fly
Rhagoletis indifferens Curran	western cherry fruit fly
Rhagoletis pomonella (Walsh)	apple maggot
Sternochetus mangiferae (Fabricius)	mango seed weevil
Thaumatotibia leucotreta (Meyrick)	false codling moth
Tilletia indica Mitra	(causal agent of karnal blunt)
Trogoderma granarium (Everts)	khapra beetle
Vaccinium spp.	includes blueberry, bilberry and cranberry
Xylella fastidiosa Wells *et al.*	(causal agent of Pierce's disease, scorch diseases, etc.)

Introduction

This guide is aimed at providing guidance on the establishment and maintenance of pest free areas (PFA), pest free places of production (PFPPs), pest free production sites (PFPSs) and areas of low pest prevalence (ALPPs) as phytosanitary measures to facilitate safe trade and improve the phytosanitary status of a country. The users of this manual may include officials in National Plant Protection Organizations (NPPOs) and Regional Plant Protection Organizations (RPPOs), as well as direct beneficiaries in the horticultural industry such as growers, packers and shippers and other stakeholders. To facilitate an understanding of the processes involved in establishing and maintaining a PFA, PFPP, PFPS or ALPP, a diagram in the form of a *Decision Tree* has been developed (Figure 1). In addition, *Case Studies* of active PFA, PFPP, PFPS and ALPP programmes have been included at the end of the guide (only some of which are referenced in the text) that further illustrate why such programmes are undertaken, how they operate, challenges they have faced, and what the benefits have been.

DECISION TREE – HOW TO USE THE GUIDE

To help structure the manual and conceptualize the decision processes and management components that are critical to successfully establishing and maintaining a PFA, PFPP, PFPS or ALPP, a stepwise decision tree has been developed (Figure 1). It is assumed that the pest status of different targeted areas has been assessed as per International Standard for Phytosanitary Measures (ISPM) 8 (*Determination of pest status in area*), resulting in the determination of the status of a regulated pest as present (area infested) or absent (area not infested). It is also assumed that, based on official records, the commodity of interest is known to be a host of the regulated pest in the area. A commodity with a non-host status category is exempt from phytosanitary regulations. In the case of fruit fly pests, guidelines for determination of host status are described in ISPM 37 (*Determination of host status of fruit to fruit flies (Tephritidae)*).

ISPM 8 (Determination of pest status in an area): Scope

This standard describes the content of a pest record, and the use of pest records and other information in the determination of pest status in an area. Descriptions of pest status categories are provided as well as recommendations for good reporting practices.

ISPM 37 (Determination of host status of fruit to fruit flies (Tephritidae)): Scope

This standard provides guidelines for the determination of host status of fruit to fruit flies (Tephritidae) and describes three categories of host status of fruit to fruit flies.

This standard includes methodologies for surveillance under natural conditions and field trials under semi-natural conditions that should be used to determine the host status of undamaged fruit to fruit flies for cases where host status is uncertain. This standard does not address requirements to protect plants against the introduction and spread of fruit flies.

The infested area can be subjected to no action (remains infested) or to three different control options:

- population eradication leading to a PFA, PFPP or PFPS
- population suppression leading to an ALPP, within which a systems approach might then be applied to facilitate exports of commodities from targeted areas
- population control through general pest management practices (PMP).

For the first two pest control options, the diagram presents a series of decisions leading to the verification, declaration, recognition and maintenance of a PFA, PFPP, PFPS or ALPP, followed by the issuance of a phytosanitary certificate attesting that a consignment meets phytosanitary import requirements.

For the third option, compliance with import requirements is achieved through the application of PMP in combination with postharvest treatments.

The non-infested area is subjected to verification, declaration, recognition and maintenance of pest free status through surveillance systems, phytosanitary measures and the application of emergency actions as part of a contingency plan should the pest of concern be detected.

Each section of the guide is referred to in the decision tree with a corresponding number in a way that allows the user to follow the logical sequence of steps leading to a PFA, PFPP, PFPS, ALPP or use of PMP. Furthermore, for better understanding of the process, the decision tree is divided into five general phases as follows: initiation, programme development, establishment, maintenance, and market access. The main actions in the initiation phase include identification of the crop(s) and pest to be regulated under a PFA/PFPP/PFPS/ALPP or with use of PMP, determination of the targeted area, and surveillance activities. It includes the gathering of baseline information necessary to conduct a pest risk analysis (PRA), as well as more general information on the commitment of critical public and private sectors (direct beneficiaries), engagement of other relevant stakeholders (law enforcement, suppliers, service contractors, etc.), sources of financial support, possible organizational structure, available infrastructure and other considerations. This phase is fundamental for decision makers as they define the objectives of the desired or intended programme to be implemented, whether that be the maintenance or establishment of pest absence (PFAs, PFPPs and PFPSs), low pest prevalence (ALPP) or pest under PMP. The decision on a pest control option to be selected will be made based on a detailed PRA including a technical and economic feasibility assessment. In the programme development phase, a strategic plan is prepared that outlines an organizational structure and financial and technical plans. In this phase, if necessary, a more detailed cost-benefit analysis can be conducted using new information available on the strategic plan. The establishment and maintenance phases include all necessary phytosanitary measures to achieve and maintain the targeted pest presence/absence level in the designated area. The market access phase includes issuance of a phytosanitary certificate that shows that a consignment meets import requirements.

STRATEGIC PLAN – GENERAL INFORMATION

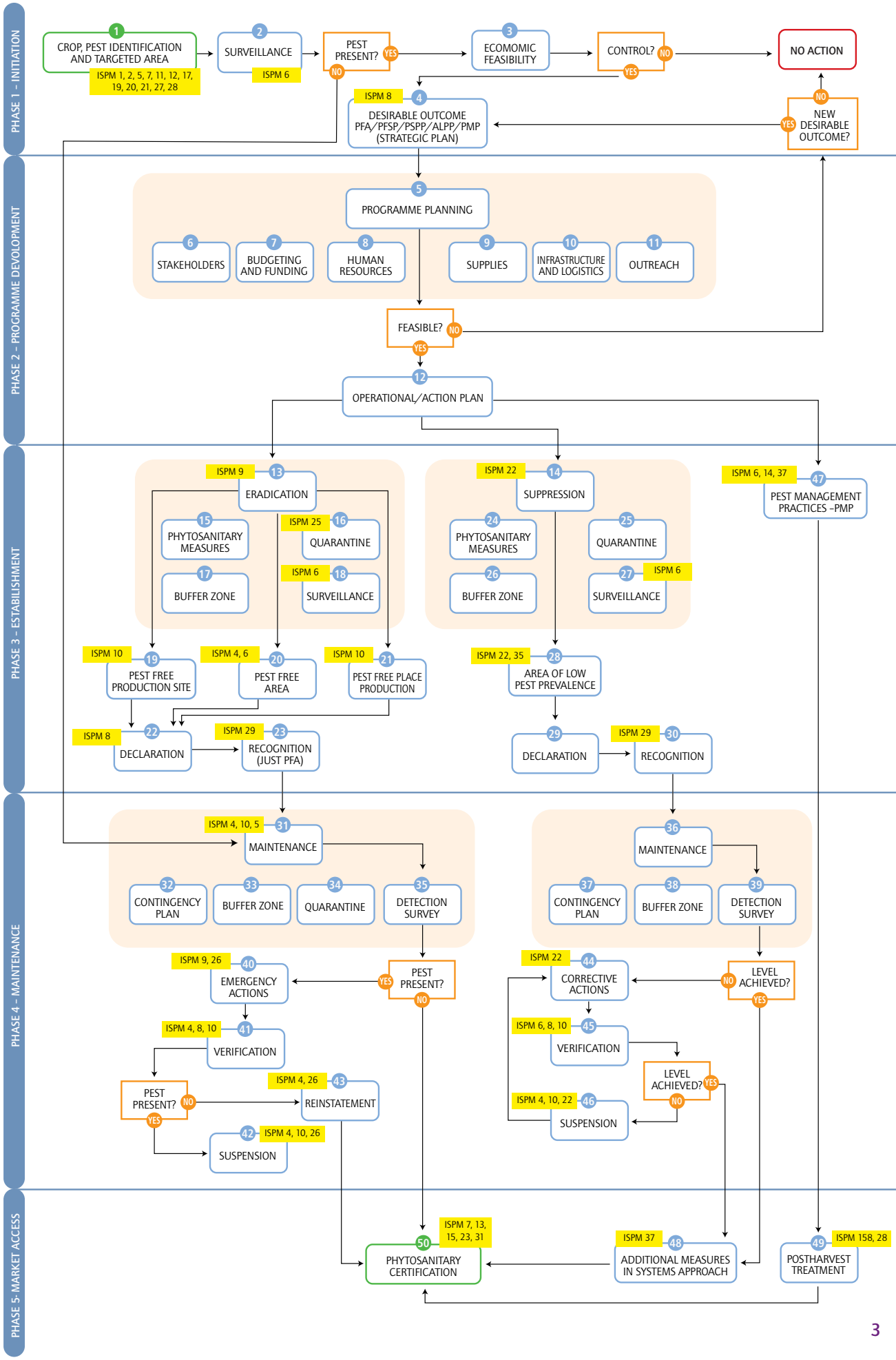
Once the objective of the pest control intervention has been defined, stakeholders should prepare a detailed and comprehensive strategic plan that will guide programme development and implementation (operational/action plan). The strategic plan provides a higher-level vision and direction for the programme for policy makers and other stakeholders involved. For reference purposes, the strategic plan may be converted into a strategic map that is a simplified graphical representation of all the steps and activities of the programme that need to be carried out. One example of a type of strategic map for implementing a pest free area is shown in Appendix 1: Example of a Strategic Map.

SCOPE OF THE PROGRAMME

The improvement of phytosanitary status can be achieved by combining a number of phytosanitary actions that document and reduce the prevalence of regulated pests in targeted areas. These actions include, among others, implementation of quarantine measures, pest surveillance or buffer zones, which may be integrated in pest eradication programmes in the case of a PFA, PFPP and PFPS or pest suppression programmes in the case of an ALPP. The effective execution of such actions can lead to the recognition of these areas, sites and places as having low pest risk and create opportunities for a country to negotiate market access. However, it should be noted that the establishment and maintenance of PFAs, PFPPs, PFPSs, ALPPs and PMP require a long-term commitment, significant investment of resources, and strong leadership to secure sustainability of the programme. In addition, for these programmes to be successful a strong relationship is required between the NPPO and the primary stakeholders that will directly benefit from the action. Long-term support from a range of other stakeholders including both the public and private sectors is often needed to ensure that a programme remains viable and a country maintains its selected markets.

When considering establishment of a PFA, PFPP or PFPS, there are a range of types of areas as defined by ISPM 4 (*Requirements for the establishment of pest free areas*) and ISPM 10 (*Requirements for the establishment of pest free places of production and pest free production sites*).

Figure 1: Decision tree for establishment and maintenance of PFAs, PFPPs, PFPSs and ALPPs



These include:

- areas that may encompass contiguous parts of two or more countries, a whole country or regions within a country (an example of the last is the *Anastrepha grandis* pest free area for melon production that encompasses regions in north-eastern Brazil (see Box 1 – Case study 1)
- a local production area or several contiguous areas within a country but limited in size
- specific production sites, usually with an appropriate infrastructure designed to exclude the pest or pests of regulatory concern within a generally infested or infected area.

PFAs and related measures are mainly trade driven, directed to a specific commodity or range of commodities and to specific markets. They target a specific pest or suite of pests that are regulated on the plants or plant products intended for export. These measures or actions are often implemented as very structured programmes under the responsibility of the NPPO. These programmes differ significantly

ISPM 4 (Requirements for the establishment of pest free areas): Scope

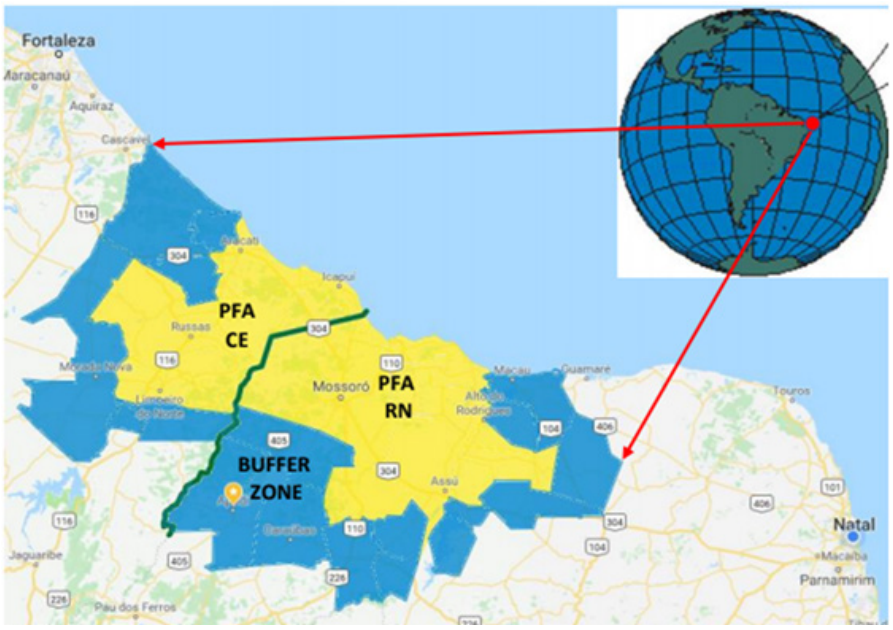
This standard describes the requirements for the establishment and use of pest free areas (PFAs) as a risk management option for phytosanitary certification of plants and plant products and other regulated articles exported from the PFA or to support the scientific justification for phytosanitary measures taken by an importing country for protection of an endangered PFA.

ISPM 10 (Requirements for the establishment of pest free places of production and pest free production sites): Scope

This standard describes the requirements for the establishment and use of pest free places of production and pest free production sites as pest risk management options for meeting phytosanitary import requirements for plants, plant products and other regulated articles.

Box 1: Scope of the programme – PFA for melon production in Brazil

Anastrepha grandis pest free area (yellow) for melon production that encompasses 13 municipalities in the state of Rio Grande do Norte (RN) and 7 municipalities in the state of Ceará (CE), protected by a buffer area (blue) composed of 19 other municipalities, in north-eastern Brazil.



© R. Carlos Papa, Federal Superintendent of Agriculture in Rio Grande do Norte State, Brazil

For more information, see Section 8: Case study 1 – Establishment and maintenance of the South American cucurbit fruit fly (*Anastrepha grandis*) PFA in the states of Rio Grande do Norte and Ceará, Brazil.

from other in-country pest management programmes that are directed towards domestic or non-regulated (i.e. non-quarantine) pests.

Organizational structures and resources of NPPOs vary between countries, as explained in the IPPC (International Plant Protection Convention) guide on *Establishing a National Plant Protection Organization*. Depending on available resources, the NPPOs of some contracting parties have a single plant health programme that addresses both regulated and non-regulated pests, while others delegate management of these pests to other branches of government or ministries or departments or to authorized entities. Phytosanitary measures that NPPOs often use to address regulated pests include those that aim to eradicate pests from an area, contain or limit pest spread, or suppress pest populations to acceptable levels in order to facilitate trade. The set of measures that an NPPO may apply to establish a PFA, ALPP, PFPP or PFPS, or to prevent the introduction of a known pest into an area designated for the production of plant or plant products, is often performed through a bilaterally agreed arrangement with a concerned trading partner and is well documented for later auditing and verification. Keeping this in mind, establishing official communications with the NPPOs of trading partners through the designated points of contact is essential. Communications should follow the IPPC transparency principle (ISPM 1 (*Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade*)) along all steps of the process from the establishment and maintenance of PFAs and ALPPs to the declaration and recognition of these areas.

ISPM 1 (Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade): Scope

This standard describes phytosanitary principles for the protection of plants that are embodied in the International Plant Protection Convention (IPPC) and elaborated in its International Standards for Phytosanitary Measures. It covers principles related to the protection of plants, including cultivated and non-cultivated/unmanaged plants, wild flora and aquatic plants, those regarding the application of phytosanitary measures to the international movement of people, commodities and conveyances, as well as those inherent in the objectives of the IPPC. The standard does not alter the IPPC, extend existing obligations, or interpret any other agreement or body of law.

LEGISLATION

The international framework for the PFA and ALPP is contained in Article VI of the World Trade Organization (WTO) SPS Agreement (Agreement on the Application of Sanitary and Phytosanitary Measures) and in the relevant IPPC Articles.

In the implementation of Article IV.2(e) of the IPPC, the NPPO is responsible for "the protection of endangered areas and the designation, maintenance and surveillance of pest free areas and areas of low pest prevalence". To comply with this responsibility, NPPOs should be supported by appropriate legislation that sets up a national phytosanitary system with the appropriate mandate and capacity.

The legislation should define key terms that will support its interpretation, including a definition of "pest" and "pest free area"[1]. It should identify the NPPO as the national authority mandated to implement provisions of the IPPC[2], and give the NPPO the authority included in Article IV of the IPPC, including the capacity to (i) declare pest free areas, production places and sites, and areas of low pest prevalence[3], and (ii) adopt the phytosanitary measures necessary to maintain, survey and verify this status.

The legislation should also provide mechanisms to maintain PFAs, PFPPs and PFPSs, which should include authorizing the NPPO to prepare a list of regulated pests[4]. This will serve to define the pests that will be subject to regulatory control and serve as the basis for the approval of surveillance programmes, including areas for cultivation and wild flora (Article IV.2(b)). The NPPO must be mandated to approve the necessary surveillance plans and to undertake surveys with the object of reporting the occurrence, outbreak and spread of pests, and of controlling those pests[5]. In the case of pest occurrence, legislation should recognize the power of the NPPO to declare an area as infested or subject to quarantine, and to adopt measures to contain the spread of the pest.

Regulatory control should restrict the movement of certain plants, plant products and regulated articles within areas of a country or countries, including buffer zones[6]. The NPPO should have a clear capacity to detain and, if necessary, seize consignments to prevent restricted movements.

[1] Article II of the IPPC and ISPM 5

[2] Article IV.1 of the IPPC

[3] Article IV.2(e)) of the IPPC

[4] Article VII.2(i) of the IPPC and 1.2.2 of ISPM 4

[5] ISPM 4 point 1.2.1

[6] ISPM 4 point 1.2.2

*Restricting pest movement – Road signs remind/warn vehicle passengers not to move homegrown tree fruit into apple maggot free counties of eastern Washington, the state's core apple growing region. The apple maggot (*Rhagoletis pomonella *(Walsh)), which is not indigenous to the Pacific northwest of the United States of America, was discovered in western Washington in 1980 and a quarantine was established thereafter. The Washington State Department of Transportation installed 70 signs along highways around the state to warn drivers of the quarantine.*

This authority should extend to all regulated articles, including persons, goods, vehicles, and conveyances affected by the operations.

In relation to the international trade of goods, legislation should regulate the importation of plants, plant products and regulated articles that may harbour a pest. To this purpose, the NPPO should be legally mandated to approve risk-based import requirements for products to enter into the country or an area[7], including phytosanitary measures such as inspection, prohibition on importation, and treatment. Legislation must recognize the authority of the NPPO to refuse entry, detail or require treatment, destroy or remove soil from plants and plant products and other regulated articles that do not comply with the prescribed phytosanitary measures[8], and to prohibit or restrict the movement of regulated pests[9] and other organisms of phytosanitary concern[10]. Legislation should establish that consignments that require phytosanitary certification will not be admitted into the country unless accompanied by certificates issued by the NPPO of the exporting country that follow the IPPC model certificate, comply with the provisions of the IPPC and its ISPMs[11], and confirm compliance with the import requirements of the importing country.

The export certification system, based on Article V of the IPPC, will also serve to confirm that consignments originate from PFAs/PFPPs/PFPSs/ALPPs.

Import requirements and other phytosanitary measures must be based on the principles of the IPPC and the SPS Agreement of the WTO, which state that requirements be based on phytosanitary considerations and technically justified[12] and be published and shared with other contracting parties upon request[13], including the rationale for phytosanitary requirements[14]. Phytosanitary measures must be risk based, proportionate, not more strict than necessary, limited to an area and time period, and revised periodically to verify that the circumstances under which they were approved still persist[15].

The NPPO must be legally entitled to designate points of entry into their country, but these should not unnecessarily impede international trade, and the list of such points should be made public[16]. Legislation should also clarify that inspections and procedures will take place as promptly as possible with due regard to the product perishability[17].

To enable implementation, legislation should regulate the designation of relevant phytosanitary officers and/or inspectors and give them the powers to implement the necessary phytosanitary actions.

[7] Article VII

[8] Article VII.1(b)

[9] Article VII.1(c)

[10] Article VII.1(d)

[11] See Article V of the IPPC, ISPM 7, ISPM 12

[12] Article VII.2 (a)

[13] Article VII.2(b)

[14] Article VII.2(c)

[15] See Article VI of the IPPC, ISPM 1, sections 1 and 2

[16] Article VII 2.(d)

[17] Article VII 2.(e)

National ports of entry – Federal regulations require that most imported plants and seeds enter the United States of America (USA) through certain ports of entry. The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine (PPQ) operates 16 plant inspection stations located at or near major international airports and seaports for the inspection and clearance of those items. At the plant inspection stations, PPQ Plant Health Safeguarding Specialists inspect imported plants and seeds to ensure that they are free from plants pests and diseases that are not known to occur in the USA and which could be damaging to either USA agriculture or natural resources.

These powers should include the ability to enter private premises, take samples and control the movement of products, as well as to seize, treat and even destroy articles in case of risk. To prevent abuses of power, legislation should contain appropriate safeguards that control the exercise of the inspectors' powers, such as requiring written justification for certain actions. Legislation should also give the NPPO the possibility to delegate certain functions, such as the implementation of monitoring and surveillance programmes. To ensure data availability, the NPPO should be legally mandated to keep records of pest outbreaks, approved phytosanitary measures and their justification, and the results of operational procedures to monitor, suppress or eradicate a pest[18].

Finally, legislation should recognize the responsibilities of operators to monitor and maintain the phytosanitary status of the areas under their management, including specific obligations for operators to monitor and collect data and to notify the NPPO of changes to their phytosanitary status including the occurrence or suspicion of a pest. It is also advisable to have legal or formal mechanisms to obtain the support of law enforcement officers to enforce legislation when required, in particular when NPPO officers do not have such authority.

[18] See ISPM 4 1.3

Table 1: IPPC framework for PFAs, PFPP, PFPS and ALPPs

Responsibilities of the NPPO (as in IPPC Article IV.2(e))	ISPMs	IPPC basic and operational principles
Protection of endangered areas and the designation, maintenance and surveillance of pest free areas and areas of low pest prevalence	• **ISPM 4** – *Requirements for the establishment of pest free areas* • **ISPM 10** – *Requirements for the establishment of pest free places of production and pest free production sites* • **ISPM 22** – *Requirements for the establishment of areas of low pest prevalence* • **ISPM 26** – *Establishment of pest free areas for fruit flies (Tephritidae)* • **ISPM 29** – *Recognition of pest free areas and areas of low pest prevalence*	**Basic principles** • Sovereignty and cooperation • Managed risk • Minimal impact • Transparency • Non-discrimination • Technical justification • Equivalence of phytosanitary measures • Modification **Operational principles** • Pest risk analysis • Pest listing • Recognition of pest free areas and areas of low pest prevalence • Official control for regulated pests • Systems approach • Surveillance • Pest reporting • Phytosanitary certification • Phytosanitary integrity and security of consignments • Avoidance of undue delays • Information exchange and technical assistance

IPPC BASIC AND OPERATIONAL PRINCIPLES

Contracting parties have sovereign authority, in accordance with applicable international agreements, to prescribe and adopt phytosanitary measures to protect plant health within their territories and to determine their appropriate level of protection including the designation of PFAs, PFPPs, PFPSs and ALPPs and relevant official control programmes within their territories to maintain a certain phytosanitary status and to set phytosanitary regulations to protect or sustain such designations. At the same time, importing contracting parties may require that imported plants, plant products and other regulated articles originate from PFAs, PFPPs, PFPSs and ALPPs, and make decisions relating to recognition of such areas.

Phytosanitary measures as they relate to the establishment, maintenance, declaration and recognition of PFAs, PFPPs, PFPSs and ALPPs, likewise any other phytosanitary measures, should be based on international standards, guidelines and recommendations developed within the framework of the IPPC and follow IPPC basic and operational principles as described in ISPM 1.

The most relevant IPPC basic and operational principles that are applicable to PFAs, PFPPs, PFPSs and ALPPs are listed in Table 1. These principles form a basis for technically justified phytosanitary measures to be applied in the international and domestic movement of people, commodities and conveyances and to cultivated and non-cultivated/unmanaged plants, wild flora and aquatic plants.

The principle of managed risk should guide

importing contracting parties when considering importing regulated articles from PFAs or ALPPs as an effective phytosanitary measure in meeting their appropriate risk level. They should base their import requirements on the ***principle of technical justification*** and not require undue additional phytosanitary measures to articles that originate from PFAs. Importing parties should be interested in providing prompt recognition of such areas in exporting countries where they are established in accordance with the relevant ISPMs. In recognizing PFAs and ALPPs, the process used by the importing party for assessing such requests from different exporting parties should be applied in a ***non-discriminatory and cooperative manner***. If the proposed PFA or ALPP is not recognized, importing parties should provide an explanation, including technical justification where applicable, for this decision.

Importing parties, in meeting their appropriate level of protection and in accordance with requirements for technical justification, may consider PFAs or ALPPs as effective phytosanitary measures and designate PFAs and ALPPs on their territories.

The concept of "pest freedom" allows exporting countries to provide assurance to importing countries that plants, plant products and other regulated articles are free from a specific pest or pests and meet the phytosanitary import requirements when imported from PFAs, PFPPs and PFPSs. In doing so, the NPPO of an exporting contracting party should, on request, make available to the NPPO of the importing party the rationale for establishment and maintenance of such areas based on the ***transparency principle***. When provided by bilateral arrangements, the NPPO of the exporting party should expeditiously provide information concerning establishment or withdrawal of PFAs, PFPPs and PFPSs to the NPPO of the importing party.

In the PFA or ALPP recognition process, updates on progress between the importing and exporting parties should be provided to the designated point of contact, as appropriate or upon request, to ensure that the process is conducted in an open and transparent manner. Contracting parties should endeavour to maintain transparency in all aspects of the recognition process. Any change in the status of the regulated pest in the area under consideration, or in the importing party's territory, that is relevant to recognition shall be communicated appropriately and promptly as required by the IPPC (Article VIII.1(a)) and relevant ISPMs (e.g. ISPM 8 and ISPM 17 (Pest reporting)). To improve transparency, contracting parties are encouraged to make available on the International Phytosanitary Portal (IPP) decisions and updated information on PFAs and ALPPs that have been recognized.

ISPM 17 (Pest reporting): Scope

This standard describes the responsibilities of and requirements for contracting parties in reporting the occurrence, outbreak and spread of pests in areas for which they are responsible. It also provides guidance on reporting successful eradication of pests and establishment of pest free areas.

IPPC operational principles are related to the establishment, implementation and monitoring of phytosanitary measures, and to the administration of official phytosanitary systems. Establishment, maintenance, declaration and recognition of PFAs, PFPPs, PFPSs and ALPPs require contracting parties to have the ability to exercise different phytosanitary measures and operate sound phytosanitary systems; therefore, all the IPPC operational principles are considered relevant.

The operational principle on ***recognition of pest free areas and areas of low pest prevalence*** states that importing parties should recognize the existence of such designations and those related to other official procedures (such as pest free places of production and pest free production sites) within an exporting country, including the designation of these phytosanitary measures as equivalent where appropriate. It may be necessary to make provision within phytosanitary regulatory systems to evaluate and accept the designations by other NPPOs and to respond accordingly.

CONSIDERATIONS WHEN DECIDING WHETHER TO ESTABLISH PEST FREE AREAS, AREAS OF LOW PEST PREVALENCE AND THE USE OF RELATED MEASURES

The motivation for NPPOs to establish a PFA, PFPP, PFPS or ALPP is usually to improve the phytosanitary status of the contracting parties (or "exporting

party") and the capacity of the agricultural industry to export specific fruit and vegetable commodities to potentially high-value external markets including organic markets that require low or no pesticide residue levels on commodities. In some instances, NPPOs could declare PFAs to protect naturally occurring areas where a harmful organism is absent or of limited distribution but could establish due to the climatic conditions, availability of host plants, and other favourable conditions.

In general, a decision to establish a PFA, PFPP, PFPS or ALPP will be determined by:

- type of pest affecting the concerned commodity (step 1 decision tree)
- population level of the regulated pest of concern in the targeted area (step 1 decision tree)
- host status of the commodity of interest (step 1 decision tree)
- a cost–benefit an economic feasibility study (step 3 decision tree)
- planning outcomes covering all of the various factors that will influence the programme (step 4 decision tree)
- benefit to stakeholders from the actions (step 6 decision tree)
- level of existing or potential investment in the production operation, both by the public and private sectors (step 7 decision tree)
- policy of the government towards support for its PFA and ALPP programmes
- technology available for surveillance and control of the pests
- capacity of the NPPO and resources available to implement the actions required, including available infrastructure such as laboratories to perform and expedite identification in case of a pest detection (step 10 decision tree)
- ability to cordon off the area and monitor and control movement through quarantine road stations to protect the PFA (step 10 decision tree)
- feasibility of stakeholders complying with legal and administrative requirements that should be instituted (step 6 decision tree)
- level of commitment to trade of the importing party
- feasibility in maintaining the PFA/ALPP after its establishment.

It is also important to consider the characteristics of the area that might favour the establishment of a PFA or an ALPP, such as (step 1 decision tree):

- climatic conditions for the establishment and spread of the target pest
- natural barriers preventing the introduction and spread of the target pest
- traffic routes with access to the area
- sea-ports or airports in the area under consideration
- host species, density and distribution in the area.

A cost–benefit analysis (step 3 decision tree) is a recommended tool to assist policy makers and technical agencies as well as primary beneficiaries in deciding whether to invest in and make the effort to establish PFAs and related measures (see Sections 2 and 3). It is also important to check whether there is a good prospect for maintaining the continuity of both the PFA/ALPP and the market that is sought.

The establishment of a multi-sectoral task force (NPPO, related ministries, grower associations, international experts, etc.) (step 6 decision tree) to meet and make recommendations/decisions on the technical aspects of implementation may be necessary. Where a PFA extends beyond a country's border, such arrangements should involve the NPPOs concerned, as well as representatives from the relevant RPPO(s) and other cooperating entities.

Considerations for establishing PFAs – The extremely dry natural conditions in Rio Grande do Norte, Brazil, favoured the establishment and maintenance of a PFA for South American cucurbit fruit fly (Anastrepha grandis). *These images were obtained at exactly the same geographical point. The region's drastic dry conditions (pictures on the left side) exclude the growth of* A. grandis *hosts as well as other plants. The absence of main roads, ports, airports or tourist sites further prevents the possibility of introduction of pests. This set of conditions helps to stabilize and maintain the* A. grandis *free area (pictures on the right side – irrigated fields of melon and watermelon).*

Section 1. Initiation

(PHASE 1 DECISION TREE)

The stages outlined in the sections that follow are usually undertaken by the NPPO of an exporting country for the establishment of a PFA, PFPP, PFPS or ALPP, or to export consignments affected by regulated pests under PMP where a postharvest treatment is necessary.

1.1 IDENTIFICATION OF CROP(S) AND PEST TO BE REGULATED UNDER A PFA/ PFPP/PFPS OR ALPP

» (step 1 decision tree - Crop, pest identification and targeted area)

It is the NPPO of the importing country that will have identified the pest to be regulated based on a PRA. An importing country NPPO would, through the PRA process, establish an acceptable level of protection or identify a measure or set of measures (e.g. a systems approach or other integrated measures) that would facilitate trade between it and the exporting country. It would then communicate these management options to the NPPO of the exporting country. When no options can be identified by either party that can reduce the pest risk to a satisfactory level, the importing country may issue a prohibition for the commodity. As stated previously, the closing of a market is usually one of the principal reasons for an exporting country to consider establishing a PFA, PFPP or PFPS, or an ALPP, if accepted by the importing country.

In many cases, the commodity of interest would most likely be already under production in the exporting country and traded either in its internal markets or with other trading partners that do not consider the targeted pest of quarantine significance. The NPPO of the new importing country would have to be satisfied that the pest it is concerned about is not present in the area from which the commodity is intended to be exported, and vice versa the exporting country NPPO will need to ensure that it and/or the relevant institutions (e.g. government agriculture extension services) have the required information (production and pest surveillance information; step 2 decision tree) on the commodity it wants to export as well as on the regulated pest(s) associated with it. The exporting country NPPO should have records dating back at least several years to document pest status. ISPM 6 (*Surveillance*) provides guidance on general surveillance that can help an exporting country NPPO obtain this information. If the crop selected is a new production endeavour to an area and there is no historical information on the crop and associated pest of concern then there could be a significant delay in getting the area recognized by the importing NPPO until such time that sufficient information is compiled.

ISPM 6 (Surveillance): Scope

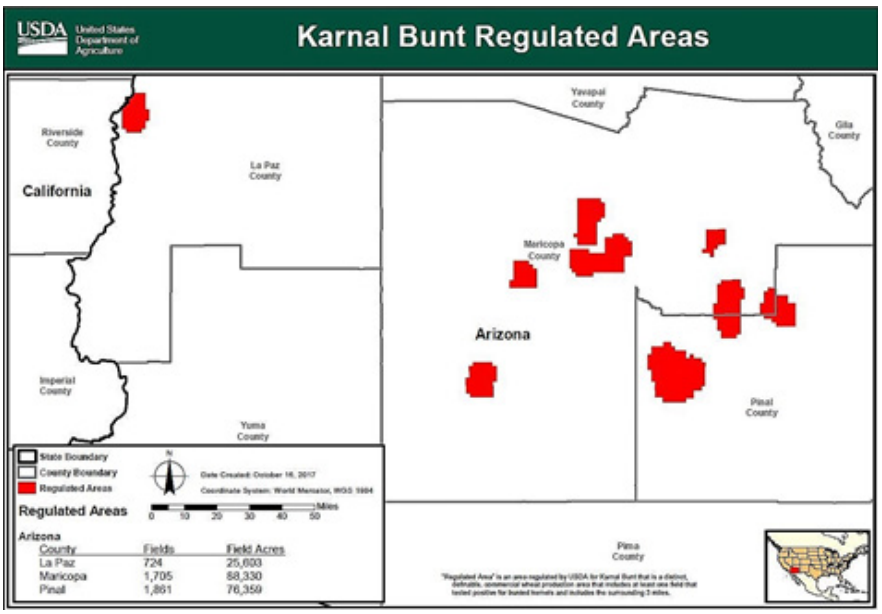
This standard describes the requirements for surveillance, including the components of a national surveillance system.

1.2 DETERMINATION OF THE TARGETED AREA

» (step 1 decision tree - Crop, pest identification and targeted area)

Once the pest to be regulated has been identified, the exporting country NPPO should verify the distribution of the pest in its territory through monitoring and delimiting surveys. In establishing a PFA, natural barriers such as deserts, glaciers, large expanses of water, and mountain ranges, can interfere in the extension of the boundary of the area to be established, but can also be part of a natural border that helps to protect the area's pest free or low pest status. Once defined and recognized, every effort should be made to maintain the area's pest status by actively preventing entry of the target pest through physical barriers, legal controls, traffic and shipping controls such as quarantine checkpoints, pest monitoring and management, and public awareness and outreach programmes. The NPPO of the exporting country should provide the NPPO of the importing country with the exact location of the targeted area including relevant information such as natural barriers, access roads, and sites of quarantine checkpoints.

©International Maize and Wheat Improvement Center (CIMMYT)



©United States Department of Agriculture, Animal and Plant Health Inspection Service

Defining targeted areas – Karnal bunt (caused by the fungus Tilletia indica *Mitra) is thought to have been inadvertently introduced into the United States of America (USA) on infested seed; it was first detected in 1996. Through a successful quarantine and national survey programme, this disease is currently confined to one USA state – Arizona. Many USA trading partners will not accept USA-origin wheat unless the wheat is certified to be from areas of the USA where karnal bunt is not known to occur. Every year, the United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) coordinates a cooperative karnal bunt national survey in wheat-producing counties outside of known regulated areas in Arizona (https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/karnal-bunt/ct_karnal_bunt). The North American Plant Protection Organization (NAPPO) Regional Standard for Phytosanitary Measures 13 (https://www.nappo.org/files/6014/7327/3959/RSPM_13_-_JULY_06-2016-e.pdf) sets the framework for establishing, maintaining and verifying karnal bunt PFAs in North America, including geographical description of the PFA, establishment of regulated articles, approved surveillance, sampling and testing protocols, and documentation of compliance.*

1.3 SURVEILLANCE ACTIVITIES PRIOR TO ESTABLISHMENT

» (step 2 decision tree - Surveillance)

A surveillance programme is an essential component for the establishment and maintenance of a PFA/PFPP/PFPS/ALPP, and will be discussed in various parts of this guide. Surveillance activities are applied at different stages of a PFA/PFPP/PFPS/ALPP:

- prior to the establishment to assist in selection of options
- during the establishment to confirm that the targeted pest status has been achieved, and
- as a continuous practice in maintenance of a PFA/PFPP/PFPS/ALPP to provide assurance that the desired pest status is being maintained.

Surveillance activities undertaken prior to the establishment of a PFA/PFPP/PFPS/ALPP serve to identify the status of the relevant pest in the area, and when appropriate in the buffer zone, for a period determined by pest biology, behaviour, climatic characteristics of the area, host availability and appropriate technical considerations. There are two major types of surveillance systems that could provide the NPPO with relevant data – general surveillance and specific surveys.

General surveillance, as defined by ISPM 6, is "a process whereby information on pests of concern in an area is gathered from various sources". Such processes may include collecting information or data published by NPPOs, other national or local government agencies, international organizations such as Food and Agriculture Organization of the United Nations (FAO) or the IPPC Secretariat, research institutions, universities, scientific societies, and scientific and trade journals, or from unpublished data and contemporary observations.

A specific survey, on the other hand, is an official procedure conducted over a defined period of time to

determine the characteristics of a pest population or to determine which species are present or absent in an area. Depending on one's knowledge of the pest, three types of specific surveys may be conducted:

- Detection surveys are used to determine whether or not a pest species is present in an area.
- Delimiting surveys determine the boundaries of an area considered to be infested or free from a pest. They can also be used as part of an emergency response protocol to delimit the extent of a pest incursion, which may or may not result in an outbreak.
- Monitoring surveys are ongoing surveys that help to establish the characteristics of a pest population including seasonal fluctuations, relative abundance, host sequence and preference, and population trends.

Results of the surveillance activities undertaken prior to the establishment of a PFA/PFPP/PFPS/ALPP form a basis for the selection of an appropriate pest intervention option.

1.4 ECONOMIC FEASIBILITY

» (step 3 decision tree - Economic feasibility)

The decision on the most suitable option for pest control (PFA/PFPP/PFPS/ALPP/PMP) should also be based on a sound economic feasibility study. Costs and benefits for the control options of interest should be computed and used to calculate the return on investment including the benefit to cost ratio, the net revenues and the payback period. Considerations for the study include the size of the intervention area and the time horizon in years that is required to achieve the pest control objective. The time horizon should be sufficient to allow benefits of the control options to fully establish. Economic feasibility studies should also take into consideration the risks involved in being able to maintain a phytosanitary status. In terms of benefits, the preferred pest control option might be a PFA. However, areas subjected to high risks of pest incursions and reinfestation might not be suited to the establishment of a PFA due to the high cost incurred in maintaining the pest free status.

1.5 PEST STATUS AND INTERVENTION OPTIONS

» (step 4 decision tree - Desirable outcome)

The selection of which pest intervention option to pursue will depend primarily on the pest status in the targeted area and the objective of the pest control programme. It is assumed that the pest status of different targeted areas has been assessed as per ISPM 8, resulting in an area or areas where the pest is present (infested) and/or absent (uninfested). If the pest is absent, the targeted area may be maintained pest free through detection surveys, contingency plans and quarantine actions. If the pest is present, the targeted area may be subjected to suppression, eradication, or to general pest management practices. The area may also be left with no pest control actions.

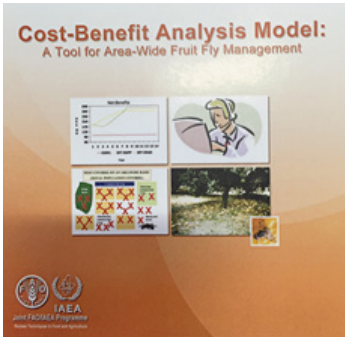
If it is determined that the pest to be regulated is present, the NPPO should:

- determine the feasibility of eradicating the pest from the infested area to establish a PFA, depending on the extent of the pest's distribution (step 13 decision tree); or
- determine the feasibility of establishing PFPSs or PFPPs (steps 19, 21 decision tree); or
- determine the feasibility of suppressing the pest population(s) (step 14 decision tree) to an agreed threshold as part of general pest management practices or for the purpose of establishing an ALPP (step 28 decision tree).

Box 2: Cost–benefit analysis model: a tool for area-wide fruit fly management

A generic fruit fly cost–benefit analysis model is available, aimed at assisting in economic decision making associated with area-wide fruit fly control options.

Ideally the model should be used as a support tool by working groups aiming at assessing the economic returns of different fruit fly control options (suppression, eradication, containment and prevention). The working group should include professionals in agriculture with experience in area-wide implementation of integrated pest management programmes, an economist and, if relevant, an entomologist with a background in the application of the sterile insect technique (SIT) (IAEA, 2007).



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Self-explanatory Excel model IAEA 2007.

Section 2: Programme Development Phase

(PHASE 2 DECISION TREE)

A programme development plan outlining the different elements of a pest control intervention is necessary. The basic elements that a plan should include are: background, problem definition, clear objectives, project duration, identification of stakeholders, implementation strategy, human and material resources needed, procurement, funding, risk elements and risk management, and communication and awareness. The plan should contain a list of expected outputs and appropriate performance indicators and means of verification to monitor and evaluate the progress of programme implementation. This information can be organized in the form of a logical framework matrix (see Appendix 2: Typical Logical Framework Matrix and Work Plan Procedure for Establishing and Maintaining an ALPP and eventually a PFA).

2.1 PROGRAMME STAKEHOLDERS

» (step 6 decision tree - Stakeholders)

Programme stakeholders are "individuals and organizations who are actively involved in the project, or whose interests may be positively or negatively affected as a result of project execution or successful project completion" (Project Management Institute (PMI®), 1996). The NPPO should prepare stakeholder matrices (Figure 2) for both the public and private sectors that include the primary entities most likely to be involved in, called upon for support for, or impacted by, the programme. Such a matrix for the public sector might include:

- operational entities (e.g. inspection staff, extension service, customs, police)
- policy/regulatory organizations (e.g. NPPO staff, forestry departments, environment departments, Ministry of Justice)
- financial institutions (e.g. Ministry of Trade, Ministry of Finance, Budget and Planning Departments of the Ministry of Agriculture, funding agencies, technical assistance providers)
- RPPOs to facilitate recognition of PFAs and ALPPs and trade of the products intended for export
- quarantine inspection site officials to ensure that the general public cooperates with traffic rules and does not transport sensitive material into the PFA, PFPP, PFPS or ALPP.

The NPPO should prepare a similar stakeholder matrix for the main entities from the private sector, which could include:

- technology providers (e.g. information technology support, logistics companies, communication and public relations companies, database providers/managers (step 10 decision tree)
- principal producers/marketers/industry representatives of the products intended for export (main beneficiaries)
- fruit and vegetable distribution centres, as well as retail stores and roadside vendors around the PFA and ALPP, to ensure sensitive products originating outside the PFA, PFPP, PFPS or ALPP are not marketed for sale or distribution inside the quarantine area
- commercial enterprises that could be impacted (e.g. suppliers of pest control products, tourist resorts, passenger and freight transport companies, including air, boat, rail and road)
- the general public, including residents in areas where phytosanitary actions are to be taken and those who traverse PFAs and areas known to be infested by the regulated pest.

These stakeholder matrices serve as internal documents that help the project team to identify the stakeholders to be engaged throughout the life of the programme. In setting up such matrices, stakeholders should be mapped according to their level of involvement or engagement. It is a living document and should be revised periodically as the stakeholder spectrum changes over time.

Programme managers should maintain a close relationship to direct beneficiaries and other stakeholders that may be impacted by the programme or be partners in implementation. Stakeholders should be adequately informed, and their feedback periodically obtained, to ensure that no major issues are arising. The relationship may be managed through the

establishment of committees, working groups, advisory bodies, etc., or through ad hoc public meetings with interested parties. These would ensure common goals and allow smooth programme implementation. Collaboration between parties should be formalized through agreements, with components such as:

- the objective of the collaboration
- roles and responsibilities of parties involved
- monitoring and evaluation of tasks to be completed.

The NPPOs involved should officially communicate programme progress. These communications could also involve field visits to the area subject to phytosanitary actions. For more information, consult the IPPC guide on *Managing relationships with stakeholders*.

Figure 2: Example of stakeholder analysis matrix

Stakeholder	Contact person & information	Link to programme	Impact on programme (H-M-L)	Influence over programme (H-M-L)	What is important to them?	Perceived attitude toward programme	How could they contribute?	Strategy for engagement
EXAMPLE								
Ministry of Agriculture	Dr Jane Brown; JaneB@gov.org, 777-919-0001	Fund capital costs; provide operating authority	High	High	Promoting agricultural production; increasing food security	Supportive	Maintain support at national level for programme funding and legal authority	Hold monthly fundholder meetings
Apple Grower Association	Stan Smith; SS@gmail.com, 777-432-6789	Taxed based on apple acreage	High	High	Increasing sales; expanding markets	Concerned about costs and efficacy	Help encourage/ enforce grower compliance with programme requirements	Attend grower meetings; appoint leaders to management team
Homeowner Advocacy Group	John Doe; JD@gmail.com, 777-666-1324	Taxed based on property value	Med	Med	Spray drift from orchards; pesticide residues on fruit	Uninformed	Increase public awareness; encourage better management or removal of urban host plants	Hold public information and feedback meetings every 6 months
Local Newspaper	Mary Hill; Hill@news.net, 777-668-1369	Local news outlet	Med	Low	Getting a good story; keeping public informed	Sceptical of government programmes	Print stories that explain and support the programme	Monthly press releases

2.2 FUNDING MECHANISM WITH CONSIDERATIONS FOR SUSTAINABILITY

» (step 7 decision tree - Budgeting and funding)

2.2.1 Pest free areas (PFAs)

» (step 20 decision tree - Pest Free Area)

Before an NPPO decides to establish a pest free area, it is important that it conducts a cost–benefit analysis (step 3 decision tree). Such an analysis encourages management officials to think critically about all of the different activities that will need to be carried out to achieve PFA status and/or to maintain an area pest free, as well as the associated cost of each activity. These costs can then be compared to the potential economic benefits of moving forward with the programme, and better inform discussions of different options for certain activities, who should bear the annual costs of the programme, and programme sustainability.

It is often difficult to determine precisely the direct costs to be borne by the private sector for establishment of a PFA. While there is immediate benefit to producers in the PFA, other producers who are not a formal part of the arrangement may see increases in the export of their products as well. In this case, the establishment of a PFA may be seen by the government as a public good and the costs may be borne entirely or partially through public funding. The NPPO, if enabled, may recover funds from the direct beneficiaries by charging fees for services rendered in connection with export certification activities, particularly after the PFA has been established. Similarly, the NPPO, if enabled, may recover funds from the general public (e.g. homeowners, tourists) in connection with shared benefits resulting from a cleaner environment and fewer negative producer/public interactions because of reduced pest management activities such as pesticide applications. In some instances, producers bear the cost of surveillance and control activities within the production areas, whereas the NPPO covers programme costs in the non-commercial marginal areas within the PFA.

2.2.2 Pest free places of production (PFPPs)

» (step 21 decision tree - Pest free place of production)

Pest free places of production (PFPPs) are essentially PFAs established on a more limited scale, for instance a farm or several farms in an area. The funding mechanism for PFPPs is generally easier to establish. In these cases, the private sector contribution towards establishment of the PFPP will be significant relative to the public sector component, the latter including the resources apportioned by the NPPO. However, the government or NPPO may adopt a cost-sharing policy with the participating beneficiaries where there is a need for promoting exports and growing the market base by adding more farms from the surrounding area to the scheme as time goes by and the PFPP is maintained. In such cases, the cost per producer/exporter/regulator will likely decrease as a result of economies of scale.

2.2.3 Pest free production sites (PFPSs)

» (step 19 decision tree - Pest free production site)

In circumstances where a defined portion of a place of production is managed as a separate unit and can be maintained free from a specific pest, it may be regarded as a pest free production site (PFPS)[1].

In this case, the brunt of the cost is borne by the private sector beneficiary. The role of the NPPO is to verify that the measures required of the site for export certification are applied effectively and that the phytosanitary integrity of consignments leaving the site is maintained until they are exported. Where the NPPO is so enabled, the actions it takes to certify exports from these sites may be recouped on a cost-recovery basis.

2.2.4 Area of low pest prevalence (ALPPs)

» (step 28 decision tree - Area of low pest prevalence)

Area of low pest prevalence (ALPP) is not a scientific term but rather a term used by trading partners to describe a defined production area where the pest of concern is kept below some maximum pest level that is acceptable to the importing NPPO. As with a PFPP or PFPS, the brunt of the cost of an ALPP is borne by the private sector beneficiary. Here, the role of the exporting NPPO is to verify that pest management practices and system approach components are applied effectively, the maximum acceptable pest level to the trading partner is not breached, and consignments in fact originate from the ALPP. Again, where the NPPO is so enabled the actions it takes to certify exports from these places or sites of production may be recouped on a cost-recovery basis.

[1] ISPM 5

© J. Umble, Fall Creek Farm and Nursery Inc., Lowell, OR

PFPP/PFA – Fall Creek is a blueberry breeding and nursery company in Lowell, Oregon, United States of America, serving commercial fruit growers and nurseries worldwide. With an expansive variety portfolio of Vaccinium *species and an array of product sizes all originating from tissue culture, Fall Creek can export to the European Union under certified pest free status for* Xylella fastidiosa*, a plant pathogenic bacterium, based on yearly detection surveys of host plants in the surrounding environs conducted by the Oregon Department of Agriculture. The company initially had to follow more extensive sampling and preventive measures specific to their operation as a PFPP until it was shown that the county in which they reside is a PFA for the bacterium.*

Box 3: Onion fly (*Delia antiqua*) ALPP – sterile insect production in Europe

In the Netherlands, onion fly (*Delia antiqua* (Meigen)) is present throughout the country and eradication cannot be maintained easily. It is more economical to mass-rear and routinely release sterile onion fly for suppression than to create a quarantine barrier to monitor and control new invasions. Because the onion flies do not disperse much beyond a particular field, it has been feasible for this sterile insect technique service to be purchased on an individual grower basis. The advantage is also that pesticide usage is reduced, and the chances for the onion fly to create a pesticide-resistant strain are also much diminished. At present, around 10 000 hectares are treated annually.

© De Groene Vlieg

For more information, see Section 8: Case study 10 – The first private sterile insect production in Europe for onion fly (*Delia antiqua*).

2.2.5 Service provision agreements

In a number of countries, and where an NPPO is enabled to institute cost-recovery mechanisms, a service agreement between the NPPO and the producer/exporter may be implemented. Such agreements are negotiated between the two parties at the start of the programme or, in the case of an ongoing PFA/PFPP/PFPS/ALPP programme, at an early stage prior to the start of the crop production cycle. Such agreements outline the responsibilities of both parties regarding the fees charged, the services provided, methods of payments, and so on. The agreement is reviewed and updated with the agreement of both parties at the end of the year or at some other predetermined time.

The producers within the target area may also be required to enlist or register with the NPPO and sign compliance/production/protocol agreements attesting that the target product may only be produced under certain specified conditions. Certain facilities may be authorized to perform specific phytosanitary functions for the NPPO, following specific legal or administrative procedures. These functions may include application of phytosanitary treatments, processing primary plant products into value-added products to eliminate specified phytosanitary risks, and/or handling, packaging and storing plant products. These agreements should also contain clauses to delist or deregister a producer should there be a change in pest status from pest freedom or low pest prevalence. During the non-compliance period, corrective actions should be taken and once the required pest status is again achieved the producer should be re-registered.

2.3 HUMAN RESOURCES

» (step 8 decision tree - Human resources)

The NPPO should determine the number and type of technical personnel needed based on the actions identified to suppress, eradicate, or exclude the target pest from the programme area. Technical personnel could range from NPPO inspectors, pest survey staff, quarantine officers stationed at checkpoints, pest diagnosticians, regulatory enforcement personnel, national and international subject matter experts, supervisory staff and managers to legal officers, media and public relations personnel and others. All technical personnel designated by the NPPO should be given official identification, particularly those that may be required to enter premises where

Box 4: Egyptian NPPO service agreement for potato production

One example of a service agreement is the agreement the Egyptian NPPO has with potato producers/exporters who grow potato crop in brown rot free areas to apply specific measures during the growing season. Among others, these include testing seed potatoes and prohibition of irrigation from contaminated water sources. As the producers/exporters apply for recognition of their production areas by the NPPO, they declare their commitment to the official regulations and all phytosanitary obligations applied to the PFA. The agreement implies delisting the grower's area from the recognized PFA if pest-free status is not maintained or interception cases are confirmed by importing countries. Other escalated penalties are applied if multiple violations occur, including application of more inspection activities resulting in increased production costs and reduced producer profits or suspension from exporting.

For more information, see Section 8:
Case study 6: Potato brown rot PFA in Egypt – challenges for funding mechanisms and continuous revision.

PFA/PFPP/PFPS, or PMP (in the case of postharvest treatments), programme activities will be undertaken. The power to enter and perform the various tasks required should be conferred by appropriate legislative means. The number of casual labourers that may be needed to support technical personnel, particularly for field work, should also be identified.

The NPPO can also identify persons from the direct beneficiaries who are pivotal to the success of a programme. These might include influential growers or owners of particularly large farms, farm managers, packing house personnel, farm/greenhouse/screenhouse technical staff, and leaders of cooperatives and grower/commodity associations. Such persons can help mobilize resources, provide in-kind support, and assist in garnering public and political support for the programme when needed.

2.3.1 NPPO staff

» (step 8 decision tree - Human resources)

The establishment of a PFA/PFPP/PFPS or ALPP is an activity that requires attention to detail, precision, responsiveness, and flexibility in approaches. The personnel directly involved should be trained to the required level of competency to deliver their assigned tasks. Consequently, each person should have written terms of reference or at the very least be briefed in detail on the activities they are to undertake. Refresher training sessions should be encouraged. Due to the breadth of actions required to put a PFA/PFPP/PFPS/ALPP in place, the NPPO should consider training its officers on technical subject matters such as trapping, monitoring, treatments, pest diagnoses, specimen collection, record keeping, and interacting with the public.

The NPPO should establish a code of conduct for all staff to avoid loss of life and property and ensure the effective, courteous delivery of their duties. Staff who deal directly with the media, stakeholders or general public, particularly all field personnel, should receive training on public relations. Field staff who are given responsibility for telephones, radios, vehicles including fuel allotments, search and seizure authority and other powers that could be abused, should also be given advanced ethics training before programme activities are launched.

2.3.2 Other technical expertise

» (step 8 decision tree - Human resources)

The NPPO should also consider training sessions for personnel who need to be knowledgeable about the objectives of the programme and who would be called upon to provide assistance at various stages during implementation. These personnel would include, among others, officers from customs departments and law enforcement, community leaders from the areas that would be affected by programme actions, farm personnel, and technical personnel from the industrial operations related to the commodity of interest.

2.4 COMMUNICATION AND AWARENESS

» (step 11 decision tree - Outreach)

Communication and public awareness strategies are essential for the development, establishment and maintenance of the PFA/PFPP/PFPS/ALPP as they help to inform and capacitate the NPPO staff, the general public and other stakeholders on the different aspects and components of the PFA/PFPP/PFPS/ALPP. This helps to secure cooperation and support for the establishment and maintenance of the PFA/PFPP/PFPS/ALPP.

Field staff with the Florida Department of Agriculture and Consumer Services, Department of Plant Industries wear identifying hats, shirts and badges when working in an official capacity and engaging the public during fruit fly eradication programmes.

The NPPO should work with outreach and media companies and staff to disseminate information on the objectives of the programme and develop the type of messages that it prefers to broadcast. Messages should target the general public and other stakeholders in a consistent manner and promote a well-grounded programme in the minds of the public and policy makers. Along with the media staff, village/town/municipal/provincial leaders, policy makers, school principals and other community persona could deliver information dissemination and public education efforts as well.

Suggested components of a communication strategy include:

- communication system (internal and/or external) with appropriate expertise and networks
- communication programme with objectives, goals, tasks, target audience, communication tools (e.g. television, radio, social media applications, newspapers, booklets, brochures, courses), timelines and budget
- media focal point and media management system to ensure consistency in the quality and nature of the information exchanged between the NPPO, the press and other clients.

NPPO internal communications are important to ensure that a PFA/PFPP/PFPS/ALPP programme is efficiently and effectively implemented and should include:

- line communication, reporting and feedback
- communication among field officers to share experiences and relevant information, problem-solve, etc.
- communication among NPPO technical managers and supporting administrative staff, regarding budget, procurement and resource distribution, staffing issues, etc.

External communication with different stakeholders ensures that all parties are directly engaged in the delivery of the programme. NPPOs should communicate with:

- industry groups, especially those directly involved in and affected by the outcomes of a PFA/PFPP/PFPS/ALPP programme, in a timely and effective manner regarding ongoing issues that may arise and anticipated implications
- third-party providers acting on behalf of the NPPO on the progress, implementation issues, ongoing monitoring and review activities
- the general public through outreach programmes to encourage effective cooperation with, among other things, restrictions on movement of plant material (where appropriate) and reporting relevant observations.

A public awareness programme should promote the understanding of the goals of the PFA/PFPP/PFPS/ALPP and phytosanitary knowledge in general. Having a detailed plan for public awareness will help ensure that stakeholders are well informed and support implementation actions.

An awareness-raising plan should identify the interests of different stakeholders and refine messages and styles of communications to match the interests of the stakeholders, helping them to understand why the PFA/PFPP/PFPS/ALPP programme is important.

An advocacy plan would target these stakeholders differently to address each group's concerns. The plan can encourage them to ensure that the PFA/PFPP/PFPS/ALPP programme receives the sustained financial, political and public support needed in order to function effectively and achieve its goals.

Awareness, education and communication efforts should be focused in the places where particular programme activities will occur. It is important to use communication channels that are common to the local inhabitants. In many cases, dissemination of information using rudimentary media and local outlets can have a greater reach than those relying on more modern technologies. It is essential to find out which communication channels best suit the reality of each situation.

The public awareness and phytosanitary education programme should be ongoing and may include information on:

- permanent or random checkpoints
- posting signs at entry points and transit corridors
- disposal bins for host material
- leaflets or brochures with information on the pest and the PFA/PFPP/PFPS/ALPP
- systems to regulate fruit movement
- non-commercial hosts
- security of the traps
- penalties for non-compliance, where applicable.

Box 5: Public outreach in California

Detections of the light brown apple moth (LBAM, *Epiphyas postvittana* (Walker)) and the European grapevine moth (EGVM, *Lobesia botrana* (Denis and Schiffermüller)) in 2007 and 2009, respectively, triggered emergency response programmes. These are both exotic Lepidoptera in the family Tortricidae and were both found in California counties in the San Francisco Bay area. However, public support for the programmes differed significantly. By most accounts, the LBAM programme failed to accomplish its goals, while the EGVM programme is considered a model for success. Although there were many factors that contributed to the different outcomes, it prompted the Animal and Plant Health Inspection Service (APHIS) Plant Protection and Quarantine (PPQ) unit of the United States Department of Agriculture (USDA) to work with the California research community to study public perceptions of emergency plant health programmes to inform possible future programmes at the federal level.

Key findings included:

- Communities will work together for or against an emergency response depending on whether they perceive the proposed actions to be necessary or unnecessary relative to the threat posed by the pest.
- The threshold for harm (perceived threat of an invasive species) differs between communities depending on community values and priorities.
- Aerial spray programmes must only be enacted with support from affected communities.
- Agencies lose credibility and trust from communities when they undertake actions against the will of the people and justify an action by implying that it is legal.
- Agencies gain credibility and trust through transparency and open communication and a willingness to engage and effect change, which includes responding to the needs of communities and the environment and adapting new information from science as appropriate.
- Sustainability factors increase with well-coordinated and effective programmes.

Zalom, F., Grieshop, J., Lelea, M.A., Jennifer, K. & Sedell, J.K. 2013. Community perceptions of emergency responses to invasive species in California: case studies of the light brown apple moth and the European grapevine moth. 41 pp. Available at http://ucanr.edu/blogs/strawberries_caneberries/blogfiles/16221.pdf (last accessed 2019).

© Moscamed Programme

Outreach should focus on those impacted by the programme – The Mediterranean fruit fly management and containment programme (Moscamed) in Guatemala and Mexico uses trained field staff to inform residents in rural areas on the objectives and benefits of the programme and how they can help, such as not moving infested fruit.

Even if some measures are covered by legislative force, it is important that people understand the establishment of a PFA/PFPP/PFPS/ALPP as a positive event for the community and the benefits it will bring.

Programme staff who interact with the public are an additional important resource of outreach programmes and should be trained to cope with potentially challenging situations. For example, field agents may experience resistance to some of the control/eradication measures being applied, particularly where pesticides must be used over wide areas or where eradication measures are taken in private property such as backyards and farms. Field agents may also face challenges when at quarantine checkpoints or needing to enter private property. In such cases, the presence of law enforcement will help to formalize the checkpoint and improve cooperation. In addition, cultural specificities and lack of knowledge of the phytosanitary risks by the population could create obstacles to be overcome. As such, it is important that inspectors or field agents build rapport with stakeholders in the communities where they operate to reduce the potential problems they may encounter in the line of duty.

2.5 PROCUREMENT

» (step 9 decision tree - Supplies)

It is generally advisable to prepare a procurement plan that is updated on an annual basis to ensure smooth programme continuity. Many NPPOs have complicated national procurement policies they must comply with, including restricting procurement to local sources of suppliers, which can lead to lengthy delays in the financial clearance process. Procurement plans should factor in these eventualities to avoid delays.

2.5.1 Materials and supplies

» (step 9 decision tree - Supplies)

Besides infrastructure and equipment, the ready availability of materials and supplies to run the programme is of utmost importance and should be highly prioritized. Delays in the supply chain and a lack of materials may result in a cessation of activities, causing pest populations to rebound and impact the effectiveness of programme operations including rapid response activities for PFAs and the quality and consistency of data collection. This can be particularly problematic once status has been achieved and

the data are used for market access. Materials and supplies may cover the following:

- laboratory supplies such as reagents, glassware, rapid diagnostic kits, advanced laboratory diagnostic materials such as primers for polymerase chain reaction (PCR) (see the *Guide to delivering phytosanitary diagnostic services*)
- field supplies such as rapid diagnostic kits, field sampling and collection kits, glassware and specimen storage receptacles, traps and lures, chemicals including pesticides, soap and killing agents, and personal protective gear
- special-use materials and supplies – lures, pesticides and sterile insects.

Some lures and pesticides require registration or special authorization prior to import and use. Sterile insects are defined as beneficial organisms and should not require a special authorization according to the ISPM 3 (*Guidelines for the export, shipment, import and release of biological control agents and other beneficial organisms*)). Nevertheless, transboundary shipments and release of sterile insects need to comply with appropriate phytosanitary certificates and import permits, as well as with handling procedures according to international standards and manuals (FAO/IAEA/USDA, 2014; FAO/IAEA, 2017a). An additional element that should be considered is quality control testing of critical programme materials, such as attractants and insecticide baits, to ensure their effectiveness.

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Traps, attractive baits, trap shelters, tracking labels, and suitable material for area signage are just a few examples of materials where failures in the delivery schedules or product quality may compromise an entire PFA programme. (Source: Anastrepha grandis PFA, Rio Grande do Norte, Brazil.)

ISPM 3 (Guidelines for the export, shipment, import and release of biological control agents and other beneficial organisms): Scope

This standard provides guidelines for risk management related to the export, shipment, import and release of biological control agents and other beneficial organisms. It lists the related responsibilities of contracting parties to the IPPC, national plant protection organizations (NPPOs) or other responsible authorities, importers and exporters (as described in the standard). The standard addresses biological control agents capable of self-replication (including parasitoids, predators, parasites, nematodes, phytophagous organisms, and pathogens such as fungi, bacteria and viruses), as well as sterile insects and other beneficial organisms (such as mycorrhizae and pollinators), and includes those packaged or formulated as commercial products. Provisions are also included for import for research in quarantine stations of non-indigenous biological control agents and other beneficial organisms.

The scope of this standard does not include living modified organisms, issues related to registration of biopesticides, or microbial agents intended for vertebrate pest control.

2.5.2 Infrastructure and equipment

» (step 10 decision tree - Infrastructure and logistics)

During the planning stages, and when it is known which measures will be applied, the NPPO should prepare a list of all equipment that will be needed to implement and sustain operations. The procurement process should be planned and executed well in advance of when the equipment will be needed and should factor in delays for delivery, customs procedures (in the case of importation), installation, calibration, quality control, and the like. Manuals of installation, operation and maintenance should be kept in close proximity to the equipment for ease of reference. For delicate equipment, the purchase of key spare parts is advisable, particularly if they are not readily available locally. Maintenance contracts for building operations (heating, air conditioning, water), information technology support (servers, computers, global positioning system (GPS) units), key pieces of equipment (generators, microscopes, release devices, etc.), spray units, vehicles (trucks, airplanes, all-terrain vehicles (ATVs)), should be considered. Special equipment such as irradiators will be necessary for the production of sterile insects.

2.6 LOGISTICS

» (step 10 decision tree - Infrastructure and logistics)

Good logistics coordination is perhaps the most challenging aspect for the smooth operation of a programme. Depending on the extent of the territory to be subjected to phytosanitary measures and its characteristics (mountainous, arid, tropical with river crossings, islands, urban, etc.), the NPPO may consider establishing teams of personnel or bases of

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Specialized equipment – Non-intrusive inspection of cargo vehicles with the use of what is popularly called a "truck scanner" is an example of the use of more advanced technologies to help maintain a PFA. The equipment has been of great value to control fruit traffic at the entrance of the Anastrepha grandis *PFA on the border between Ceará and Rio Grande do Norte, Brazil. The trucks go through X-ray equipment that generates images of the load for video monitoring. Only if the team identifies suspect goods in the video will the cargo be opened and subjected to physical inspection.*

operations situated in the appropriate zones where the actions are needed. Mobility will be essential, particularly where technicians are required to perform routine tasks such as setting and servicing traps along established routes on a regular basis. These personnel will need reliable transportation appropriate to the work and conditions that prevail in the targeted area. Watercraft, when needed, should also accommodate necessary tools, materials, supplies and emergency equipment, and have the capability to traverse the distances required, for actions to be properly implemented. Aircraft should be accessible and have the space necessary for the mounting of specialized equipment including for sterile insect release devices, radar, high-resolution cameras and video surveillance. Air transport (e.g. helicopters) may also be needed to take technical officers, when necessary, into areas that may be challenging to access by other means of transport. In the case of aircraft crossing official borders for the transboundary release of sterile insects, appropriate permits from national civil aviation of the countries involved are required.

2.7 PROGRAMME PLANNING

» (step 5 decision tree - Programme planing)

An operational/action plan should be developed that clearly defines the pest concerns the programme is trying to address, the objectives of the programme and how they will improve the pest situation, and the scope of the programme's activities, in particular key steps and actions that need to be accomplished in order for the programme to establish a PFA/PFPP/PFSP/ALPP or use PMP.

Converting an infested area into an ALPP or a PFA often requires a large-scale intervention and implementing all of the mandated programme activities over a large area can be challenging. As such, the plan should consider/contain a scheme that divides the targeted area into smaller fractions with relevant specific activities that are phased in over time in a

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The importance of good logistics – A technician performing routine monitoring tasks at the Anastrepha grandis *PFA in Rio Grande do Norte, Brazil. The vehicle has been adapted to carry traps, baits, water to clear traps, sieves, bottles with alcohol to conserve the captured species and all the other instruments needed for monitoring work. Appropriate transportation and supplies are critical to ensuring field operations are conducted in a timely fashion and material collected is maintained under proper conditions for reliable analysis.*

stepwise fashion. The plan for pest suppression (leading to an ALPP) and/or eradication (leading to a PFA) typically goes through a number of operational phases including preparation, suppression (step 14 decision tree) or eradication (step 13 decision tree), declaration of achieved pest status (steps 22, 29 decision tree), stakeholder official recognition, maintenance and corrective actions as needed (steps 31, 36, 40, 44 decision tree). In the case of large-scale interventions, each of these steps will often require a considerable amount of time and effort depending on the pest biology, available financial resources and operational efficiency. The intervention will follow a stepwise conditional approach where progress to the next step is subject to completing the previous step. Smaller scale interventions will go through similar operational steps, but these may be achieved simultaneously in the entire area or in shorter periods of time. While dividing a large area into smaller fractions may help maintain the activities and annual funding to more manageable levels, programme managers should keep in mind that the duration of the programme will be stretched out and some producers will receive benefits before others. The operational/action plan should contain a section on required resources for each scenario, including financial and human resources as well as the roles and responsibilities of all possible stakeholders such as the NPPO(s) and industry. Specific technical and budget work plans should be prepared (see Appendix 3: Typical Technical and Budget Work Plan for Establishing and Maintaining a PFA).

The work plans should be reviewed and adjusted periodically as the situation changes, whether positively or negatively. Contingencies for replacement of personnel and capital equipment should be factored into the plans. Some of the most common problems that may affect the continuity of the action plan are difficulties in finding and maintaining the right human resources, failures in the logistics of programme operations, changing government policies, unpredicted climatic factors such as El Niño effects, typhoons or hurricanes, and unforeseen costs associated with labour and supplies (e.g. increases in costs associated with traps and lures for monitoring or diet ingredients for insect mass rearing to be used for SIT).

2.8 BUDGETING AND FUNDING

» (step 7 decision tree)

Budgeting for the establishment or maintenance of PFA/PFPP/PFPS/ALPP and PMP programmes is very closely associated with the operational/action plan (step 12 decision tree). After technical issues and stakeholder support have been addressed and a strategic plan has been developed (step 4 decision tree), the decision to move forward with a PFA/PFPP/PFPS/ALPP/PMP programme is contingent upon getting financial and other resource commitments to be able to implement the plan. In this case, federal, state, provincial or additional sources of funding or in-kind contributions need to be sought.

Box 6: OKSIR shared programme costs

The Okanagan-Kootenay Sterile Insect Release (SIR) Program for area-wide management of codling moth (*Cydia pomonella*) in British Columbia, Canada, was able to garner support from the federal and provincial governments to share in the upfront costs to build a mass-rearing facility and establish the programme's infrastructure. Ongoing operational costs are paid by growers through a tax on apple and pear acreage, as well as by the general public through a property tax that recognizes the value that apple growers bring to the community in terms of quality of life and economic benefits through agriculture and tourism.

For more information, see Section 8: Case study 15 – Sterile insect release for area-wide management of codling moth (*Cydia pomonella)* in British Columbia, Canada.

For each phase and activity of the programme, it must be clear what the anticipated costs and the financial contribution and outlay schedules are, and where the funds will come from. The main types of expenditure that may be needed to run a programme are listed in Table 2.

Table 2: Main areas for budgeting

Type of expenditure	Examples	Phases of use
Consultancy	Hiring consultants for pest risk and cost–benefit analysis, development of strategic and action plans and guidelines	Initiation Feasibility and programme development
Infrastructure and equipment	Facilities and equipment including for laboratories, vehicles computers and other means for communication	Establishment
Salaries	Wages of permanent and temporary/seasonal staff, including laboratory, security, drivers, trappers	Establishment Maintenance
Office supplies	Supplies for office routine, utilities	Establishment Maintenance
Laboratory supplies	Consumables and utilities for operating and maintaining laboratory activities, safety equipment	Establishment Maintenance
Field operation supplies	Fuel, maintenance of vehicles, equipment, consumables including traps, lures, pesticides, biocontrol agents, sterile insects, etc. and accessories, safety equipment	Establishment Maintenance
Travel	Per diem, daily and overtime pay, accommodation, other travel costs	Planning Establishment Maintenance
Other fixed costs	Rental costs of facilities, salaries of non-technical personnel, insurance	Planning Establishment Maintenance
Training	Development of training materials and training of personnel	Establishment Maintenance
Unforeseen expenses	Compensation for producers to enforce eradication measures, emergencies such as failure in maintenance and others	Planning Establishment Maintenance

Section 3: Establishment Phase

(PHASE 3 DECISION TREE)

Once the targeted area has been identified and characterized and the pest status has been documented and categorized, a relevant pest control option is selected:

- suppression (ALPP) (step 14 decision tree) and systems approach
- eradication (PFA/PFPP/PFSP) (step 13 decision tree)
- general pest management with a postharvest treatment (steps 47, 49 decision tree).

3.1 ORGANIZATIONAL/MANAGEMENT STRUCTURE

For the successful implementation of the PFA/PFPP/PFPS/ALPP, it is critical to establish a management system with clear lines and channels of communication and an appropriate supervisory structure. Inspectors that interact with direct beneficiaries of the programme and the general public impacted by programme activities should have the appropriate authority (whether delegated or not), backed by legislation, to execute their functions. This is particularly important when field surveys or treatments or eradication measures are to be conducted in urban areas and/or on private lands. It is advisable that the supervisor of the field programme meets with these stakeholders during key stages of activities in order to establish good lines of communication and answer any questions that they may have. The NPPO should also establish a clear line of command for the dissemination of official information and ensure that personnel assigned to the programme are able to comply with internal regulations.

Box 7: Emergency response management structure

While there are many ways to organize a management system and each programme will have its own unique requirements and challenges, a useful starting point or point of reference is the incident command system developed in the United States of America for emergency response programmes. There are five major management functions upon which it based: Command, Planning, Operations, Logistics and Finance/Administration.

For more information, see Section 8: Case study 18 – Incident command system.

3.2 SUPPRESSION

» (step 14 decision tree - Suppression)

Pest suppression may be applied for purposes of:

- reducing target pest population to an acceptable level
- establishing an ALPP that can be used as part of a systems approach to reach export certification or as a buffer zone to protect a PFA (case study Box 7)
- reducing target pest populations as part of a process leading to pest eradication in an area to establish a PFA.

Population suppression may be achieved through the integration of a number of phytosanitary measures (step 24 decision tree). Depending on the regulated pest of concern, these may include: tools for pest monitoring surveys such as traps baited with specific attractants and commodity or host sampling; and tools for pest suppression, including specific pheromones for male annihilation and mating disruption, insecticide-bait sprays, attract and kill bait stations, orchard sanitation, mechanical control such as host removal and pruning, biological control and the sterile insect technique (SIT) (Annex 3 to ISPM 26 (*Establishment of pest free areas for fruit flies (Tephritidae)*). Suppression programmes aimed at establishing an ALPP may also require the implementation of regulatory measures such as quarantine checkpoints (step 25 decision tree) placed at specific pest risk sites.

In cases where the aim is to export fruits and vegetables from an ALPP, the level will be specified and agreed to by the NPPO of the exporting country in conjunction with the NPPO of the importing country. In this case, the agreed level will be contained in a bilateral work plan subscribed by the NPPOs of the

Box 8: South Africa Mediterranean fruit fly (*Ceratitis capitata*) suppression programme

In 1997, a pilot project to control fruit flies integrating the sterile insect technique (SIT) was implemented in 10 000 hectares in and around the Hex River Valley. The goal was to suppress, in a cost-effective and environment-friendly manner, the Mediterranean fruit fly (medfly, *Ceratitis capitata* (Wiedmann)) populations to below the economic threshold, and then create an internationally recognized ALPP. A partnership was established between Infruitec/Nietvoorbij (a branch of the Agricultural Research Council; a parastatal body, with a mandate to conduct research, technology development and transfer) and the Hex River Valley Research Services Trust (which represents the deciduous fruit growers). By replacing insecticide applications with a combination of aerial and ground releases of sterile male medflies in hot spots, the reduction in control costs was substantial, from USD 350 000/year with chemical control to USD 130 000/year with SIT. Rejections, due to fruit fly infestation, of exported cartons of table grapes from the valley were reduced by approximately 50 percent. In 2000, a reduction of 60 percent in rejection of cartons by phytosanitary inspectors of importing countries represented savings of USD 150 000. For the 2001/2002 season, the direct benefits totalled USD 370 000/year, at a cost of USD 130 000, which is equivalent to a benefit-to-cost ratio of 2.8:1. The relevant ISPMs include: ISPM 22 (*Requirements for the establishment of areas of low pest prevalence)* and ISPM 30 (*Establishment of areas of low pest prevalence for fruit flies (Tephritidae)*), the latter now revoked and incorporated into ISPM 35 (*Systems approach for pest risk management of fruit flies*).

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High mountains surrounding a fruit production valley in the Western Cape of South Africa provide natural isolation of the medfly population, which facilitates the maintenance of an ALPP and provides suitable conditions for application of sterile insect technique.

For more information, see Section 8: Case study 9 – South Africa Mediterranean fruit fly Suppression Programme.

ISPM 22 (Requirements for the establishment of areas of low pest prevalence): Scope

This standard describes the requirements and procedures for the establishment of areas of low pest prevalence (ALPP) for regulated pests in an area and, to facilitate export, for pests regulated by an importing country only. This includes the identification, verification, maintenance and use of those ALPPs.

ISPM 26 (Establishment of pest free areas for fruit flies (Tephritidae)): Scope

This standard provides guidance for the establishment of pest free areas for fruit flies (Tephritidae) of economic importance, and for the maintenance of their pest free status.

ISPM 35 (Systems approach for pest risk management of fruit flies (Tephritidae)): Scope

This standard provides guidance for the development, implementation and verification of integrated measures in a systems approach as an option for pest risk management of fruit flies (*Tephritidae*) of economic importance to facilitate trade of fruit fly host products or to minimize the spread of regulated fruit flies within an area..

respective countries. In the case of population suppression aiming at establishment and maintenance of an ALPP as a buffer zone protecting a PFA or as part of a process of population suppression aimed at eradication and establishment of a PFA, setting a low pest prevalence level is an important internal operational requirement. In these situations, the required pest population level is generally very low. If the programme is aimed at controlling a pest population to reduce direct damage, a significantly higher population level may be acceptable. Specific survey tools (step 27 decision tree) for population monitoring will indicate if the desired pest population level has been achieved and is being maintained. If the population has increased above the required level, a contingency plan (step 37 decision tree) will be enforced applying the necessary phytosanitary measures to bring the pest population back to the required level and to reinstate the ALPP status. Such phytosanitary measures may include: suspension of the phytosanitary status of the area (step 46 decision tree), suspension of harvesting, suspension of export licenses, use of pest suppression measures such as chemical control, and release of sterile males, all measures being implemented according to the work plan agreed by the NPPOs of the contracting parties concerned (step 44 decision tree).

3.2.1 Setting the low prevalence level

» (step 28 decision tree - Area of low pest prevalence)

Low pest levels can occur naturally or be achieved through the development and application of phytosanitary measures (step 24 decision tree) aimed at controlling the pest (ISPM 22 (*Requirements for the establishment of areas of low pest prevalence*)).

Specified levels of low pest prevalence will depend on the level of risk associated with the target pest species–host–area interaction. These levels should be set up by the NPPO of the country in which the ALPP is located and with sufficient precision to allow assessment of whether surveillance data and protocols are adequate to determine that pest prevalence is below these levels.

Individual NPPOs may draw on a variety of different factors when determining exactly what an appropriate level of pest prevalence should be for a given ALPP. Some commonly considered factors include the following:

- levels stipulated by NPPOs of importing countries in order for trade to proceed
- levels in use by other NPPOs for the same or similar pest species, host and agro-ecological conditions.

To assess the low prevalence level of a pest population, cost-effective tools for population monitoring need to be available. These can be devices such as traps baited with specific attractants aimed at catching the pest in the adult stage and for immature stages, and random and targeted host or commodity sampling of specific plant parts, including fruits, leaves, stems and roots, as well as soil.

The population level may be established as a relative population index that provides information on the abundance of the pest in a specific area at a specific time. If the index is computed continuously at a fixed interval for long periods of time, it may be possible to compare changes in spatial and temporal distribution of the pest. These data will be used by pest control managers as baseline information when making decisions on appropriate application of pest control tools. As a reference, a population index widely used by NPPOs for fruit fly control programmes is the average number of flies per trap day (FTD) (Appendix 1 (Fruit fly trapping (2011)) to ISPM 26) and FAO/IAEA, 2018):

$$FTD = \frac{F}{T \times D}$$

where,

F = Total number of fruit flies caught

T = Total number of traps

D = Average number of days that traps are exposed in the field

Monitoring surveys are used to verify the FTD index. A sustained FTD of zero is required to maintain a PFA. For certain fruit fly species and combinations of traps and lures, an area with an FTD of 0.1 to 0.5 is considered as having a low pest prevalence level and an area with an FTD greater than 0.5 is regarded as an area with a medium to high population level. An FTD of 0.1 (0.14) is the equivalent of having a total of (1) one fly in one trap in a seven-day trap exposure interval (1/(1 × 7)), whereas an FTD of 0.5 (0.57) is the equivalent of having a total of four flies in one trap in a seven-day trap exposure interval (4/(1 × 7)). An ALPP that has an FTD greater than 0.5 will require the implementation of a contingency plan as stated in the previous section. The FTD level can also be used as an action threshold to trigger the release of sterile insects in programmes that apply area-wide SIT for population suppression and/or eradication. For example, in fruit flies an FTD ranging from 0.05 to 0.1 is considered appropriate for sterile insect releases. An FTD greater than 0.1 will stop the release of sterile insects and will trigger bait spray applications for population suppression.

An appropriate pest population index should be computed for each pest or group of pests, as well as the population thresholds for an ALPP and for areas with medium to high population levels. Factors that should be considered in assessing a population index are: biology of the pest, efficiency of the monitoring system and the pest–host relationship. When possible, mark–release–recapture field trails can be conducted to assess the efficiency of a monitoring system based on adult traps and to establish the population thresholds (FAO/IAEA, 2016; FAO/IAEA, 2018).

3.2.2 Surveillance plan

» (steps 18, 27 decision tree - Surveillance)

An effective, efficient surveillance programme is an essential component in establishment and maintenance of PFAs, PFPPs, PFPSs and ALPPs. Surveillance activities are applied at different stages of a PFA/PFPP/PFPS/ALPP: before the establishment phase to assist in selection of options, during the establishment phase to confirm that the targeted pest status has been attained, and as an ongoing activity to assure trading partners that the desired pest status is maintained.

When developing a surveillance plan to support a suppression programme, an NPPO should consider the size of the intervention area, topography, access roads, areas with hosts, populated areas, areas with no access, pest density, sensitivity of surveillance elements such as lures/traps, and other relevant elements. These elements will be a basis for establishing the surveillance routes in the target area, and for assessing the density and type of surveillance tools (e.g. fruit fly traps) and total number of surveillance units required. With this information, it will be possible to estimate the surveillance materials, equipment such as vehicles, and human resources needed to operate the surveillance network on a continuous basis. The density of the surveillance units and the area under surveillance may be changed with time. This is particularly true when the surveillance is a part of suppression leading to an ALPP, or eradication leading to a PFA. Surveillance is mostly stable when applied to maintain the pest status in an ALPP and PFA. For some pests, procedures to set up and manage trapping networks based on risk factors are available (Enkerlin *et al.*, 2012; FAO/IAEA, 2018). Availability of detailed cartographic information and maps of the area containing this basic information is essential for designing a surveillance plan. Tools such as GPS equipment to georeference surveillance units and geographic information systems (GIS) for analysis and reporting are important for preparing a surveillance plan and maintaining a surveillance network. The surveillance plan should include an estimate of the capital and operational costs. The cost of maintaining a surveillance network should not outweigh the value of the benefit and an adequate return on investments should be anticipated. Other considerations to be taken into account are:

- level of stakeholder interest and involvement in the surveillance programme
- available field, diagnostic and administrative human resources to implement the surveillance programme
- available target-specific traps, lures and other tools for pest detection.

The involvement of stakeholders in surveillance activities is crucial. Key personnel within the NPPO should be assigned to create, manage and maintain stakeholder relations to ensure that stakeholders are informed about:

- methods to be used for monitoring, sample screening, management and general surveillance
- availability of subject matter specialists
- availability of pest reference collection repositories.

Pest-specific surveys with clear protocols and using commercially available traps and diagnostic tools will be easier to deploy uniformly and monitor regularly.

3.2.2.1 Specific survey

Three main types of specific pest surveys are acknowledged: detection survey, delimiting survey and monitoring survey. For establishment and maintenance of a PFA/PFPP/PFPS, the three types of surveys are necessary. For an ALPP, only delimiting and monitoring surveys are applied. For an area under general pest management programme, only the monitoring survey applies.

A **detection survey** (steps 35, 39 decision tree) as defined in ISPM 6 is a "survey conducted in an area to determine if pests are present (or absent)". By definition, a detection survey is applied in areas where the pest is not known to be present or the pest status is not known. Survey tools are used at low to medium density. Detection surveys are implemented by NPPOs to report any new pest occurrence in the territories of a country by means of systematic sampling and laboratory detection/identification of the target pest.

Detection surveys can be essential tools to declare an entire country/region as a PFA, or to establish a PFA in an uninfested part of a country/region in which a limited infested area is present. An importing country has the right to ask for scientific evidence supporting the pest free status of a country or designated areas, which is usually provided by the results of detection surveys applied in such areas.

Detection surveys start by determining the pest, crop(s) and area(s) to be regulated under a PFA/PFPP/PFPS or ALPP. At such a stage, gather as much information as possible on the target pest, which may include: biological behaviour, life cycle, strains and genetic diversity, host range, vectors/means of transmission, possible introduction pathways, economic damage, diagnostic protocols and control strategies. Such information can be gathered from previous PRA, pest databases (CABI, Plantwise, EPPO global database), scientific publications, official and non-official technical reports, extension programmes, fact sheets and general resources on the internet. Also, detailed information should be collected regarding the targeted crop(s), such as: growth habits, cultivation regimes, national/regional distribution, cultivars/varieties, resistance/tolerance, and importation information, and – if applicable – information on closely related crop(s)/host(s). In addition, sufficient information on the area to be selected as a PFA/PFPP/PFPS/ALPP and that will be surveyed should be collected, which may include information regarding geographical location, terrain maps, weather conditions and accessibility to vehicles and personnel.

A **delimiting survey** is defined as a "survey conducted to establish the boundaries of an area considered to be infested by or free from a pest". It may be implemented in an infested area either initially to delimit the spatial distribution of the pest in the area or to confirm pest distribution from earlier surveys. It can be applied in ALPPs to delimit an area or areas where the pest is thought to have increased above the established low prevalence level. It can also be applied in a PFA as part of a contingency plan in

The United States Department of Agriculture (USDA), Plant Protection and Quarantine (PPQ) works with its state partners to conduct prioritized targeted Cooperative Agricultural Pest Surveys (CAPS) each year to support specific export certification programmes for pests such as Tilletia indica *(which causes the disease karnal bunt) and western cherry fruit fly (*Rhagoletis indifferens *Curran) (shown above), as well as to prevent the introduction of non-native invasive pest species such as false codling moth (*Thaumatotibia leucotreta *(Meyrick)), European grapevine moth (*Lobesia botrana*), Mediterranean fruit fly (*Ceratitis capitata*), khapra beetle (*Trogoderma granarium *(Everts)), oak decline bacterium, and others (https://www.aphis.usda.gov/aphis/ourfocus/planthealth/pest-detection).*

response to a pest incursion, to assess if the incursion is a **detection** or an **outbreak** (see Definitions) and to delimit the infested area. In this case, highly sensitive population sampling is required and so survey tools are typically used at a higher density than for detection. The area immediately surrounding each detection is termed a core area that is defined by a set radius surrounding each find. The size of the core area may vary depending on the pest species, types of survey tools such as insect traps, and other considerations. The area defined by the radius is often squared off to produce a grid. The survey tool density in the core area is higher than that used for detection surveys. The density of the survey tool in the surrounding zones may be proportionally decreased, the further away they are from the core area.

A **monitoring survey** is defined as a "survey to verify the characteristics of a pest population". For both ALPPs and PFAs, it may be implemented after the initial delimiting survey to confirm absence in the case of a PFA or the presence and level of the population in the case of an ALPP (step 2 decision tree). This is achieved by monitoring the population for a period of time. The period should be established based on the biology and ecology of the pest, and the climatic characteristics of the area. In the case of PFAs, for some pests the accepted period is at least 12 consecutive months in all relevant areas of commercial and non-commercial host plants to demonstrate that the pest is not present in the area. There should be no populations detected during the monitoring activities prior to establishment. Monitoring surveys may also be used to assess the population levels during population suppression aimed at establishing an ALPP and during population eradication aimed at establishing a PFA. To verify characteristics of the target pest, survey tools are used at low density. To determine the efficacy of control measures, survey tools are used at medium to high density.

3.2.2.2 Sampling procedures

Sampling units and sampling sites should be defined. In some sampling plans, these may be geographically defined according to different levels of locations: area, district, place, field site and sampling site. Each can be defined depending on political boundaries, physical boundaries, administrative boundaries, road network, ownership, cultivation system and crop spacing. But it is essential to at least define the location level that will identify the sampling unit which is represented by one sample.

The sampling plan should be designed based on a statistically valid approach. The approach will depend upon the population size and distribution of the targeted pest in the sampling sites, the efficiency of the sampling units and the desired confidence level. The sample size should be based on the estimated population level. In monitoring surveys for an ALPP, it is also important to estimate the population level to prevent over-sampling and the waste of resources. The sampling schedule should be based on documented evidence of pest population dynamics.

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Traps for monitoring surveys are distributed in the production areas, buffer areas and urban areas in order to verify the absence / presence or characteristics of the population of the target pest. (Source: Anastrepha grandis *PFA, Rio Grande do Norte, Brazil.)*

Four main sampling methodologies are commonly known to be applied in survey programmes: random sampling, systematic sampling, stratified random sampling and targeted site sampling (McMaugh, 2005). It is worth noting that at the establishment stage of an ALPP, and as a monitoring survey is selected, it is useful to design the sampling plan to favour detection of the targeted pest.

To increase the probability of detection, survey activities should be implemented on a continuous basis, following the pest population dynamics, climate conditions and host susceptibility.

Surveyors should receive clear instructions and have access to standard operating procedures (SOPs). These and other field activity SOPs should be made publicly available as part of a program's public outreach and information efforts. The sampling sites should be clearly marked, so the site can be easily identified if re-sampling is required. Standard paper-based forms or devices with relevant software should be used to record survey activities and collect as much data as possible. These should include geographical data and records on local contacts, host plants (vegetative stage, presence of symptoms and their extent), cultural or pest management practices applied, weather conditions and any other relevant useful information (e.g. information on soil type and irrigation system may be useful to collect in case of some soil-borne pathogens).

More information on sampling is available in the IPPC guide on *Plant pest surveillance*. Specific fruit sampling procedures for fruit flies are available in FAO/IAEA (2017b).

3.2.2.3 Sample management and diagnostic services

The proper handling of plant pest samples is a critical step as it can significantly affect the laboratory diagnosis and consequently the results of survey programmes. This is particularly true when sampling for pathogens. Survey activities and sample collection is a time-consuming and costly process, and inappropriate management of the sample can cause misdiagnosis or meaningless results.

Sample management protocols will vary with the type of sample and the nature of the target pest. The

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*Sample management – Field capturing, sorting, identification and packaging of samples in labelled packages is the monitoring routine of the Universidade Federal do Semi Árido in cooperation with the Committee of Exporters (Coex) in the risk mitigation system for a complex of fruit flies – Mediterranean fruit fly (*Ceratitis capitata*), West Indian fruit fly (*Anastrepha obliqua*) and South American fruit fly (*Anastrepha fraterculus*) – on mango cultivated in the Açu Valley, Rio Grande do Norte, Brazil.*

general rule to be followed is to keep the specimen intact, minimize storage and transportation time so that the sample is not affected (particularly when culturing methods will be used in the laboratory diagnosis) and store under the appropriate conditions away from direct sunlight. Special care should be given to preventing the spread of quarantine pests/pathogens to new areas. To this end, samples of quarantine pests/pathogens should be sealed in safe containers/bags, which are not allowed to be opened until they arrive in a laboratory with quarantine facilities. Samples should be properly labelled with persistent waterproof markers, pencil or any other stable means that can stand transportation, handling and storing, and a unique identifier code should be assigned to each sample.

Box 9: Detection survey activities against *Xylella fastidiosa* in Egypt

In some cases, special measures must be taken to ensure proper sampling is achieved; for example, when sampling for *Xylella fastidiosa.* This bacterial pathogen can infect more than 563 hosts and can be potentially vectored by any xylem-sap sucking insect.

Samples can be collected from either host plants or potential insect vectors "sharpshooters". If plant samples are collected from a symptomatic plant, it is preferred that they are collected from the closest point to the parts showing symptoms, but avoiding any dead, dry parts of the plant. If collected from asymptomatic plants, samples should be collected from the four directions of the plant at two levels (e.g. 1.5 m and 3 m for a tree) to improve the chances of detecting the pathogen as it has uneven distribution in the host. To collect insect vectors, a sweep net is used and moved above ground level. The leafhopper insects are then preserved in ethanol in tubes until laboratory identification and testing for the presence of the pathogen. To avoid unintentionally spreading the disease outside the infested area during the survey activities, no live insects should be transported from the sampling location to outside of the infested area. Therefore, any insects should be shaken-off the plant shoots before putting plant samples in the bags. Also, before sample processing at the laboratory, plant samples may be stored at low temperature for 24 hours to reduce the activity of any insect vector present on the sample and allow for the removal of insects by vacuum suction.

In the case of stratified sampling, the sampling sites or host plants may be divided into categories (strata) depending on the characteristics of the site or plant. It is therefore crucial, particularly for detection survey, to record the bases for stratifying the sampling site or host plants, and to make such information available to the diagnostic service unit. Such information may assist in detection or identification of the pest. However, this might not be necessary when random sampling is employed, as the sampling unit or host plants are selected randomly. Field and laboratory personnel should be adequately trained in pest identification and the symptoms of plant diseases.

Authorized laboratories should be close to or preferably in the PFAs and ALPPs, to minimize the time between sample collection and sample identification and hence allow a rapid response to pest detections and more efficient programme execution.

More information on sample management and diagnostics can be found in ISPM 27 (*Diagnostic protocols for regulated pests*), as well as in the IPPC guides on *Delivering phytosanitary diagnostic services* and *Plant pest surveillance*.

ISPM 27 (Diagnostic protocols for regulated pests): Scope

This standard provides guidance on the structure and content of the International Plant Protection Convention (IPPC) diagnostic protocols for regulated pests. The protocols describe procedures and methods for the official diagnosis of regulated pests that are relevant for international trade. They provide at least the minimum requirements for reliable diagnosis of regulated pests.

3.2.3 Suppression measures

» (step 14 decision tree - Suppression)

Measures for pest suppression should be applied using an integrated management approach and on an area-wide basis. In most cases, suppression will involve the use of more than one treatment option. The type of measures, as well as the area and time of their application, will depend on a number of factors, including: pest species, biology and ecology of the pest, population density, agroecological characteristics of the area, and climate.

Measures applied alone or in combination to suppress pests may include the following measures:

- biocontrol in combination with other measures
- soil sterilization and solarization

- elimination of hosts
- soil treatments
- chemical control (pesticides, fumigation, growth regulators, bait sprays aerial and ground, pheromones)
- sanitation (disposal of crop residues)
- mechanical control (cultivation practices, removal of certain stages of hosts)
- bait stations
- sterile insect technique
- male annihilation technique (MAT)
- mass trapping
- mating disruption
- tolerant varieties
- thermotherapy of seeds
- cultural controls (cropping, intercropping)
- physical barriers (fruit bagging, tarping).

Phytosanitary procedures for fruit fly (Tephritidae) management are presented in Annex 3 to ISPM 26. The procedures may be applied for population suppression or population eradication.

The NPPO should train the producers concerned in the application of pest management options that will result in suppression of the target regulated pest to the levels acceptable to the trading partner.

The measures that are applied could be specific chemical control measures, field sanitation or a combination of measures (integrated) that achieve the same result. The measures that are finally agreed for application should have been communicated to the NPPO of the importing country well beforehand. The NPPO or trained personnel from the private sector should conduct monitoring of the crop in the targeted area and collect samples and specimens for diagnostics. The NPPO may take additional measures to reduce the chance of increasing the levels of the target regulated pest in the targeted area by limiting movement of people, goods and other regulated articles capable of harbouring the pest. A systems approach could also be considered and agreed between both NPPOs.

The NPPO laboratory or its designated laboratory(s) should perform the testing and the results kept in a register managed by the NPPO. The inspectors of the NPPO should sample the final products prior to export to certify that the population of the target regulated pest is below the agreed level.

3.2.4 Buffer zones

» (step 26 decision tree)

ALPPs are established and maintained through pest population suppression. No buffer zones are required to protect an ALPP. However, an ALPP can act as a buffer zone to protect a PFA. See Section 3.5.3.

3.2.5 Quarantine measures

» (step 25 decision tree)

The production of consignments for export from an ALPP will require the application of quarantine measures (measures that are used to officially control quarantine pests within a quarantine area) under a systems approach. This includes cases where an ALPP functions as a buffer zone for a PFA. Depending on the assessed pest risk, these measures may include:

- movement control of host material into the area
- application of less than probit-9 postharvest treatments as a part of measures under a systems approach (ISPM 14 (*The use of integrated measures in a systems approach for pest risk management*) and ISPM 28 (*Phytosanitary treatments for regulated pests*)).
- listing of the target pest on a quarantine pest list
- regulation of the pathways and articles that require control to maintain the ALPP
- where necessary for cases of non-compliance, the application of appropriate phytosanitary measures (e.g. treatment, refusal or destruction).

Examples of quarantine measures used to maintain an ALPP can be found in Table 3.

ISPM 14 (The use of integrated measures in a systems approach for pest risk management): Scope

This standard provides guidelines for the development and evaluation of integrated measures in a systems approach as an option for pest risk management under the relevant international standards for pest risk analysis (PRA) designed to meet phytosanitary import requirements for plants, plant products and other regulated articles.

ISPM 28 (Phytosanitary treatments for regulated pests): Scope

This standard presents as annexes phytosanitary treatments evaluated and adopted by the Commission on Phytosanitary Measures (CPM). It also describes the requirements for submission and evaluation of the efficacy data and other relevant information on a phytosanitary treatment that can be used as a phytosanitary measure and that will be annexed to this standard after its adoption.

The treatments are for the control of regulated pests on regulated articles, primarily those moving in international trade. The adopted treatments provide the minimum requirements necessary to control a regulated pest at a stated efficacy.

The scope of this standard does not include issues related to pesticide registration or other domestic requirements for approval of treatments (e.g. irradiation)

3.3 VERIFICATION OF THE POPULATION LEVEL FOR AN ALPP

Once an ALPP is established, the NPPO should maintain the documentation and verification procedures, and continue following phytosanitary procedures, movement controls and record keeping. The main cause leading to a change in the status of an ALPP is the detection of the specified pest at an incidence exceeding the specified pest level within the ALPP. In order to verify (step 45 decision tree) if a pest population is being maintained at the established low prevalence level or if the level has been exceeded, a pest population monitoring tool appropriate for the specified level should be kept at all times in the ALPP (ISPM 22). For some pests such as fruit flies, if the pest prevalence is observed to be increasing (but remains below the specified level for the area), a threshold set by the NPPO for the application of additional control measures may be applied. At this point, the NPPO may require implementation of such measures (as described in Section 3.2.3). This threshold should be set to provide adequate warning of potentially exceeding the specified level of low pest prevalence and hence to avert suspension of the ALPP (ISPM 22).

A change in ALPP status should result in the implementation of a corrective action plan (step 44 decision tree). The corrective action plan should be initiated as soon as possible after confirmation that the specified pest level has been exceeded in the ALPP.

Depending on the outcome of the actions taken, the ALPP may be:

- continued (status not lost), if the phytosanitary actions taken (as part of the corrective action plan in the case of detection of a specified pest above a specified pest level) have been successful
- continued, if a failure of regulatory actions or other deficiencies has been rectified
- redefined to exclude a certain area, if the specified pest level of a pest is exceeded in a limited area that can be identified and isolated
- suspended.

If an ALPP is suspended (step 46 decision tree), an investigation should be initiated to determine the cause of the failure.

The NPPO should have a documented plan to be implemented if a specified pest level is exceeded in the ALPP, or when appropriate in buffer zones. The plan may include a delimiting survey to determine the area in which the specified pest level has been exceeded, commodity sampling, pesticide applications and/or other suppression activities. Corrective action plans should also address all of the pathways (ISPM 22).

The suspension of the ALPP should remain in effect until it is demonstrated that populations of the pest are below the specified pest level for an appropriate period of time, or that the other deficiencies have been corrected. As with the initial establishment of an ALPP, the minimum period of time below the specified pest level for reinstatement of ALPP status will depend on the biology of the specified pest. Once the cause of the failure has been corrected and compliance with the operational plan has been verified (steps 44, 45 decision tree), the ALPP can be reinstated (ISPM 22).

3.4 DECLARATION AND RECOGNITION OF ALPPS

» (steps 29, 30 decision tree - Declaration, Recognition)

Recognition of areas of low pest prevalence (ALPPs) is a technical and administrative process in which NPPOs of exporting and importing countries have clearly defined roles and responsibilities born from the provisions of the IPPC and ISPMs. The process should follow the IPPC basic and operational principles:

- Contracting parties to the IPPC should proceed with a recognition and resolve any disagreements related to the recognition process without undue delay and

discrimination between contracting parties.

- Contracting parties should endeavour to maintain transparency in all aspects of the recognition process.
- Updates on progress between the importing and exporting contracting parties should be provided to the designated point of contact, as appropriate or on request, to ensure that the recognition process is conducted in an open and transparent manner.
- Any change in the status of the regulated pest in the area under consideration, or in the importing contracting party's territory, that is relevant to recognition shall be communicated appropriately and promptly as required by the IPPC (Article VIII.1(a)) and relevant ISPMs (e.g. *ISPM 17*).

Recognition of ALPPs implies the following steps from involved contracting parties:

- request for recognition
- acknowledgement of receipt of the request and the accompanying information package
- description of the process
- assessment of the information provided
- communication of the results of assessment
- provision of official recognition.

The whole process, from initial request to final decision, should be properly documented by contracting parties so that the sources of information and rationale used in reaching the decision can be clearly identified and demonstrated.

Recognition of an ALPP should remain in effect unless:

- there is a change in pest status in the area concerned and it is no longer an ALPP
- there are significant instances of non-compliance related to the areas in question, or related to the bilateral arrangement, noted by the importing contracting party.

Note: Official recognition of low pest prevalence is obtained on a bilateral basis.

3.4.1 Role of the NPPO (exporting country)

The NPPO of the exporting contracting party has the following responsibilities:

- Establish and declare the area concerned as an ALPP in accordance with the relevant ISPMs.
- Submit a request for recognition of the established ALPP to an importing contracting party. The exporting contracting party may consult with the importing contracting party before submitting a request to facilitate the recognition process.
- Designate a point of contact for communication relating to the request for recognition (other public service entities such as ministries of trade, economy, commerce or foreign affairs might need to be informed and/or involved).
- Provide a sufficiently detailed technical information package to demonstrate objectively that the area is, and is likely to remain, an ALPP, as appropriate and to facilitate assessment by the importing NPPO. The package should include the following information:
  - location and description of the area to be recognized, with supporting maps, as appropriate
  - pest under consideration, biology and known distribution relevant to the area
  - commodity/commodities or other regulated article(s) to be exported
  - general information on hosts and their prevalence within the designated area
  - phytosanitary measures and procedures applied for the establishment of the ALPP, and results of these measures
  - phytosanitary measures and procedures applied to maintain the ALPP, and results of these measures
  - relevant phytosanitary regulations relating to the ALPP
  - record-keeping arrangements relating to the area
  - relevant information, directly related to the request for recognition, on the structure of and resources available to the NPPO of the exporting contracting party
  - a description of corrective action plans, including related communication arrangements with the importing contracting party concerned
  - other relevant information (e.g. recognition of the area in question by other contracting parties, and possible systems approaches relating to ALPPs).
- Respond to technical concerns raised by the NPPO of the importing contracting party and submit any missing information, or provide an explanation for its absence.
- Cooperate in the organization of on-site verification visits, if requested by the importing contracting party.

The exporting contracting party may request cancellation or postponement of the assessment at any time. Should the exporting contracting party request postponement of the assessment, this may result in changes in the anticipated time frame.

3.4.2 Role of the NPPO (importing country)

Importing contracting parties should be interested in providing prompt recognition of ALPPs as the way to meet their appropriate level of protection. The NPPO of the importing contracting party has the following responsibilities:

- Determine the type of information that will be required in order to recognize an ALPP, depending on the type of area and its geography, the method used to establish the ALPP, its appropriate level of protection, and other factors for which technical justifications exist.
- Limit any information or data requests associated with an assessment of recognition to those which are necessary.
- Designate a point of contact for communications relating to the request for recognition.
- Promptly acknowledge receipt of the request and of the accompanying information package to the NPPO of the exporting contracting party.
- Describe the process to be used for the recognition process including any necessary legislative or administrative steps or requirements that will need to be completed and, if possible, an estimated time frame for the evaluation.
- Assess the information without undue delay and based on the provisions of relevant ISPMs.
- Notify the exporting contracting party if at any stage progress is not proceeding in accordance with the anticipated time frame, if established, and provide reasons for that upon the request of the exporting contracting party. In such cases, a new time frame should be prepared and provided by the importing contracting party to the exporting contracting party.
- Identify and communicate to the NPPO of the exporting contracting party if any significant component of the information package is missing, or if other significant information may be needed to assess the request.
- Take into consideration all information previously provided by the exporting contracting party and any relevant details in the corresponding technical explanation related to the previous assessment if the exporting contracting party resubmits a request for recognition of an ALPP in the following circumstances:
  - when further data are acquired, or new or additional procedures are implemented and verification has been provided by the exporting contracting party that the information remains valid
  - due to a previous non-acceptance of a request
  - if a contracting party has withdrawn an ALPP and wishes to reinstate it.
- Communicate and justify to the NPPO of the exporting country the need for on-site verifications and cooperation, or for on-site review of operational procedures if justified, based on the results of ongoing assessment, records of previous trade between the two parties (in particular if there is a lack of information, interception records, non-compliance with import requirements), or previous recognition of areas between the two parties or by other parties. The schedule, agenda and content of the on-site verification or review should be agreed bilaterally, and access provided as necessary.
- Communicate the results of the assessment to the exporting contracting party and proceed as follows:
  - If the area is recognized, promptly modify any phytosanitary regulations, as appropriate.
  - If the area is not recognized, provide an explanation, including technical justification where applicable, to the exporting contracting party.

When possible, it is good to establish a bilateral work plan, signed by the NPPOs and built together with the stakeholders, that describes the obligations of all concerned and provides sufficient detail to avoid doubt in the event of litigation.

3.4.3 Role of the IPPC

The IPPC International Phytosanitary Portal provides a means for NPPOs to communicate information regarding the establishment of pest free areas and pest status, to help them comply with national reporting obligations. Through the portal, the exporting countries' official contact points give notification of ALPPs recognized by their trading partners and changes in pest status.

3.5 ERADICATION

» step 13 decision tree - Eradication

A programme for pest eradication may be developed by a national plant protection organization as:

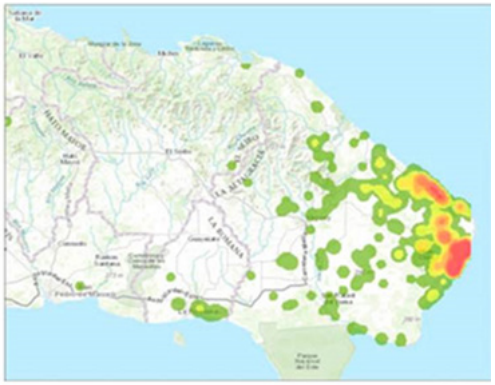
- an emergency measure to prevent establishment or spread of a pest following its recent entry (re-establish a pest free area) (Box 9); or
- a measure to eliminate an established pest (establish a pest free area) (Box 10).

The decision to undertake an eradication programme results from an evaluation of the circumstances of detection of a pest, its identification, the risk identified by a pest-initiated PRA, estimation of the present and potential distribution of the pest, and assessment of the feasibility of conducting an eradication programme. It is normally good practice to give due consideration to all the elements recommended. However, this may be limited by the availability of data and resources. Particularly in cases where emergency eradication measures seem necessary (e.g. recent entry of a pest capable of rapid spread), the need to take action rapidly should be balanced against the need for more detailed analyses and planning.

For successful eradication, it is important to ensure that the right team has been selected to implement the programme. The team could include external collaborators and private sector officials who will be involved directly in implementation. The NPPO should play the lead role and tasks for everyone should, at this stage, be very well-defined.

Box 10: Re-establishing the Dominican Republic as a medfly free area

The presence of the Mediterranean fruit fly (*Ceratitis capitata* (Wiedmann)) (medfly) in the Dominican Republic was officially reported in March 2015. The pest had already spread to 2 053 km^2 in the eastern part of the country, constituting a major outbreak. An immediate ban on most exports of fruits and vegetables was imposed by trading partners, causing a loss of over USD 40 million for the remaining nine months of 2015. As an emergency response, the Government, through its Ministry of Agriculture, established the Moscamed Programme in the Dominican Republic (Moscamed-RD), providing the required financial and operational support to carry out all required surveillance and eradication activities. The Guatemala, Mexico, USA Moscamed Programme was instrumental in transferring sterile insect technique (SIT) for medfly eradication. National and international organizations including the International Atomic Energy Agency (IAEA), FAO, United States Department of Agriculture (USDA), Organismo Internacional Regional de Sanidad Agropecuaria (OIRSA) and Instituto Interamericano de Cooperacion para la Agricultura (IICA) made joint efforts with the Ministry of Agriculture against the medfly outbreak. An FAO/IAEA technical advisory committee provided oversight throughout the eradication campaign. An integrated pest management approach based on area-wide SIT was used to eradicate the pest. Official eradication was announced in July 2017 after six fly generations of zero catches.



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Location of the Mediterranean fruit fly (medfly, Ceratitis capitata*) outbreak in the Dominican Republic (left: red denotes highest pest density and green the lowest). Packing of sterile medflies before field release. Medfly pupae were shipped from the Moscamed El Pino mass-rearing facility in Guatemala to the Dominican Republic where they were emerged and packaged for daily aerial releases over infested areas.*

For more information, see Section 8: Case study 14 – Mediterranean fruit fly (*Ceratitis capitata*) eradication from the Dominican Republic.

Box 11: Establishing Patagonia, Argentina, as a medfly (*Ceratitis capitata*) free area

Eradication of the Mediterranean fruit fly (*Ceratitis capitata* (Wiedemann)) (medfly) represents the elimination of costly quarantine treatments to most of the three million boxes of quality pears and apples that are exported from Patagonia, Argentina, every year. A programme to eradicate medfly from Patagonia was launched by Servicio Nacional de Sanidad y Calidad Agroalimentaria (SENASA) and Fundacion Barrera Zoofitisanitaria Patagonica (FUNBAPA) in 2001. Eradication was achieved through an intensive area-wide programme using sterile insect technique. Sterile flies were shipped from the mass rearing and sterilization facility located in the Province of Mendoza. Of fundamental importance to protect the PFA, was the extensive quarantine barrier operated effectively by FUMBAPA. Patagonia was officially declared a medfly pest free area (PFA) in 2004. Trading partners, including the United States of America and Mexico, recognized Patagonia as a medfly free area.

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Inspections, with the help of detection dogs, were used at key entry points to the FUNBAPA quarantine in Patagonia, Argentina, to ensure infested host material was not being brought into the eradication zone.

For more information, see Section 8: Case study 5 – Patagonia, Argentina – a Mediterranean fruit fly (*Ceratitis capitata*) PFA.

Eradication typically requires significant resources to execute and may take a significant amount of time to achieve the desired results (for a database of costs for historical eradication programmes consult GERDA – http://b3.net.nz/gerda/). Actions and results should be frequently reviewed to ensure that the objectives of the programme are being met. The time needed to achieve pest freedom varies immensely, ranging from a few months to a few years, and is related to the successful delivery of the programme as a whole and its credibility, reproducibility and sustainability. However, in very general terms, and certainly not the rule, the time needed would be the longest in terms of PFAs (sometimes measured in years), moderate in PFPPs (a few months to a few years) and the least in cases of PFPSs (months). The NPPO should do the following:

- conduct a cost–benefit analysis for eradication over the short and long term, this including consideration of the option to take no action, or to take a pest management approach, as well as eradication options
- prepare an emergency or contingency plan that clearly outlines the roles and responsibilities of each stakeholder in an eradication
- define the work programme well (it is important to note that the assessment of the programme needs to be done through objective and clearly defined indicators)
- hold frequent meetings with its staff and key stakeholders and adjust work plans as necessary
- review the programme indicators and give continuity and follow up to the action plans in execution
- assign a field manager and/or supervisor to lead the programme
- conduct delimiting, monitoring and detection surveys for the target pest, using the appropriate methods and techniques
- determine the scope of the phytosanitary measures needed, basing this on pest biology and pest related scientific studies (measures need to be applied on an area-wide basis to achieve eradication and pest freedom)

- implement phytosanitary measures to achieve eradication in accordance with agreed protocols and methodologies
- ensure that the personnel involved receive regular training on new technologies/techniques relevant to the tasks
- ensure that refresher training is provided at appropriate intervals (particularly after non-compliance incidents or other failures in the programme are detected)
- document the measures implemented to eradicate the pest and their results
- determine the penalty for involved stakeholders not fulfilling measures.
- determine and address critical (weak) points of official checks.

NPPOs should ensure that they have ready access to funds in order to respond rapidly to a pest detection/incursion that could compromise an already established PFA/PFPP/PFPS.

3.5.1 Surveillance plan

A regular survey programme (step 18 decision tree) should be established and implemented for the establishment of a PFA. A surveillance plan should include detection or delimiting surveys that will follow a plan that is developed by the NPPO of the exporting country and approved by the NPPO of the importing country.

Pest specific surveillance tools should be used to determine pest absence or presence in an area. For certain pests, host sampling may sometimes be required to complement direct standard sampling methods. During the establishment and prior to the declaration of a PFA, surveillance should be undertaken for a period determined by the climatic characteristics of the area and pest biology in all relevant areas of commercial and non-commercial host plants to demonstrate that the pest is not present in the area. For a PFA to be declared, there should be no pest detections for an agreed period of time (e.g. three life cycles in the case of some insect pests). A single pest detection, depending on its status (in accordance with ISPM 8), may not disqualify an area from subsequent designation as a PFA. There will be different sampling and survey schemes for different pest species. For example, fruit fly surveys should be conducted according to the guidelines in Appendixes 1 and 2 in ISPM 26.

For PFPPs and PFPSs, the NPPO should normally specify a set of conditions to be met by the producer, enabling the place of production or production site to be subsequently declared pest free. These requirements will concern the characteristics of the place of production or production site (and the buffer zone, if appropriate) and the operational capabilities of the producer. Formal agreements may be required between the producers (or their organizations) and the NPPO to ensure that specific measures are taken. In some cases, the NPPO may require that pest freedom should be verified by official surveys for one or more years before the year in which consignments are certified for export. The methods used to verify freedom in this way may be the same as, or different from, those used for verifying freedom in the year of export. In other cases, the NPPO may only require that pest freedom be verified in the year of production. In any case, the objective of the NPPO and the producers will generally be to maintain the pest free status of a place of production or production site continuously over a period of years. In the cases where pest free production sites are established, delimiting surveys may be used to determine their extent.

3.5.1.1 Specific surveillance and sampling procedures (monitoring, detection surveys)

The type of surveys and methodologies will be more rigorous during the establishment phase (step 18 decision tree) until pest absence is achieved. It is crucial that there are zero detections/captures over the span of the agreed number of life cycles. As the number of detections decreases, the NPPO should ensure that more sensitive detection methods and techniques (e.g. intensification of trapping, use of molecular techniques) are used and adjusted as appropriate to detect the low level of pests. Surveillance activities should take into account the fact that when pest prevalence is very low, or the pest has been subject to adverse conditions – either natural or man-made – the pest can change its biological behaviour, which may affect its abundance and distribution within a specific environment (host plant, soil, water bodies). For example, some bacteria form spores or viable-but-not-culturable forms that cannot be easily detected, and some nematodes migrate to a deeper soil layer in the absence of their hosts or under adverse conditions.

3.5.1.2 Sample management and diagnosis

As with suppression, the proper handling of plant pest samples is a critical step as it can significantly affect the laboratory diagnosis and consequently the results of survey programmes. The same general principles discussed previously in Section 3.2.2.3 (Sample management and diagnostic services) will apply, including:

- minimizing transportation time
- proper labelling and recording of data
- trained personnel
- use of authorized laboratories and diagnostic methods.

More information on sample management and diagnostics can be found in ISPM 27, as well as in the IPPC guides on *Delivering phytosanitary diagnostic services* and *Plant pest surveillance*.

3.5.2 Eradication measures

» (step 13 decision tree - Eradication)

Types of eradication measures are mostly the same as suppression measures. The primary difference is in the management strategies. Eradication and suppression have marked differences in the scale of operation, the required time frame and the intensity of application of the measures. Eradication is typically applied over the entire area where the pest of concern is present to minimize the risk of reinfestation. The time frame of an eradication programme is usually longer as the entire area needs to be covered and the aim is to completely eliminate the population. This may include more intense surveillance systems, such as the use of a higher density of survey tools for detection and delimiting, as well as more intense control measures such as a greater number of insecticide-bait sprays, a higher density of bait stations and a higher density and frequency of released sterile flies.

Other differences in eradication compared to suppression measures are the need for quarantine checkpoints (step 16 decision tree) to protect the PFA and that no postharvest treatments are required once a PFA has been declared.

3.5.3 Buffer zones

» (step 17, decision tree - Buffer zone)

A buffer zone is defined as "an area surrounding or adjacent to an area officially delimited for phytosanitary purposes in order to minimize the probability of spread of the target pest into or out of the delimited area, and subject to phytosanitary or other control measures, if appropriate" (ISPM 5 (*Glossary of phytosanitary terms*)).

ISPM 5 (Glossary of phytosanitary terms): Scope

This reference standard is a listing of terms and definitions with specific meaning for phytosanitary systems worldwide. It has been developed to provide a harmonized internationally agreed vocabulary associated with the implementation of the International Plant Protection Convention (IPPC) and International Standards for Phytosanitary Measures (ISPMs).

Within the context of the IPPC and its ISPMs, all references to plants should be understood to continue to include algae and fungi, consistent with the International Code of Nomenclature for algae, fungi, and plants.

Buffer zones may be established as part of a pest population eradication programme during the establishment of a PFA/PFPP/PFPS, or as part of a fixed containment barrier to protect a PFA/PFPP/PFPS once eradication has been achieved and pest free

status has been declared (Figure 3), or to maintain commercial production areas at low pest prevalence (ALPP) as part of a systems approach. Buffer zones should be established around a PFA/PFPP/PFPS if the biology of the pest concerned makes it possible for it to enter the PFA/PFPP/PFPS from adjacent areas, if geographical isolation is not considered adequate to prevent introduction to or reinfestation of the PFA/PFPP/PFPS, or if there are no other means of preventing movement of the pest to the PFA/PFPP/PFPS.

The pest population in the buffer zone needs to be maintained at or below a low pest tolerance level specified by the NPPO of the importing country.

The NPPO should describe, with the use of supporting maps, the boundaries of the buffer zone. The extent of the zone is determined by the NPPO, based on a distance over which the likely natural spread of the pest will occur during the growing season. It must be free from hosts of the target pest or they must be under adequate control. It should be located at a sufficient distance from sources of target pest infestation, with appropriate insulation. The physical characteristics of buffer zones can act as barriers to pest movement. If necessary, the producer or NPPO should be able to apply the same phytosanitary measures to the buffer zone as appropriate for the PFA, PFPP or PFPS.

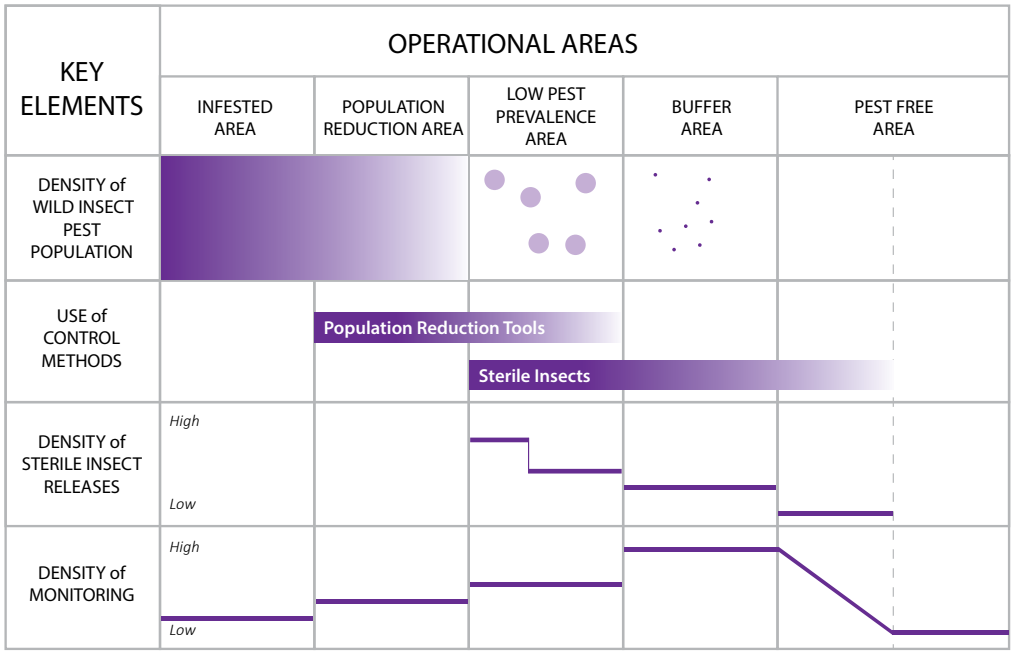
Verification surveys (step 18 decision tree) should be conducted with adequate frequency during one or more growing seasons. If the pest is detected in the buffer zone, the actions to be taken will depend on the NPPO requirements. Adequate procedures may be established to support the assurance that the absence of a pest is maintained and that, should this change, the pest-free status of PFA, PFPP or PFPS may be withdrawn or appropriate control measures may be required.

Buffer zones may be either temporary or more permanent (ISPM 22).

Temporary Buffer Zones

Pest eradication programmes that proceed in phases or blocks might require buffer zones between the intervention blocks to temporarily protect areas where the pest has been eradicated in each new operational phase of the advancing programme. Hence, these buffer zones attempt to ensure that any migrating gravid females, or those that are transported across a permeable quarantine, cannot re-establish new populations. These temporary buffer zones will prevent influx of the pest from blocks where eradication measures are being applied to areas where the pest has been eradicated. Temporary buffer zones

Figure 3: Schematic representation of a containment barrier with a buffer zone protecting a PFA from an infested area (figure from Hendrichs *et al.*, 2005)



were established during the progressive eradication campaign of the New World screwworm (*Cochliomyia hominivorax* (Coquerel)) in Mexico and Central America (Wyss, 2000). The programme always included (at the back end of the moving eradication front) a large screwworm-free buffer area in which sterile insects were released as an insurance in case screwworm-infected cattle were moved into the PFA. The areas where buffer zones have to be established should be identified during the collection of baseline data and the programme planning activities of the pre-intervention phase.

Permanent Buffer Zones

Permanent buffer zones are often established for containment. These buffers should have a width sufficient to intercept any immigrating insect and the capacity to deal with the progeny of any gravid female that enters the area. In tsetse flies, for example, which are relatively poor fliers and have no free-living immature stage, the dispersal potential is much lower (Feldmann and Jannin, 2001) than that of New World screwworms (Lance and McInnis, 2005). However, the potential for reinvasion of screwworm flies is much lower than that of polyphagous fruit flies, which are present in innumerable small hosts that can contain larvae, and are easily transported by travellers or postal shipments. Therefore, in addition to buffer zones, rigorous quarantine measures (see 3.6.4 Quarantine measures) have to be established to intercept any insect that is transported passively with animal or plant commodities, such as fruit fly larvae in fruit, screwworm larvae in livestock, pets, and humans, codling moth pupae in packing boxes, nematods in roots, and medfly resting on vehicles.

Areas acting as a buffer zone to protect a PFA can be established and maintained as an ALPP from where commodities can be exported following a systems approach (ISPM 22) (see Section 2.2.4).

Pest free places of production or pest free production sites can be applied on a temporary (one growing season) or permanent basis. In appropriate cases, the establishment and maintenance of a PFPP or a PFPS include procedures related to the buffer zone associated with the place of production or production site. In this case, the extent of the buffer zone should be determined by the NPPO, on the basis of the distance over which the pest is likely to spread naturally during the course of the growing season. Monitoring surveys should be conducted at adequate frequency over one or more growing seasons. The action to be taken, if the pest is detected in the buffer zone, will depend on the requirements of the NPPO. The pest free status of the place of production or production site may be withdrawn or appropriate control measures may be required in the buffer zone.

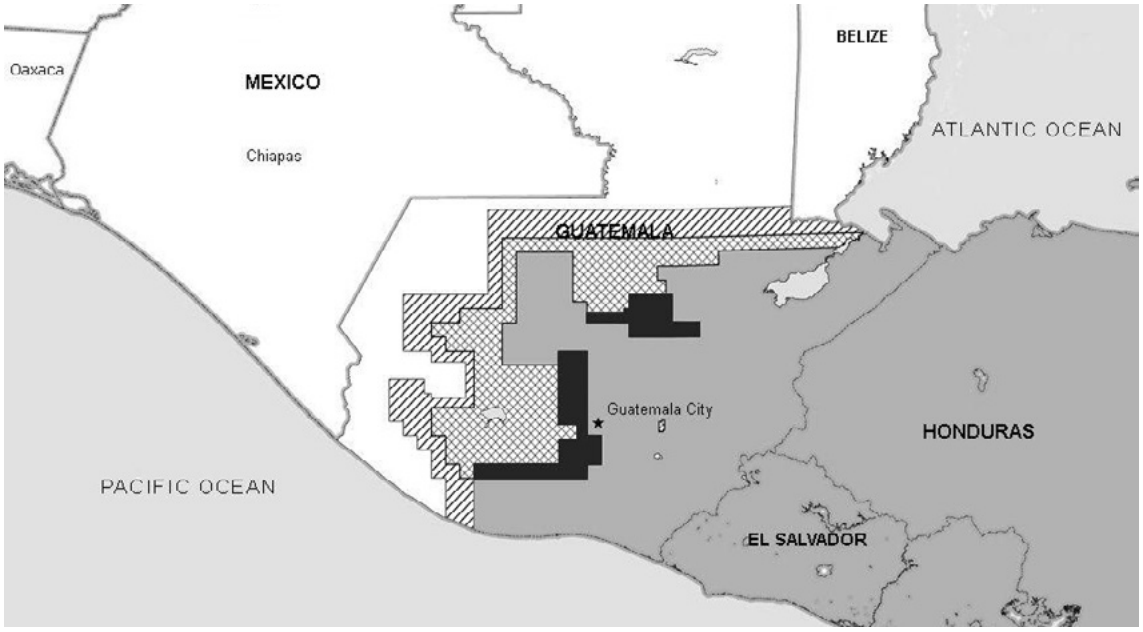
Box 12: Permanent buffer zone

A good example of an effective permanent buffer zone is the sterile Mediterranean fruit fly containment barrier and buffer zone of more than 34 000 km^2 that has been maintained for more than 35 years (since 1982) along the Mexico–Guatemala border, as part of the Moscamed containment programme (Villaseñor *et al.* 2000; Enkerlin *et al.* 2015, 2017). The barrier protects the northern movement of the pest back into Mexico and into the United States of America. Aircraft release nearly 1.3 billion sterile flies per week over approximately 7 000 km^2 of carefully designed sterile release blocks. The large size of the barrier is required because of the high mobility of medfly along the coffee belt that extends from Guatemala into the pest free area in Chiapas, Mexico, as well as the artificial movement of the pest in large volumes of commercial host fruit to be sold in town markets along the border. The requirements and optimal dimensions for efficient buffers are often underestimated and, when combined with insufficient resources, frequently result in the establishment of localized inefficient buffers that "leak" (Dyck *et al.* 2005).

For more information, see Section 8: Case study 3: Guatemala, Mexico, USA Moscamed programme for the eradication and containment of the Mediterranean fruit fly (Ceratitis capitata).

Permanent buffer zones are also needed around areas of low pest prevalence (ALPPs) – commercial production areas where suppression, rather than containment or eradication, is the strategic goal. The objective is to reduce the impact of gravid females moving into such areas by applying pest control beyond the core commercial production areas.

Since suppression is the strategic objective in these situations, these permanent buffer zones do not require the establishment of rigorous quarantine procedures, and can be much more modest



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*Location of the Mediterranean fruit fly (*Ceratitis capitata*) containment barrier in Guatemala in 2015.*

than those required for containment or eradication programmes. Nevertheless, the width of these buffers also needs to be determined. Examples include: the integration of released sterile codling moths and mating disruption, between British Columbia, Canada, and Washington State, United States of America (Calkins *et al.*, 2000); and the buffer area (treatment of "hot spots" and releases of sterile Mediterranean fruit flies) covering wild-host areas and commercial orchards at the entrance to the Hex River Valley in South Africa (Barnes *et al.*, 2004).

Factors that should be considered in the establishment and the effectiveness of a buffer zone include (Barclay *et al.*, 2011):

- pest mobility
- host availability and density, cropping systems, natural vegetation
- climatic conditions
- the geography and topography of the area
- capacity for natural spread through identified pathways
- tolerable damage threshold
- population pressure from surrounding areas.

Pest suppression techniques which may be used to reduce the pest population, include:

- use of selective insecticide-bait
- spraying
- sterile insect technique
- male annihilation technique
- biological control
- mechanical control
- systems to monitor the effectiveness of the buffer zone (e.g. trapping network).

3.5.4 Quarantine measures

The establishment of a PFA implies the application of quarantine measures (step 16 decision tree) that would aim to restrict the movement of regulated articles including pests. These measures, as defined in ISPM 26, include:

- listing of the target pest species on a quarantine pest list
- domestic restrictions to control the movement of regulated articles into the PFA
- establishment and operating of quarantine checkpoints
- regulation of the pathways and articles that require control to maintain the PFA
- inspection of regulated articles, examination of relevant documentation as appropriate and, where necessary for cases of non-compliance, the application of appropriate phytosanitary measures (e.g. treatment, refusal or destruction).

Application of quarantine measures may affect the routine not only of those involved in production and export, but also the general population. Relevant awareness-raising programmes could help to educate the public on handling regulated articles and the phytosanitary risks associated with the movement of material through airports, ports, internal barriers and border checkpoints.

Examples of quarantine measures to maintain a PFA/PFPP/PFPS or ALPP are listed in Table 3.

Table 3: Examples of quarantine measures used to maintain a PFA or ALPP

Quarantine measures	Example	Responsible party
Treatment of regulated articles	Sanitizing of machinery, farm equipment, tools, clothing and shoes, and packaging to prevent the movement of, among other things, pathogens and nematodes	NPPO, producers
Regulation of the pathways and articles	Assurance of integrity and security of consignments	NPPO, stakeholders involved in logistics, producer(s)
	Adequate transport to prevent reinfestation of consignments	
Restrictions to the movement of regulated articles into the PFA and ALPP	Quarantine checkpoints List of regulated articles (hosts) or other materials that could harbour pests Movement of regulated articles limited to phytosanitary corridors (specific routes for movement of consignments) Phytosanitary certificates, certificates of origin and permits to move consignments into endangered area	NPPO, other relevant ministries and public agencies
Refusal or destruction	Disposal and destruction of infected materials Rejection to entry of consignments into endangered area	NPPO, producer(s)
Application of phytosanitary measures in the field	General Inspection of PFA, PFPP, PFPS and ALPP Inspection of buffer zone Increased numbers of surveillance units Control of places for product consolidation, packing houses and wholesale depots	NPPO, producer(s)

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Restrictions on the movement of regulated articles into PFAs and ALPPs can be made through fixed inspection stations (top) or mobile check points that change locations from day to day (bottom). (Source: Anastrepha grandis *PFA, Rio Grande do Norte, Brazil)*

3.6 VERIFICATION OF PEST ABSENCE FOR ESTABLISHING PFAs, PFPPs AND PFPSs

Prior to establishment of a PFA, PFPP or PFPS, pest absence should be verified (ISPM 4, ISPM 8 and ISPM 10). Verification is carried out by NPPO staff or authorized personnel, who conduct specific monitoring surveys (step 18 decision tree) through field inspections, followed by laboratory analysis of suspicious samples or detected specimens. Verification surveys should be conducted for a specific period of time, during which no specimens of the target pest should be detected. The duration of the verification period will depend on the biology of the target pest and the environmental conditions that prevail in the area. Surveys are intensified to increase the probability of pest detection depending on the pest density around the area to be established as free. Data from the monitoring survey should be recorded, filed and presented to the NPPO of the importing country when requested.

3.7 DECLARATION AND RECOGNITION OF PFAs

» (steps 22, 23 decision tree) - Declaration, Recognition (just PFA)

The importing contracting party is responsible for determining the type of information that will be required in order to recognize a PFA, depending on the type of area, its geography and the method used to establish the pest free status of the area. When eradication of the regulated pest from the target area is achieved for the first time, the NPPO makes a national declaration of pest freedom (step 22 decision tree), but it should bear in mind that recognition of pest freedom by the importing contracting party (step 23 decision tree) will not be immediate. The NPPO should consider that some time is needed for verification through several biological life cycles of the target pest to obtain the recognition from its trading partner. The number of life cycles that should pass before pest freedom is declared may depend on guidance provided in an ISPM or it may be bilaterally agreed with a trading partner.

Recognition of a PFA implies the following steps from involved contracting parties:

- request for recognition
- acknowledgement of receipt of the request and the accompanying information package
- description of the process
- assessment of the information provided
- communication of the results of assessment
- provision of official recognition.

The whole process, from initial request to final decision, should be properly documented by contracting parties so that the sources of information and rationale used in reaching the decision can be clearly identified and demonstrated.

Recognition of a PFA should remain in effect unless:

- there is a change in pest status in the area concerned and it is no longer a PFA
- there are significant instances of non-compliance[1] related to the areas in question, or related to the bilateral arrangement, noted by the importing contracting party.

Note: Official recognition of PFAs is obtained on a bilateral basis.

Usually, PFPPs and PFPSs should not require recognition using the steps described above. The issuance of a phytosanitary certificate (step 50 decision tree) for a consignment by the NPPO should confirm that the requirements for a PFPP or a PFPS have been fulfilled. The importing country may require an appropriate additional declaration on the phytosanitary certificate to this effect.

However, the NPPO of the exporting country should, on request, make available to the NPPO of the importing country the rationale for establishment and maintenance of PFPPs or PFPSs. Where bilateral arrangements or agreements stipulate, the NPPO of the exporting country should expeditiously provide information concerning establishment or withdrawal of PFPPs or PFPSs to the NPPO of the importing country.

In cases when complex measures are needed to establish and maintain a PFPP or PFPS because the pest concerned requires a high degree of phytosanitary security, an operational plan should be developed based on bilateral agreements or arrangements listing specific details required for the operation of the system including the role and responsibilities of the producer and trader(s) involved. In such cases, recognition may follow the steps described above or another bilaterally agreed procedure.

3.7.1 Role of the NPPO (exporting country)

The NPPO of the exporting contracting party has the following responsibilities:

- Establish and declare the area concerned as a PFA in accordance with the relevant ISPMs.
- Submit a request for recognition of the established PFA to an importing contracting party. The exporting contracting party may consult with the importing contracting party before submitting a request to facilitate the recognition process.
- Designate a point of contact for communication relating to the request for recognition (other public service entities such as ministries of trade, economy, commerce or foreign affairs might need to be informed and/or involved).
- Provide a sufficiently detailed technical information package to demonstrate objectively that the area is, and is likely to remain, a PFA, as appropriate and to facilitate assessment by the importing NPPO. The package should include the following information:
  - location and description of the area to be recognized, with supporting maps, as appropriate
  - pest under consideration, biology and known distribution relevant to the area
  - commodity/commodities or other regulated article(s) to be exported
  - general information on hosts and their prevalence within the designated area
  - phytosanitary measures and procedures applied for the establishment of the PFA, and results of these measures
  - phytosanitary measures and procedures applied to maintain the PFA, and results of these measures
  - relevant phytosanitary regulations relating to the PFA
  - record-keeping arrangements relating to the area
  - relevant information, directly related to the request for recognition, on the structure of and resources available to the NPPO of the exporting country

[1] *ISPM 13*

  - a description of corrective action plans, including related communication arrangements with the importing country concerned
  - other relevant information (e.g. recognition of the area in question by other contracting parties).
- Respond to technical concerns raised by the NPPO of the importing contracting party and submit any missing information, or provide an explanation for its absence.
- Cooperate in the organization of on-site verification visits, if requested by the importing contracting party.

The exporting contracting party may request cancellation or postponement of the assessment at any time. Should the exporting contracting party request postponement of the assessment, this may result in changes in the anticipated time frame.

3.7.2 Role of the NPPO (importing country)

Importing contracting parties should be interested in providing prompt recognition of PFAs as the way to meet their appropriate level of protection. The NPPO of the importing contracting party has the following responsibilities:

- Determine the type of information that will be required in order to recognize a PFA, depending on the type of area and its geography, the method used to establish the PFA, its appropriate level of protection, and other factors for which technical justifications exist.
- Limit any information or data requests associated with an assessment of recognition to those which are necessary.
- Designate a point of contact for communications relating to the request for recognition.
- Promptly acknowledge receipt of the request and of the accompanying information package to the NPPO of the exporting contracting party.
- Describe the process to be used for the recognition process including any necessary legislative or administrative steps or requirements that will need to be completed and, if possible, an estimated time frame for the evaluation.
- Assess the information without undue delay and based on the provisions of relevant ISPMs.
- Notify the exporting contracting party if at any stage progress is not proceeding in accordance with the anticipated time frame, if established, and provide reasons for that upon the request of the exporting contracting party. In such cases, a new time frame should be prepared and provided by the importing contracting party to the exporting contracting party.
- Identify and communicate to the NPPO of the exporting contracting party if any significant component of the information package is missing, or if other significant information may be needed to assess the request.
- Take into consideration all information previously provided by the exporting contracting party and any relevant details in the corresponding technical explanation related to the previous assessment if the exporting contracting party resubmits a request for recognition of a PFA in the following circumstances:
  - when further data are acquired, or new or additional procedures are implemented and verification has been provided by the exporting contracting party that the information remains valid
  - due to a previous non-acceptance of a request
  - if a contracting party has withdrawn a PFA and wishes to reinstate it.
- Communicate and justify the need for on-site verifications and cooperation in their organization, or for on-site review of operational procedures if justified, based on the results of the ongoing assessment, records of previous trade between the two parties (in particular if there is a lack of information, interception records, non-compliance with import requirements), or previous recognition of areas between the two parties or by other parties. The schedule, agenda and content of the on-site verification or review should be agreed bilaterally, and access provided as necessary.
- Communicate the results of the assessment to the exporting contracting party and proceed as follows:
  - If the area is recognized, promptly modify any phytosanitary regulations, as appropriate.
  - If the area is not recognized, provide an explanation, including technical justification where applicable, to the exporting contracting party.

It might be useful to establish a bilateral work plan, signed by the NPPOs and built together with the stakeholders, that describes the obligations of all concerned parties and provides sufficient detail to avoid doubt in the event of litigation.

3.7.3 Role of the IPPC

The International Phytosanitary Portal (IPP) provides a means for NPPOs to communicate information regarding the establishment of pest free areas and pest status, to help them comply with national reporting obligations. Through the portal, the exporting countries' official contact points give notification of PFAs recognised by their trading partners and changes in pest status.

3.8 DECLARATION AND RECOGNITION OF PFPPs AND PFPSs

Usually, PFPPs and PFPSs should not require recognition using the procedures described for PFAs and ALPPs in the relevant sections above (3.4 and 3.7). The issuance of a phytosanitary certificate for a consignment by the NPPO confirms that the requirements for a PFPP or a PFPS have been fulfilled. The importing country may require an appropriate additional declaration on the phytosanitary certificate to this effect. However, ISPM 10 also indicates that the NPPO of the exporting country should, on request, make available to the NPPO of the importing country the rationale for establishment and maintenance of PFPPs or PFPSs. Where bilateral arrangements or agreements so provide, the NPPO of the exporting country should expeditiously provide information concerning establishment or withdrawal of PFPPs or PFPSs to the NPPO of the importing country. As also described in ISPM 10, when complex measures are needed to establish and maintain a PFPP or PFPS, because the pest concerned requires a high degree of phytosanitary security, an operational plan may be needed. Where appropriate, such a plan would be based on bilateral agreements or arrangements listing specific details required in the operation of the system including the role and responsibilities of the producer and trader(s) involved. In such cases, recognition may be based on the procedure recommended in sections 3.5 and 3.8 of this guide or described in a bilaterally agreed procedure between trading partners.

Section 4: Maintenance of PFAs, PFPPs, PFPSs and ALPPs

(PHASE 4 DECISION TREE)

The phytosanitary measures to be applied for maintenance of PFA/PFPF/PFPS/ALPP status depend on the level of risk of incursion and outbreak of the pest and the feasibility of applying measures for maintaining the desired low pest prevalence level (for ALPP) (steps 36, 37, 38, 39 decision tree) or for pest freedom (PFA/PFPP/PFPS) (steps 31, 32, 33, 34, 35 decision tree). The level of risk of incursion is higher if the pest is generally present throughout the country. In such cases, the NPPO may limit in-country movement of host plant materials and other regulated articles capable of harbouring the pest to minimize risk of introduction in the targeted area. The NPPO may also seek to establish buffer zones around the pest free areas, production places or sites to minimize chances of reinfestation.

When pest freedom or low pest prevalence level is attained, it is important that the system instituted to achieve this milestone is sustained. The NPPO should study the pathways for likely reinfestation/introduction/outbreak and develop a contingency plan (see also Section 6 Review and audit of the programme) to respond rapidly and decisively to any new incursion/introduction. In all cases, the NPPO, along with its private sector partners, will need to establish an early detection/warning and rapid response system

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Periodic inspections by NPPO stakeholders are critical to the recognition and maintenance of PFAs. Here an inspector from Argentina checks traps and trap records of the Anastrepha grandis *PFA programme in Rio Grande do Norte, Brazil.*

(steps 40, 41, 42, 43, 44, 45, 46 decision tree). Such protocols should cover, among other things:

- declaration of areas under quarantine (issuance of notices, legal instruments, etc.)
- implementation of quarantine actions, including deployment of the relevant support personnel (quarantine officers, police officers, etc.) in the appropriate zones
- access to emergency funds to deal with the cases of outbreaks/incursions, including procurement of materials, extra staff, financing for operations, etc.
- activation of surveillance delimitation teams and eradication staff
- diagnostic staff placed on standby to process samples
- media communication and alerts (official communications, calls for support of the public and affected stakeholders and other general information as needed).

4.1 SURVEILLANCE PLAN

Specific survey activities (step 35 decision tree) are required to maintain a PFA. After verifying and declaring the PFA, the official surveillance programme must be kept at a level assessed as being necessary for maintenance of the PFA. Continuous detection survey activities will serve to verify absence of the target pest. Requirements for surveillance activities are essentially the same as for establishment of the PFA but with differences in frequency, density and locations, these being dependent upon the assessed level of risk of introduction of the target species. Regular technical reports of the survey activities should be generated (for example monthly). The collection and recording of detection data are crucial to demonstrate pest absence to a trading partner.

The verification of pest free status for PFPPs and PFPSs is done by NPPO personnel or by persons duly authorized by the NPPO, who undertake the specific surveys to assess the pest free status of the PFPP or PFPS (and the buffer zone, if required). These most often take the form of growing-season inspections, but may also include other detection methods (sampling followed by laboratory testing, trapping, soil tests, etc.). Pest free status may be verified by a stated number or frequency of inspections or tests (e.g. three inspections at monthly intervals). The inspections or other procedures may concern a single growing season, or may be required over several seasons. Inspection or testing of the harvested commodity may be required at the place of production or production site. Pest freedom over a number of years may also be required and the growing of host plants on the site in previous years may be prohibited. Verification procedures should be based on a design, which should relate to the division of the place of production into individual plots, and may, according to the pest and its symptoms, be conducted by overall estimation or by taking samples. The incidence of the pest in the area surrounding the pest free place of production or pest free production site may influence the intensity of the survey required.

4.2 CONTINGENCY PLANS

It is desirable that the NPPO has contingency plans (step 32 decision tree) to address specific pests or pest groups that have a high potential for introduction, and for which an eradication plan is deemed to be both feasible and necessary, before the pest is found in an area. The development of such plans is advantageous because it provides additional time for the deliberation, evaluation and research necessary to ensure that an eradication programme is well designed and can be executed quickly and effectively. Such plans are particularly important where cooperative programmes are anticipated, as they allow for the actions of cooperating parties to be specified and agreed upon prior to implementing the programme. Knowledge gained from previous successful eradication programmes can be extremely useful for developing contingency plans or judging the feasibility of eradication programmes under consideration. A general contingency plan is also particularly useful for ensuring rapid action in the case of emergency eradication measures.

Some of the main elements that a contingency plan should include are:

- purpose and scope
- roles and responsibilities of the lead government agencies and other stakeholders
- structure of the emergency management system
- pre-planning, including resources, systems and processes
- response, including levels of incident management (PFA, ALPP)
- reporting, documentation and record keeping
- internal and external communications, including pest reporting
- suspension and reinstatement
- review and evaluation of the contingency plan.

If, after detection of a pest, it is determined that an outbreak has occurred in the PFA/PFPP/PFPS, or the agreed low pest prevalence level is surpassed, the PFA/PFPP/PFPS or ALPP status in the affected area might be suspended, depending on the characteristics of the outbreak. Contingency plans and planned phytosanitary measures should be immediately enforced, including quarantine restrictions to movement of regulated articles that can host the pest, and, as appropriate, fruit disinfestation and the operation of quarantine checkpoints for PFAs to prevent the movement of infested fruit from the affected area to the rest of the PFA. Other emergency measures could be adopted if agreed by the importing country, for example postharvest treatments, increased surveys, supplementary trapping. The affected area may be limited to parts of the PFA or may be the whole PFA.

The criteria for determining that eradication of an outbreak has been successful include no further detection of the target pest species for a period determined by the biology of the species and the prevailing environmental conditions, as confirmed by surveillance. Similarly, for an ALPP, ongoing monitoring activities need to demonstrate that the pest is being maintained at or below the agreed threshold level. Once the criteria have been fulfilled, the following actions should be taken:

- notification of NPPOs of importing countries
- reinstatement of normal surveillance levels
- reinstatement of the PFA/PFPP/PFPS or ALPP (step 43 decision tree).

4.2.1 Suspension, emergency and corrective actions

» (steps 40, 41, 42, 44, 45, 46 decision tree) - Emergency actions, verification, suspension, corrective actions

When an outbreak occurs, the NPPO should immediately notify trading partners of the incident and the measures that are being taken to re-eradicate the regulated pest or bring the programme back to compliance. The NPPO of the importing country, depending on the level of outbreak, may suspend the pest free or low pest prevalence status until further notice.

The programme should be reviewed to identify the reason for failure. It is sometimes helpful to have an unbiased third party evaluate the programme, as personnel managing the programme daily might not perceive certain weaknesses.

The contingency plan to re-establish the desired pest status should be applied to all affected areas as quickly as possible. Record keeping is critical to demonstrate execution of the plan, both for the ongoing management of the PFA/PFPP/PFPS or ALPP and to provide a basis for re-establishment and recognition of pest status by the NPPOs of trading partners. Records should be kept for a previously determined length of time.

4.2.2 Verification and reinstatement of recognition (PFA/PFPP/PFPS or ALPP)

» (steps 41, 43 decision tree)

When the desired pest status is again attained, the NPPO will communicate to the NPPO of trading partner(s) the renewed status and seek their recognition. The steps taken to regain recognition will and should become less rigorous as the programme matures and the level of confidence improves between the NPPOs of the trading countries.

Section 5: Market Access

(PHASE 5 DECISION TREE)

Gaining access to a new market for a plant commodity can, in some circumstances, involve a relatively straightforward process, while in other circumstances the process can be protracted. The complexity of the process will reflect the nature and the level of the phytosanitary risk the importing country might be exposed to, and whether regulatory measures are available to address that risk. Sometimes legal or policy requirements imposed on procedures assessing market access requests.

The initiation of the process whereby a country considers a request for market access usually takes the form of a written submission from the relevant government authority of the exporting country to the counterpart agency of the importing country. However, in some cases it may simply take the form of a request for an import permit from one country to another originating from industry or from government sources.

The amount of information included in the request for market access is at the discretion of the applicant. However, the recipient government authority will assess the information provided and usually seek supplementary information that will help it identify any phytosanitary risks that could be associated with the proposed imports. In some instances, procedures for applications for market access can be found for specific countries on the websites of their relevant government authorities.

Information that countries commonly request upon receipt of a market access proposal include:

- proposed commodity/plants
- production area
- production and cultivation practices
- pests associated with the proposed commodity
- postharvest management
- current export protocols
- results of PRA carried out by other countries
- relevant references.

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*The NPPO of the exporting contracting party may cooperate in the loading of product at the point of origin and provide an on-the-spot verification inspection, if requested by the importing contracting party. In this case, it is important for inspectors to check the asepsis state of the vehicle and place of loading, the condition of screens and container closures that protect product from pest exposure, for tags with traceability codes, and whether wood packing containers are properly treated (ISPM 15 (*Regulation of wood packaging material in international trade*)), if applicable. Here, export certification is being carried out by a Ministry of Agriculture, Livestock and Supply inspector at the point of origin for melon loads being shipped from the* Anastrepha grandis *PFA in the state of Rio Grande do Norte, Brazil, to Chile.*

Market access negotiations require a team approach from relevant governmental authorities of the countries involved. The steps to be followed are:

- prioritisation of market access requests
- gathering of information and compilation of a dossier by the NPPO of the exporting country as per requirements of the NPPO of the importing country
- preparation and submission of a market access proposal by the NPPO of the exporting country
- consultation between contracting parties
- evaluation of the proposal by the NPPO of the importing country
- conducting of risk analysis and consideration of results by the NPPO of the importing country
- research into scientific, technical and economic issues by the NPPO of the exporting country to address areas of scientific, technical or economic concern, if applicable
- engagement in bilateral negotiations
- review by visiting delegations to the exporting country
- confirmation of the terms of trade
- commencement of trade.

Acceptance of the terms of trade will require the NPPO of the exporting country to take legal responsibility to provide assurance to the NPPO of the importing country that consignments meet the importing country's phytosanitary requirements. The instrument of assurance used by NPPOs is phytosanitary certification.

Detailed information and context on phytosanitary aspects of market access negotiations are described in the IPPC guide on *Market access*.

5.1 PHYTOSANITARY MEASURES IN SYSTEMS APPROACHES

» (step 49 decision tree)

Contracting parties to the IPPC share the obligation to observe the principle of equivalence by considering pest risk management alternatives that will facilitate safe trade. When setting and maintaining ALPPs, systems approaches can provide significant opportunities to develop new and alternative pest risk management strategies to meet the acceptable level of protection as set by an importing country. The development and implementation of a systems approach requires consultation and cooperation at a national as well as an international level. Depending on the number and nature of measures included in a systems approach, a significant amount of data may be required. Both exporting and importing countries should cooperate in the provision of sufficient data and the timely exchange of relevant information in all aspects of the development and implementation of pest risk management measures (Box 13).

As described by ISPM 14, the systems approach is a pest risk management option that integrates different phytosanitary measures to meet phytosanitary import requirements. An advantage of the systems approach is that it addresses variability and uncertainty by modifying the number and strength of measures to meet phytosanitary import requirements. In general, a systems approach implies using at least two independent phytosanitary measures that have a cumulative effect, and may include any number of measures that are dependent on each other, of which ALPPs can be one of them.

Phytosanitary measures used in a systems approach vary with regards to the life stage of the target pest and the place and time in the production chain at which they are applied. Measures applied might contribute to the systems approach by reducing pest populations, preventing the possibility of infestation (e.g. maintaining the integrity of lots, requiring pest-proof packaging, screening packing areas) or killing pests already infesting the crop. Other measures of a systems approach could include designated harvest or shipping periods, restrictions on the maturity, colour, hardness, or other condition of the commodity, the use of resistant hosts, and limited distribution or restricted use of the commodity at the destination.

The development of a systems approach ideally should be undertaken through the cooperation of NPPOs of exporting and importing countries in consultation with industry, the scientific community, and any other relevant stakeholders involved in the production chain. However, the NPPO of the importing country decides on the suitability of the systems approach in meeting its requirements, subject to technical justification, minimal impact, transparency, non-discrimination, equivalence and operational feasibility.

Box 13: Non-host status to fruit fly pests and a systems approach

To be able to export Hass avocado (*Persea americana* Mill.) from Michoacán in Mexico to the United States of America (USA), the requisite was to demonstrate non-host status to three fruit fly species (*Anastrepha* spp.) and absence of three avocado seed weevils (*Conotrachelus* spp.) and the avocado branch borer (*Copturus aguacatae*). Stakeholders included Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria (SENASICA), Mexico, United States Department of Agriculture (USDA) Agriculture Research Service (ARS), and Asociación de Productores Exportadores de Aguacate de Michoacán (APEAM). Through a host status determination, the Hass avocado produced in Mexico was classified as a non-host of three fruit fly species of quarantine concern to the USA. In 1994, SENASICA presented the experimental results to USDA, which were validated and accepted. The rule allowing imports of Hass avocado from Mexico into the USA was published in the Federal Register of the USA in 1997. A systems approach against these pests was implemented in 1997 under the supervision of SENASICA inspectors and the oversight of the USDA Plant Protection and Quarantine (PPQ). That same year the first shipments of Hass avocado crossed the Mexico–USA border. Initially, fruits could be exported to 13 USA states for four months. Eventually, the whole of the USA for the entire 12 months of the year was opened to Hass avocado imports from Mexico as a result of additional research. In 2017, over one million tonnes of avocado were exported from Michoacán, Mexico to the USA with a value of over USD 1.5 billion. This case is an example of a win–win situation where benefits spread across growers, industry and consumers. Relevant ISPMs include: ISPM 35 (*Systems approach for pest risk management of fruit flies (Tephritidae)*) and ISPM 37 (*Determination of host status of fruit to fruit flies (Tephritidae)*)

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Photo taken on 3 June, 2017 shows a cargo of 20 tons of avocados at Avo Hass, one of the avocado packing plants in Uruapanat, in the state of Michoacan, Mexico. (Xinhua/D. de la Paz/www.NEWS.CN).

For more information, see Section 8: Case study 16 – Hass avocado (*Persea americana*) from Mexico – non-host status to fruit fly pests and a systems approach.

Essential factors to be considered when developing a systems approach are:

- PRA results (identity of the pest risk and the description of the pathway)
- place and time for management measures to be applied (control points)
- definition of measures and other factors or conditions that are essential to the system
- identification of independent and dependent measures and options for dealing with uncertainty
- assessment of the individual and integrated efficacy of measures that are essential to the system, as well as their feasibility and trade restrictiveness
- implementation aspects, including documentation and reporting
- evaluation of the system
- review and modification as necessary.

Responsibilities of an importing country's NPPO include:

- providing an exporting country's NPPO with specific information regarding its requirements (pest of concern; import requirements; types and level of assurance required, e.g. certification and the identification of points requiring verification)
- in consultation with the exporting country where appropriate, selecting least trade restrictive measures where there are options
- proposing improvements or alternative options
- auditing (planned evaluation and verification of the systems approach)
- specifying actions for non-compliance
- reviewing a systems approach and giving feedback.

Responsibilities of an exporting country's NPPO include:

- providing sufficient information to support evaluation and acceptance of the systems approach (commodity; place of production and expected volume and frequency of shipments; relevant production, harvest, packing/handling and transport details; pest–host relationship; pest management measures proposed; relevant efficacy data and references)
- monitoring/auditing and reporting on system effectiveness
- taking appropriate corrective actions
- maintaining appropriate records
- providing phytosanitary certification in accordance with the requirements of the system.

5.2 PHYTOSANITARY CERTIFICATION

» step 50 decision tree - Phytosanitary certification

Phytosanitary certification facilitates international trade in plants, plant products and other regulated articles by providing an internationally agreed document attesting that consignments meet phytosanitary import requirements. Provisions for a phytosanitary export certification system and preparation and issuance of certificates are provided in the IPPC and further detailed in ISPM 7 (*Phytosanitary certification system*) and ISPM 12 (*Phytosanitary certificates*).

ISPM 7 (Phytosanitary certification system): Scope

This standard contains requirements and describes components of a phytosanitary certification system to be established by national plant protection organizations (NPPOs).

ISPM 12 (Phytosanitary certificates): Scope

This standard provides the requirements and guidelines for the preparation and issuance of phytosanitary certificates (phytosanitary certificates for export and phytosanitary certificates for re-export).

The NPPO of the exporting country has the sole authority to undertake phytosanitary certification. For this, an export certification system should be established to deal with the legislative and administrative requirements and to undertake operational activities such as sampling and inspection of plants, plant products and other regulated articles, detection and identification of pests, surveillance of crops, application of treatments, establishment and maintenance of record keeping, monitoring and evaluation of the system, development of guides and standard operational procedures and training of staff. For the establishment and maintenance of PFAs, PFPPs, PFSPs or ALPPs, specific training programmes should be developed and delivered to NPPO staff and involved stakeholders. The training will cover topics such as biology

of the target pest and procedures to be established and implemented as detailed in the bilateral protocols, as well as pest detection and identification, and application or supervision of phytosanitary treatments required prior to the certification and surveillance activities related to phytosanitary certification.

In accordance with Articles V.2 and V.3 of the IPPC, NPPOs shall use the model phytosanitary certificates of the IPPC. The issuance of phytosanitary certificates shall be carried out by public officers who are technically qualified and duly authorized by the official national plant protection organization.

An important point in the certification process of consignments originating from PFAs, PFPPs, PFPSs or ALPPs is when the consignment is delivered to a country of re-export. In these cases, repackaging operations are not allowed and the integrity of the consignment should be maintained. The original export certificate and certificate of origin should accompany the consignment to the destination country. If the country of destination has special requirements that cannot be fulfilled by the re-exporting country, no re-export certificate may be issued, unless they can agree on and apply equivalent phytosanitary measures. In the case of transit, as provided in ISPM 12, if a shipment is not exposed to infestation or pest contamination, the NPPO of the country of transit does not need to issue a phytosanitary certificate or a phytosanitary certificate for re-export.

5.3 RECORDS

To gain or maintain market access it is important that all actions undertaken by the NPPO in support of establishment and maintenance of a PFA, PFPP, PFSP or ALPP programme is well documented. NPPOs should ensure that records of information supporting all stages of suppression, containment, eradication and exclusion strategies are kept for an identified period. The NPPO of a trading partner may wish to conduct site visits or perform audits of the programme, and records are crucial to convince and instil confidence in the trading partner that the export certificates provided by the NPPO are backed by a solid programme that is supported by sound science.

Records that are essential include the following (among others):

- data assembled to establish and maintain the PFA, PFPP, PFPS or ALPP
- various administrative measures taken in support of the PFA, PFPP, PFPS or ALPP
- phytosanitary regulations applied
- programme operational plan and strategy, including contingency and corrective action plans
- staff terms of reference
- the role and responsibilities of the producers and traders
- agreements with collaborators, including laboratories for pest diagnosis
- third-party service provider agreements and delegations
- surveillance protocols and data
- trapping routes, schedules and data
- sample and specimen collection forms
- specimen submission forms (pest diagnostics)
- pest diagnoses records
- farm inspection records
- packing house/screen-house/greenhouse inspection records
- equipment calibration and maintenance records
- information reflecting all stages of the eradication process
- relevant records of cultural and pest control procedures applied
- control measures, including corrective actions
- movement certificates (in-country movement of plants, plant products and regulated articles)
- quarantine checkpoint inspection records
- reports of quality control checks and formal audits conducted
- procedures to ensure product identity and phytosanitary security of the consignment
- procedures for withdrawal and reinstatement of pest status
- review and audit records.

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*In the systems approach adopted for the export of mango (*Mangifera indica*) from the Açu Valley, Rio Grande do Norte, Brazil, criteria were established for the monitoring of the target pests in the field, traceability of harvested fruits, sampling at the packing house with fruit cutting, hydrothermal treatment, constant monitoring of selection processes, packaging, storage, loading and load certification. All operations are always observed by an inspector of the NPPO of the exporting country (Brazil) and one from the importing country (United States of America).*

Section 6: Review and Audit of the Programme

The establishment and maintenance of a PFA/PFPP/PFPS or ALPP requires a very highly coordinated management system, as the detection of a single specimen of the regulated pest of concern in the field or on a consignment can compromise the status of a PFA/PFPP/PFPS or ALPP. Consequently, it is highly advisable that the management system incorporates the following elements:

- The NPPO has in place a system to perform internal and external audits or periodic performance reviews of the programme. Verification of third-party laboratory diagnostic performance is conducted to lend credibility to the programme.
- Routine operations are subject to quality control:
  - placing known specimens in traps to see whether inspectors detect them
  - submitting known samples to the diagnostic laboratories to evaluate the correct identification
  - calibrating pesticide equipment and evaluating treatment efficiency.
- Surveys are conducted to collect feedback from beneficiaries and other stakeholders affected by the programme.

6.1 TRACE BACK AND NON-COMPLIANCE

All consignments exported from a PFA/PFPP/PFSP/ or an ALPP must be traceable back to the production site/area at all stages of the supply chain: production, handling, transportation, and export to the point of sale. The NPPO of the importing country should be advised as soon as possible if an exported consignment may not have complied with the phytosanitary requirements. Non-compliance would result in suspension of the status of the area and exports from the PFA/PFPP/PFPS or ALPP.

Detailed information about non-compliance and emergency action is contained in ISPM 13 (*Guidelines for the notification of non-compliance and emergency action*). In general, the NPPO of the importing country may notify the NPPO of the exporting country of significant cases of non-compliance that put the importing country at risk, such as:

- a significant instance of failure of an imported consignment to comply with specified phytosanitary requirements
- a significant instance of failure of an imported consignment to comply with documentary requirements for phytosanitary certification

Box 14: Case study on PFA for potato brown rot in Egypt

The establishment of a PFA for potato brown rot in Egypt has developed over 12 years as a result of regular revision and auditing of the system. Importing countries in the European Union (EU) revised the concept of "qualified areas" requested by the European Commission and implemented in Egypt, and the review process resulted in the need to establish a PFA according to ISPM 4. Regular meetings were held between the Egyptian NPPO and importing countries to review the system, and on-site auditing was arranged during production seasons. In addition, audits were performed on laboratory capabilities for sample management and diagnostic procedures. In every case where violation or nonconformity was proven, a bilateral committee (Egypt and EU) held an investigation to review the system and identify the root-cause for system failure. These meetings resulted in technical recommendations that were delivered to decision makers. Continuous revising and auditing have resulted in the issuance of more than 12 ministerial decrees, each introducing a corrective action to the PFA system.

For more information, see Section 8: Case study 6 – Potato brown rot PFA in Egypt – challenges for funding mechanisms and continuous revision.

- an emergency action taken on the detection in an imported consignment of a regulated pest not listed as being associated with the commodity from the exporting country
- an emergency action taken on the detection in an imported consignment of organisms posing a potential phytosanitary threat.

ISPM 13 (Guidelines for the notification of non-compliance and emergency action): Scope

This standard describes the actions to be taken by countries regarding the notification of:

- a significant instance of failure of a consignment to comply with specified phytosanitary import requirements, including the detection of specified regulated pests
- a significant instance of failure of an imported consignment to comply with documentary requirements for phytosanitary certification
- an emergency action taken on the detection in an imported consignment of a regulated pest not listed as being associated with the commodity from the exporting country
- an emergency action taken on the detection in an imported consignment of organisms posing a potential phytosanitary threat.

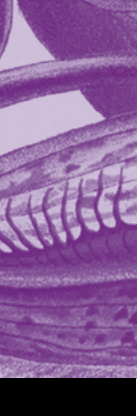
Examples where emergency phytosanitary action may be justified include the following:

- the detection of regulated pests in an imported consignment from a PFA/PFPP/PFPS or ALPP at a level which exceeds the required level of freedom
- evidence of failure to meet bilaterally agreed requirements, such as field inspection, laboratory tests, registration of producers or facilities, lack of pest monitoring or surveillance, failure of integrity of consignment and its phytosanitary security
- invalid or missing phytosanitary certificate or other required documentation.

The type of phytosanitary action will depend on the circumstances and should be the minimum necessary to counter the pest risk identified. Administrative errors such as incomplete phytosanitary certificates may be resolved through liaison with the NPPO of the exporting country. Other infringements may require action at the point of entry, such as the following:

- Detention: this may be used if further information is required, taking into account the need to avoid consignment damage as far as possible.
- Sorting and reconfiguring: the affected products may be removed by sorting and reconfiguring the consignment, including repackaging if appropriate.
- Treatment: used by the NPPO when an efficacious treatment is available.
- Destruction: the consignment may be destroyed in cases where the NPPO considers the consignment cannot otherwise be handled.

The NPPO of the importing country should report interceptions, and instances of non-compliance and emergency actions to the NPPO of the exporting/re-exporting countries so that the NPPOs of the exporting countries understand the basis for phytosanitary actions taken against their consignments and to facilitate corrective action in their export systems.



Section 7: Possible Constraints for Programme Implementation

There are two main constraints that could jeopardize the establishment and maintenance of PFAs/PFPPs/PFPSs and ALPPs. These are long-term funding and stakeholders' support. The NPPO can face pressure for rapid results by the private sector and political fallout if the programme is not producing the results expected, particularly if the costs of operation exceed initial estimates. Examples of some of the more common challenges to establishing and maintaining a PFA/PFPP/PFPS or ALPP that will affect public and private sector stakeholders are:

- termination of government mandate
- economic instability
- divergences between central and local government
- leadership turnover
- sustainable financial support
- changes in agribusiness priorities
- fluctuation in market demand
- maintenance of consensus on programme objectives among industry and other stakeholders
- maintenance of a strong managerial system
- access to qualified human resources
- realization of long-term returns on investments
- international cooperation.

Section 8: Case Studies

I – PFA CASE STUDIES

Case study 1, PFA

Establishment and maintenance of the South American cucurbit fruit fly (*Anastrepha grandis*) PFA in the states of Rio Grande do Norte and Ceará, Brazil

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Timeline of the case study

Ongoing from 1984

Content of the case study

The establishment of this programme involved a range of stakeholders on different levels and from different sectors, such as:

- **Federal institutions:**
  - Ministry of Agriculture, Livestock and Supply (MAPA)
  - Department of Plant Protection (DSV)
  - Federal Agricultural Superintendence in Rio Grande do Norte State (SFA RN)
  - Federal Agricultural Superintendence in Ceará State (SFA CE)
- **State institutions:**
  - RN State Phytosanitary Defence Agency (IDIARN)
  - CE State Phytosanitary Defence Agency (ADAGRI)
- **Laboratories and research institutions:**
  - Universidade Federal do Semi Árido – Mossoró (UFERSA)
  - Instituto Federal de Educação, Ciência e Tecnologia do Ceará (IFCE)
- **Private sector:**
  - Committee of Exporters (COEX).

Until 1984, almost all the melon produced in Brazil was destined for the domestic market and a small part for the European market, due to the difficulties of accessing foreign markets. At that time, producers from the region of Mossoró, Rio Grande do Norte (RN), through its Committee of Exporters (COEX), realized that there was a new business opportunity to export melon to the United States of America (USA) if a quarantine requirement of the importing country on the need to produce melon in an area free of South American cucurbit fruit flies – *Anastrepha grandis* (Macquart) – was met. This motivated COEX to get in touch with the Brazilian Ministry of Agriculture to initiate and support a research project to investigate the status of *A. grandis* in the municipalities of Mossoró and Assú, RN, the main producer and exporter municipalities of melon in Brazil. Research activities began in 1985 and ended in 1990, when, through a bilateral agreement between Brazil and the USA, the area was recognized as being free of *A. grandis*, allowing the melon produced in Mossoró and Açu to have access to the USA market without postharvest quarantine treatment. In March 2008, the Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA) recognized the expansion free-status status of *A. grandis* for another 11 municipalities in the state of Rio Grande do Norte and 7

municipalities in the state of Ceará, totalling 20 municipalities with permission to export melon to the USA. The export programme has now been extended to the Mercosur countries and the pest free status of *A. grandis* is attracting the attention of other importing countries around the world.

◆ **The following ISPMs were successfully implemented:**

- ISPM 1 (*Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade*)
- ISPM 2 (*Framework for pest risk analysis*)
- ISPM 4 (*Requirements for the establishment of pest free areas*)
- ISPM 6 (*Surveillance*)
- ISPM 7 (*Phytosanitary certification system*)
- ISPM 8 (*Determination of pest status in an area*)
- ISPM 12 (*Phytosanitary certificates*)
- ISPM 26 (*Establishment of pest free areas for fruit flies* (Tephritidae))

The great efforts and investments by the private sector, the commitment of the federal and state governments, and support provided by the laboratories of the federal universities of the RN and CE states under coordination by the Department of Plant Protection of the Brazilian Agricultural Ministry, resulted in the successful implementation and maintenance of this PFA. At the same time, it is a challenge to maintain the spirit of collaboration among the stakeholders involved. Future plans include promotion of the expansion of the PFA to adjacent production areas to gain increased market access.

References:

Federal Normative Instruction MAPA No. 13, 31 March 2006. It establishes the conditions for the pest free area, as a recognized risk management option for the purpose of Phytosanitary Certification with Additional Declaration, for *Anastrepha grandis* in melon (*Cucumis melo* L.), watermelon (*Citrullus lanatus* Thunb.), squash (*Cucurbita* spp.) and cucumber (*Cucumis sativus* L.).

Federal Register Vol. 73, No. 42, 3 March 2008 / Notices [Docket No. APHIS – 2008-0013]. Determination of pest-free areas within the states of Ceará and Rio Grande do Norte, Brazil; Request for Comments. Agency: Animal and Plant Health Inspections Service, USDA.

RN State Decree No. 16.245, 6 August 2002, that prohibits the entry of Cucurbitaceae in the region comprising the municipalities of Mossoró, Baraúna, Tibau, Grossos, Areia Branca, Serra do Mel, Porto do Mangue, Carnaubais, Alto do Rodrigues, Afonso Bezerra, Ipanguaçu, Açu, Upanema, and other measures.

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The establishment and recognition of the Anastrepha grandis *free area of Rio Grande do Norte, Brazil, took five years. It included the monitoring of urban and production sites, development of a protection (buffer) area, control of alternate hosts, etc. During this period, no melon was exported to the United States of America from the region, demonstrating a high level of commitment to reaching the goal of accessing new markets. This status has now attracted buyers from all over the world.*

Case study 2, PFA

Chile – a fruit fly free country

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Timeline of the case study

1994–2018

Content of the case study:

In 1980, the Government of Chile, through the Servicio Agricola Ganadero de Chile (SAG) of the Ministry of Agriculture (MAG), created Chile's National Fruit Fly Programme to prevent the introduction and establishment of any fruit fly species of economic importance, including the Mediterranean fruit fly and the economically important species of the genera *Anastrepha* and *Bactrocera* (Olalquiaga and Lobos, 1993).

The National Fruit Fly Programme in Chile operates through a centralized organizational structure of the Ministry of Agriculture. As part of a regional approach to the fruit fly problem, the Government of Chile has subscribed binational agreements with Argentina and Peru. The main stakeholders involved in the establishment and maintenance of Chile as a fruit fly free country were therefore MAG-SAG, and the NPPOs of Argentina and Peru through cooperative agreements, while FAO and the International Atomic Energy Agency (IAEA) had a fundamental role in capacity building and technology transfer through technical cooperation projects.

Following various failed attempts to eradicate the Mediterranean fruit fly from northern Chile using baits sprays, in late 1990 SIT was introduced. In 1995, after six years of an intensive integrated area-wide programme based on SIT, the fly was eradicated in Arica, and Chile was declared a fruit fly free country (MAG-SAG, 1995).

- **Chile's success in achieving its fly-free status was driven by implementing two major strategic activities:**
  - There is an effective national and international quarantine system (including interprovincial quarantine road stations and international quarantine at ports of entry), and an extensive and highly sensitive fruit fly-trapping network to detect fruit fly introductions at an early stage. Outbreaks of exotic fruit flies, mainly the Mediterranean fruit fly, have been eradicated through the effective execution of an emergency eradication plan based on detecting and eradicating infestations. A *Bactrocera dorsalis* (Hendel) outbreak on Easter Island was eradicated in 2011 at a cost of USD 100 000 (AGROMEAT, n.d.).
  - In Arica province, there is an ongoing Mediterranean fruit fly area-wide integrated pest management (AW-IPM) programme that integrates SIT functions as a containment barrier to avoid the natural or artificial spread of fly populations into northern Chile, protecting the main fruit and vegetable production areas in the central and southern parts of the country.

Since Chile was declared a fruit fly free country, fruit exports have grown to an annual 320 million boxes of fruits, mainly table grapes, apples, stone fruits, kiwis, and avocados, valued in 2016 at USD 4 000 million (ASOEX, n.d.). Chile's fruit fly free status has allowed one of the most important export-oriented horticulture industries in the world to develop.

Implementation of the requirements of ISPM 9 (*Guidelines for pest eradication programmes*), ISPM 10 (*Requirements for the establishment of pest free places of production and pest free production sites*) and ISPM 26 (*Establishment of pest free areas for fruit flies* (Tephritidae)) proved to be a viable option to open export markets.

- **Future plans of stakeholders encompass:**
  - maintaining Chile's fruit fly free status to protect its high value horticultural industry
  - incorporating new advanced technology for optimization of fruit fly surveillance and control tools.

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©Ricardo Rodriguez, SAG Chile

*Mediterranean fruit fly (*Ceratitis capitata*) mass rearing and sterilization facility in Arica, Chile*

Case study 3, PFA

Guatemala, Mexico, USA Moscamed Programme for the eradication and containment of the Mediterranean fruit fly (*Ceratitis capitata*)

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Timeline of the case study

1977–2018

Content of the case study

In 1975–1978, the invasion of medfly (*Ceratitis capitata* (Wiedemann)) in Guatemala and in Chiapas, Mexico threatened the horticultural industry of the region (Guatemala, Mexico and United States of America) and led to the establishment and implementation of the federal programme operated by the NPPOs of Guatemala (Ministerio de Agricultura, Ganadería y Alimentación (MAGA)), Mexico (Secretaria de Agricultura, Ganaderia, Desarrollo Rural, Pesca y Alimentacion (SAGARPA)) and the United States of America (USDA). In 1975–1977, cooperative agreements were subscribed between the interested countries to eradicate and contain medfly using an area-wide approach based on SIT. The eradication activities for medfly in Mexico were undertaken in 1977–1982. The containment barrier with a buffer zone in Guatemala, set in 1982, is still maintained. FAO and IAEA had a fundamental role in capacity building and technology transfer through technical cooperation projects.

This case proved that area-wide eradication and containment of an invasive insect pest using an integrated pest management (IPM) approach including SIT, is technically and economically feasible.

ISPM 4 (*Requirements for the establishment of pest free areas*), ISPM 9 (*Guidelines for pest eradication programmes*) and ISPM 26 (*Establishment of pest free areas for fruit flies* (Tephritidae)) were successfully implemented.

◆ **Stakeholders involved aim to:**

- continue protecting the PFA north of the containment barrier in Guatemala by maintaining a solid containment barrier
- incorporate state of the art technology into the programme to improve its cost-effectiveness.

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Mediterranean fruit fly mass rearing and sterilization facility, Metapa de Dominguez, Chiapas, Mexico

Case study 4, PFA and ALPP in a systems approach

Mexican fruit fly (*Anastrepha ludens*) and West Indian fruit fly (*A. obliqua*) national management and containment campaign in Mexico

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Timeline of the case study:

1988–2018

Content of the case study:

Anastrepha spp. fruit flies are major horticultural pests in Mexico. A thorough economic feasibility study (P. Reyes *et al.*, 1991) revealed the positive return on investment that would be achieved by integrating SIT into the control of fruit flies in major commercial fruit production areas.

In 1992, the Mexican federal government approved the National Fruit Fly Campaign (Campana Nacional Contra Moscas de la Fruta (CNCMF)), for the suppression and eradication of Mexican fruit fly (*Anastrepha ludens* (Loew)) and the West Indian fruit fly (*A. obliqua* (Macquart)) using an area-wide SIT approach. In that year, a facility was built in Metapa de Dominguez Chiapas, Mexico, for the mass rearing and sterilization of these two species of fruit flies of economic significance. In 1997, fruit flies of economic importance were eradicated from more than 35 000 hectares of commercial plantations of citrus, mango, apple and peach in north-west Mexico, completely freeing the states of Chihuahua, Sonora, Baja California Norte, and Baja California Sur from fruit flies of economic importance (SAGARPA, 2001).

The main stakeholders involved in these operations are the NPPO of Mexico (Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria (SENASICA), Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA)), state and federal government agricultural authorities, and the state plant protection committees of producer associations.

The CNCMF operates through state governments and fruit-grower associations under compliance agreements subscribed to by the three parties (federal and state governments, and fruit industry). The federal government supplied the sterile flies and provided the infrastructure for packing and release, the state government contributed financial resources for operations, and the industry implemented activities on the commercial orchards including trapping and fruit sanitation. Strategic alliance between federal government, state governments and the horticultural industry proved to be an effective way to operate a national programme aimed at suppressing and eradicating fruit flies of economic significance for the establishment of a PFA.

In 2001, after fruit fly eradication in north-west Mexico was officially declared and PFAs established, the direct benefits (reduced fruit fly damage and increased yield) amounted to USD 25 million. In addition, in the same time period, the benefits obtained from the price differential paid by export markets, and savings in postharvest treatments, totalled approximately USD 35 million. Thus, the total benefits in these fruit fly free areas over four years amounted to USD 60 million, with a total cost of USD 4 million over the same time period, resulting in a benefit-to-cost ratio of 15:1 (SAGAR/IICA, 2001).

This case proved that area-wide eradication and containment of an invasive insect pest using an IPM approach including SIT, is technically and economically feasible.

ISPM 4 (*Requirements for the establishment of pest free areas*), ISPM 9 (*Guidelines for pest eradication programmes*) and ISPM 26 (*Establishment of pest free areas for fruit flies* (Tephritidae)) were successfully implemented.

Future plans include sustaining the current PFA and expanding the use of area-wide SIT to establish new PFAs in the country.

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Sterile fly packing and emergence facility in Guerrero, Mexico

© G. Iriarte, Programa Moscamed Guatemala

Sterile fly aerial release

Case study 5, PFA

Patagonia, Argentina – a Mediterranean fruit fly (*Ceratitis capitat*a) PFA

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Timeline of the case study:

2001–2004

Content of the case study:

A programme to eradicate medfly (*Ceratitis capitata* (Wiedemann)) from Patagonia, Programa de Control y Erradicación de Mosca del Mediterránea (PROCEM-SENASA), was launched by Servicio Nacional de Sanidad y Calidad Agroalimentaria (SENASA) and Fundacion Barrera Zoofitisanitaria Patagonica (FUNBAPA).

Medfly eradication actions started in 2001. Patagonia was officially declared a medfly PFA in 2004. Trading partners, including the USA and Mexico, recognized Patagonia as a medfly free area. FAO and IAEA had a fundamental role in capacity building and technology transfer through technical cooperation projects.

The eradication of medfly represents the elimination of costly quarantine treatments to most of the three million boxes of quality pear and apple that this region exports annually. Eradication was achieved through an intensive area-wide programme using SIT. Strategic alliances between federal and state government as well as with the private sector, are fundamental to the achievement of success in large scale pest interventions that apply an integrated approach including SIT.

Sterile flies were shipped from the mass rearing and sterilization facility located in the Province of Mendoza. Of fundamental importance to protect the PFA, was the extensive quarantine barrier effectively operated by FUMBAPA.

ISPM 4 (*Requirements for the establishment of pest free areas*), ISPM 9 (*Guidelines for pest eradication programmes*) and ISPM 26 (*Establishment of pest free areas for fruit flies* (Tephritidae)) were successfully implemented.

References:

De Longo, O., Colombo, A., Gomez-Riera, P. & Bertolucci, A. 2000. The use of massive SIT for the control of the medfly, *Ceratitis capitata* (Wied.), strain SEIB 6-96, in Mendoza, Argentina. In: K.-H. Tan, ed. *Area-wide control of fruit flies and other insect pests*. Joint Proceedings of the International Conference on Area-Wide Control of Insect Pests and the Fifth International Symposium on Fruit Flies of Economic Importance, 28 May–5 June 1998, Penang, Malaysia, pp. 351–359. Pulau Pinang, Malaysia, Penerbit Universiti Sains Malaysia.

Guillen, D. & Sanchez, R. 2007. Expansion of the National Fruit Fly Control Programme in Argentina. In: M.J.B. Vreysen, A.S. Robinson & J. Hendrichs, eds. *Area-wide control of insect pests: from research to field implementation*, pp. 653–660. Dordrecht, The Netherlands, Springer.

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Medfly mass rearing and sterilization facility in Mendoza, Argentina

Case study 6, PFA

Potato brown rot PFA in Egypt – challenges for funding mechanisms and continuous revision

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Timeline of the case study:

1998–2010

Content of the case study:

Egypt is one of the top exporters of ware potatoes, mainly to the European Union (EU), the Russian Federation and Arabic countries. Potato brown rot disease (causal agent *Ralstonia solanacearum* (Smith) Yabuuchi *et al.*) is endemic in Egyptian traditional cultivated lands, but continuous interception of infected potato consignments coming from Egypt, with multiple cases of outbreaks in EU potato farms, alerted EU phytosanitary authorities to potato brown rot as a threat to EU production of seed potatoes. The resulting European Commission decision (98/105/EC) required Egypt to produce potato intended for exportation to the EU in "qualified areas", which was a premature, less-restrictive system than PFAs. The Egyptian phytosanitary authority was required to provide the EU with a list of these areas before the growing season, and to apply control measures that included: testing of grown seed potatoes that also had to have been previously planted in "qualified areas"; field scouting and inspection for visual symptoms; sampling of plants for laboratory testing; monitoring and supervision of harvesting by NPPO; inspection at packing houses and sampling for laboratory testing; separation of production, machinery and tools from other areas; establishment of traceability system; registration of exporters; application of legislative measures with an additional declaration to the phytosanitary certificate. In addition to that, limitations to points of entry and inspection at arrival were applied in the importing country.

Due to shortcomings and failure to export pest-free potato consignments from Egypt to the EU, another decision was taken by the EU to replace "qualified areas" with "pest free areas" in which the bacterial causal agent of brown rot disease is known not to occur, as established by official surveys and monitoring procedures in accordance with ISPM 4. The Egyptian authorities responded by issuing ministerial decree 426/1998 to set up a national committee for potato that has members from the Ministry of Agriculture, the Egyptian NPPO, the Ministry of Trade, the Ministry of Foreign Affairs, and representatives of traders/growers/exporters associations and unions. This committee was responsible for establishing the legislation and regulations concerning the establishment of the PFA, following up on the implementation steps, and regularly reviewing the efficiency of the system.

The two main challenges when establishing the PFA were the shortage of technical expertise and the limitation of funding. As the EU represented the main beneficiary from establishing a PFA, Egypt requested that a cooperative framework be set up to establish the PFA, that would secure the technical and scientific requirements and fund the initial stages. As the system needed two to three years before the potato trade would be resumed, it was difficult to convince Egyptian traders/growers/exporters to fund the initial stages that involve training, procurement of equipment and tools, laboratory setup, hiring staff, survey activities and regular meetings. Therefore, the Egypt–EU Potato Brown Rot Project (PBRP) phase I was initiated and started between 1998 and 2002, and was then extended to phase II from 2002 to 2006. During the project, there were always resident experts from the EU to offer technical and financial assistance to the new system. Between 1998 and 2000, the survey programme was planned and started. The output showed that the pathogen concerned was widespread in the Nile delta and valley cultivated lands, and feasibility studies concluded that eradication of disease in the endemic land would not be possible with available resources and costs for maintenance were not affordable by small growers/farmers cultivating the Nile delta and valley. It was then decided to avoid the disease by establishing a PFA in new lands outside the traditional lands, the new land being cultivated for the first time, irrigated by ground water and managed by large-scale companies. By 2000, the PFA was functional and according to ministerial decree 61/2000 it was prohibited to export potato to the EU from outside the newly established PFA.

To secure the required revenue that would be used for establishment and maintenance of PFA, the Egyptian NPPO has imposed fees for registration of farms to export potato, and has imposed other fees for inspection, monitoring and laboratory testing of potato production.

Since 2000, the official committee has held regular meetings, including meetings with EU officials and representatives from traders/growers/exporters. The committee has been required to meet and review the PFA system annually, and can also convene their meetings in the event of emergency situations, when potato consignments are

intercepted at importing countries. Such situations were frequently encountered during the first four years, due to shortcomings and gaps in the system that allowed for fraud. The most common fraud was the use of forged documents for exporting potato grown outside the PFA. Every year, as technical audits have been performed by the Potato Brown Rot Project, recommendations have been delivered to the committee to "fine adjust" the system and issue new regulations. This was particularly evident in relation to the penalty system that added new restrictions and imposed more severe punishment for fraud and nonconformity cases.

The establishment of the PFA was successful in reducing interception cases from over 50 every year to near zero (one interception case every three years), and to increase potato exportation from 350 000 tons to more than one million tons every year. This was supported by implementation of ISPM 4 (*Requirements for the establishment of pest free areas*) and ISPM 6 (*Surveillance*).

Until now, the PFA for potato brown rot is the only PFA established in Egypt. Egyptian trade in other agricultural products is challenged by infestation with many other pests. Expansion of the PFA/PFPP/PFPS/ALPP programme in Egypt to cover other pests and other crops would increase market access for many Egyptian products.

Field inspection and sampling of potato plants at 75 days old in the PFA

Samples are processed at the laboratory

Laboratory testing for potato samples using immunofluorescent staining

© S. ElHadad, Potato Brown Rot Project, Egypt

Case study 7, PFA

Recognition of PFA in Mexico for spotted wing drosophila (*Drosophila suzukii*) on table grapes imported into New Zealand

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Timeline of the case study:

2011–2014

Content of the case study:

In November 2011, spotted wing drosophila (SWD, *Drosophila suzukii* (Matsumura) was first reported in Mexico. SWD is a regulated pest for New Zealand and table grapes are a known host of SWD. March 2012, New Zealand NPPO notified Mexico NPPO of emergency measures for SWD on table grapes imported from Mexico. In April 2012, New Zealand NPPO amended the import health standard (IHS) for table grapes from Mexico to reflect the emergency measure for SWD. In the same month, Mexico NPPO requested New Zealand NPPO to recognise a PFA for SWD for the municipalities of Caborca and Hermosillo in the State of Sonora where table grapes are produced for export to New Zealand.

In April – December 2012, New Zealand NPPO assessed the Mexico NPPO proposal of PFA against ISPM 4. In July 2012 senior officials from the New Zealand NPPO visited Mexico to assess the export pathway. The New Zealand NPPO published "Risk Management Proposal (RMP): Measures for the import of table grapes (a host of *Drosophila suzukii*) from the municipalities of Hermosillo and Caborca, Mexico" and "Amendment to the Import Health Standard for Table Grapes (*Vitis vinifera*) from Mexico" for public consultation in December 2012. At the same time, the New Zealand NPPO sent a draft official assurance programme (OAP) to the Mexico NPPO.

In March 2013, the New Zealand and Mexico NPPOs reached agreement on the OAP. Later in April 2013, the New Zealand NPPO issued the revised IHS for table grapes from Mexico and trade resumed.

The New Zealand and Mexico NPPOs formally signed the OAP in March 2014.

This was achieved through the involvement of:

- New Zealand Ministry for Primary Industries (MPI, the NPPO) – assessing biosecurity risk posed by SWD on table grapes from Mexico; proposing measures and analysing how they effectively manage phytosanitary risk; establishing the feasibility and practicality of implementation of the proposed measures; publicly consulting with stakeholders on the proposed phytosanitary measures (the RMP and IHS); drafting and seeking agreement on the OAP with the Mexico NPPO, which enabled trade to resume.
- National Service of Food and Agriculture, Health, Safety and Quality (SENASICA, the Mexico NPPO) – providing information; implementing emergency measures; undertaking surveillance; providing official assurance and certification; and other NPPO responsibilities to set a system to establish, maintain and verify SWD freedom.
- Mexico National reference laboratory – diagnosis and pest identification.
- Growers, packers and public – training/education and awareness of SWD.
- New Zealand public stakeholders – providing feedback on the RMP and IHS during public consultation.

◆ **The following ISPMs were implemented:**

- ISPM 1 (*Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade*).
- ISPM 4 (*Requirements for the establishment of pest free areas*).
- ISPM 8 (*Determination of pest status in an area*).
- ISPM 17 (*Pest reporting*).

Lessons learned:

- The assurance system agreed between New Zealand and Mexico is multifaceted and does not rely on any single unsupported activity to establish, maintain or verify pest freedom. It is a result of NPPO collaboration and public consultation.
- Where possible, phytosanitary measures are aligned with international standards, guidelines (the ISPMs), and recommendations as per New Zealand's obligations under Article 3.1 of the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) and section 23(4)(c) of the New Zealand Biosecurity Act 1993.
- The RMP and IHS that MPI consulted on, as well as the OAP agreed between New Zealand and Mexico, has set MPI's benchmark for other countries seeking similar PFA recognition for *Drosophila suzukii*.

References:

Risk Management Proposal: Measures for the import of table grapes (a host of *Drosophila suzukii*) from the municipalities of Hermosillo and Caborca, Mexico.

Pest risk analyses assessments for SWD:

- Ministry for Primary Industries (MPI) (2012a) Pest Risk Assessment: *Drosophila suzukii*: spotted wing drosophila (*Diptera: Drosophilidae*) on fresh fruit from the USA;
- DAFF (Department of Agriculture, Forestry and Fisheries). 2010. Draft pest risk analysis report for *Drosophila suzukii*, October 2010. Canberra, Biosecurity Australia.
- MPI (Ministry for Primary Industries). 2012b. Risk management document on the proposed amendment to the IHS for table grapes from the United States of America (State of California).

II – ALPP CASE STUDIES

Case study 8, ALPP

Risk mitigation system for a complex of tephritid fruit flies – Mediterranean fruit fly (*Ceratitis capitata*), West Indian fruit fly (*Anastrepha obliqua*) and South American fruit fly (*Anastrephafraterculus*) on mango cultivated in Açu Valley (Rio Grande do Norte (RN) state) and San Francisco Valley (Pernambuco (PE) and Bahia (BA) states), Brazil

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Timeline of the case study:

Ongoing from mid 1990s

Content of the case study:

The establishment of this risk mitigation system involved a range of stakeholders at different levels and from different sectors, such as:

- **Federal coordination:**
  - USDA Animal and Plant Health Inspection Service (APHIS)
  - Ministry of Agriculture, Livestock and Supply (MAPA)
  - Department of Plant Protection (DSV)
  - Federal Agricultural Superintendence in RN State (SFA RN)
  - Federal Agricultural Superintendence in Pernambuco State (SFA PE)
  - Federal Agricultural Superintendence in Bahia State (SFA BA)
- **State institutions:**
  - RN State Phytosanitary Defence Agency (IDIARN)
  - PE State Phytosanitary Defence Agency (ADAGRO)
  - BA State Phytosanitary Defence Agency (ADAB)
- **Laboratories and research institutions:**
  - Universidade Federal do Semi Árido - Mossoró (UFERSA)
- **Private sector:**
  - Committee of Exporters (COEX)
  - FINOAGRO (mango producer and exporter)
  - Biofábrica Moscamed Brasil
  - Representative of the Mango Exporters from Brazil.

In the mid 1990s, the prospect of mango (*Mangifera indica* L.) export to the United States of America (USA) prompted producers of the microregion of the Açu Valley (Rio Grande do Norte state) and San Francisco Valley (Pernambuco and Bahia states), in the north-east region of Brazil, to initiate an export programme to the USA. A work plan that established the requirements for exporting mango to the USA was developed and agreed. The work plan, that is still valid today, includes protocols for the risk mitigation system for Mediterranean fruit fly (*Ceratitis capitata*), West Indian fruit fly (*Anastrepha obliqua*), South American fruit fly (*Anastrepha fraterculus* (Wiedmann)) and for the mango seed weevil (*Sternochetus mangiferae* (Fabricius)).

One of the import requirements is the requirement for mango to be hot water treated (HWT) as specified by USDA-APHIS. To meet that requirement, some private companies installed hot water treatment (HWT) plants in the San Francisco Valley and one in Açu Valley to offer the treatment to interested producers. These treatment facilities are recertified annually under the oversight of APHIS staff based on the work plan requirements.

Registration of the production units, pest monitoring (FTD below or equal to 1.0), monitoring and sampling of each lot, the packaging of fruits in a single warehouse with the presence of federal inspectors from Brazil and the USA throughout the treatment process until the container with consignment is sealed, are other import requirements. ISPMs successfully implemented are as follows:

- ISPM 1 (*Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade*)

- ISPM 6 (*Surveillance*)
- ISPM 7 (*Phytosanitary certification system)*
- ISPM 8 (*Determination of pest status in an area)*
- ISPM 12 (*Phytosanitary certificates)*
- ISPM 14 (*The use of integrated measures in a systems approach for pest risk management*)
- ISPM 22 (*Requirements for the establishment of areas of low pest prevalence*).

The success of the programme lies in the high degree of commitment and collaboration of the engaged producers maintaining proper phytosanitary operations in their orchards, auditors of the MAPA, and APHIS professionals supporting them to implement the agreed export programme/work plan. In Açu Valley, in almost 20 years of mango export to the USA, there has been no detection of larvae of *Ceratitis capitata, Anastrepha obliqua, Anastrepha fraterculus* or *Sternochetus mangiferae* in the samples checked for the presence of pests at the beginning of the production line.

However, there are challenges as well, such as:

- keeping the stakeholders in constant vigilance to maintain low levels of the pests and to continue with the export programmes
- maintaining fruit fly controls and improving them with the use of advanced technology.

References:

Work Plan for the Brazilian Mango, Hot Water Treatment and Preclearance Program – Operated Under Agreement Among the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) and The Department of Plant Health (DSV) of Animal and Plant Health Secretary (SDA) of Ministry of Agriculture, Livestock and Food Supply (MAPA) and the Representative of the Mango Exporters from Brazil – June 2008.

Fruit cut sampling at mango warehouse

Case study 9, ALPP

South Africa Mediterranean fruit fly (*Ceratitis capitata*) suppression programme

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Timeline of the case study:

1997–2018

Content of the case study:

The Hex River Valley is a major production area for table grapes in South Africa. An average of 15.5 million cartons are exported annually. The dominant and most economically important pest species is the Mediterranean fruit fly (*Ceratitis capitata*). It causes direct damage to fruit, requiring costly insecticide sprays, and infested fruit results in rejections of boxed table grapes by the phytosanitary inspectors of importing countries (Barnes and Eyles, 2000), while Natal fruit fly (*Ceratitis rosa* Karsch) occurs in the Western Cape province, South Africa.

In 1997, a pilot project to control fruit flies by integrating SIT was implemented in 10 000 hectares (100 km^2) in and around the Hex River Valley, South Africa. The goal was to suppress, in a cost-effective and an environment-friendly manner, the Mediterranean fruit fly populations to below the economic threshold, and then create an internationally recognized area of low pest prevalence (Barnes *et al.*, 2004). By replacing insecticide applications with a combination of aerial and ground releases of sterile male flies at hot spots, the reduction in control costs was substantial, from USD 350 000/year with chemical control to USD 130 000/year with SIT. Rejections, due to fruit fly infestation, of exported cartons of table grapes from the valley were reduced by approximately 50 percent. In 2000, a reduction of 60 percent in rejection of cartons by phytosanitary inspectors of importing countries represented savings of USD 150 000. For the 2001/2002 season, the direct benefits totalled USD 370 000/year, at a cost of USD 130 000, which is equivalent to a benefit-to-cost ratio of 2.8:1.

The organizational structure of this project is rather unique. It is a partnership between Infruitec/Nietvoorbij (a branch of the Agricultural Research Council (ARC), a parastatal body, with a mandate to conduct research, technology development and transfer) and the Hex River Valley Research Services Trust (which represents the deciduous fruit growers). Through an export carton levy, the growers raise funds to support programme operations (Barnes and Eyles, 2000). The sterile male production, initially established by the ARC, is now managed by the private sector, and growers manage the fly release and other field operations.

Population suppression of fruit fly pests using an area-wide IPM approach including SIT, proved to be a cost-effective approach for establishing and maintaining an ALPP. ISPM 22 (*Requirements for the establishment of areas of low pest prevalence*) and ISPM 30 (*Establishment of areas of low pest prevalence for fruit flies (Tephritidae)*)[1] were successfully implemented.

The plan for the future is to expand to other fruit production valleys the areas under suppression of fruit fly and other economically important pests.

[1] Revoked in 2018 and incorporated into ISPM 35

References:

Barnes, B.N. & Eyles, D.K. 2000. Feasibility of eradicating *Ceratitis* spp. fruit flies from the Western Cape of South Africa by the sterile insect technique. In: K.-H. Tan, ed. *Area-wide control of fruit flies and other insect pests*. Joint Proceedings of the International Conference on Area-Wide Control of Insect Pests and the Fifth International Symposium on Fruit Flies of Economic Importance, 28 May–5 June 1998, Penang, Malaysia, pp. 449–455. Pulau Pinang, Malaysia, Penerbit Universiti Sains Malaysia.

Barnes, B.N., Eyles, D.K. & Franz, G. 2004. South Africa's fruit fly SIT programme — the Hex River Valley pilot project and beyond. In: B.N. Barnes, ed. Proceedings of the 6th International Symposium on Fruit Flies of Economic Importance, 6–10 May 2002, Stellenbosch, South Africa, pp. 131–141. Irene, South Africa, Isteg Scientific Publications.

Enkerlin, W. 2005. Impact of fruit fly control programmes using the sterile insect technique. In: V.A. Dyck, J. Hendrichs & A.S. Robinson, eds. *Sterile insect technique. Principles and practice in area-wide integrated pest management*, pp. 651–673. Dordrecht, The Netherlands, Springer.

Case study 10, ALPP

The first private sterile insect production in Europe for onion fly

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Timeline of the case study:

1980–ongoing

Content of the case study:

The onion fly (*Delia antiqua* (Meigen)) is the key pest of the onion crop in the Netherlands. Repeated occurrence of resistance to insecticides prompted the development of alternative techniques for control and preliminary research was begun in 1965 to develop the sterile-male technique. Later, in 1970, it was decided to try to develop other ways of genetic control by chromosomal translocations.

Onion fly is present throughout the region and eradication cannot be maintained easily. It is more economical to routinely release sterile onion fly for suppression than to create a quarantine barrier to monitor and control new invasions. Because the onion flies do not disperse much beyond a particular field, it has proved feasible for this SIT service to be purchased on an individual grower basis.

From May to September, sterile flies are released in the fields to make wild females mate with an overflow of sterile flies. The sterile flies are released in the provinces of Flevoland, North and South Holland, north Brabant, Limburg and Zeeland. Around 10 000 hectares is treated annually, mainly onions for seed production, but also other members of the onion family.

Farmer doubts about the effectiveness of SIT compared to insecticides gradually disappeared as the benefits of SIT technology became more apparent. With the increasing trend of areas being managed under a SIT-based programme, the cost-effectiveness of SIT is increasing and losses to neighbours' fields are substantially decreasing.

The unique positive contribution of SIT to the region, however, has been the reduction in pesticides used and the continued management of populations that might develop pesticide resistance. The SIT approach for onion fly also has been below, or is competitive with, the cost of chemicals. This suggests that the use of SIT for onion fly in the Netherlands could increase more rapidly if the government recognized the public benefit of this approach and maintained a policy that encouraged its adoption by more individual farmers, to pay for the service.

Sterile insect technique for onion fly suppression is profitable and it compares to the cost of insecticide-based control. The area treated is, on average, increasing by 5 percent per year and investment to increase the rearing capacity is underway. Around 50 percent of the farmers in the area where SIT is being used are applying SIT and the other half continue to use chemical control, with some using a low input chemical control or no control at all.

◆ **The following ISPMs were successfully implemented:**

- ISPM 14 (*The use of integrated measures in a systems approach for pest risk management*)
- ISPM 22 (*Requirements for the establishment of areas of low pest prevalence*)
- ISPM 29 (*Recognition of pest free areas and areas of low pest prevalence*).

References:

Everaats, T.C. 2006. De steriele-insecten-techniek tegen de uienvlieg. *Entomologische Berichten*, 66(1): 21–23.

Loosjes, M. 1976. *Ecology and genetic control of the onion fly,* Delia antiqua *(Meigen)*. Agricultural Research Reports 857. Wageningen, The Netherlands, Pudoc. vii + 179 pp.

Loosjes, M. 1998. The sterile insect technique for commercial control of the onion fly. In: K.-H. Tan, ed. *Area-wide control of fruit flies and other insect pests*. Joint Proceedings of the International Conference on Area-Wide Control of Insect Pests and the Fifth International Symposium on Fruit Flies of Economic Importance, Penang, 28 May–5 June 1998, Penang, Malaysia, pp. 181-184. Pulau Pinang, Malaysia, Penerbit Universiti Sains Malaysia.

Robinson, A.S. & van Heemert, C. 1980. Genetic control of the onion fly, *Delia antiqua*, with chromosomal rearrangements. In: A.K. Minks & P. Gruys, eds. *Integrated control of insect pests in the Netherlands*, pp. 99–102. Wageningen, The Netherlands, Pudoc. 304 pp.

III – PFPP AND PFPS CASE STUDIES

Case study 11, PFPS and PFPP

Montelíbano and Santa Rosa Mediterranean fruit fly free places and sites of production, Honduras, Central America

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Timeline of the case study

2011–2018

Content of the case study:

To be able to export melon (*Cucumis melo L.*) from Honduras to Taiwan, the requisite was to export from an area free of the Mediterranean fruit fly (medfly) and other fruit fly pests of quarantine significance. The problem with these regulated pests was addressed together by the main stakeholders such SENASA, Honduras, and melon growers and exporters from the Montelíbano and Santa Rosa regions.

Through a careful review of the relevant ISPMs (ISPM 10), the Servicio Nacional de Sanidad e Inocuidad Agroalimentaria y Agropecuaria (SENASA) determined that the pest risk mitigation scheme that could apply in this case was the "pest free places of production and pest free production sites". Following international fruit fly trapping guidelines (Appendix 1 to ISPM 26; FAO/IAEA, 2018), as the Servicio Nacional de Sanidad e Inocuidad Agroalimentaria y Agropecuaria SENASA established the fruit fly surveillance network in July 2011 for the Montelíbano production site of 400 hectares and 800 hectares in Santa Rosa. Trapping results clearly indicated the absence of fruit fly pests in the areas of interest. These results and the fact that melon is defined as a conditional host of the target fruit fly species were the critical technical factors used in the bilateral negotiations between the phytosanitary authorities of Honduras and Taiwan that resulted in an agreement to export melon using a pest risk mitigation scheme. A major advantage of this pest risk mitigation scheme is that no internal quarantine checkpoints are required and that places and sites of production need to be fruit fly free only during the fruit production and harvest period. Mitigating pest risk through the use of PFPP and PFPSs based on the requirements of ISPM 10 (*Requirements for the establishment of pest free places of production and pest free production sites*), supported by the implementation of ISPM 26 (*Establishment of pest free areas for fruit flies (Tephritidae)*) and ISPM 37 (*Determination of host status of fruit to fruit fly (Tephritidae)*), is a viable option to open export markets.

The current aim of the stakeholders involved is to maintain and expand to other melon production areas the medfly free places and sites of production.

Melon production and harvest from a medfly free site of production in Honduras

References:

César Augusto, N.P. 2017. Servicio Nacional de Sanidad e Inocuidad Agroalimentaria y Agropecuaria (SENASA), Honduras. *Insect Pest Control Newsletter*, 89: 32–33. Available at http://www-naweb.iaea.org/nafa/ipc/public/IPC-NL-89.pdf (last accessed 29 September 2018).

Case study 12, PFPS

Exports of dragon fruit to the United States of America from PFPSs in Ecuador

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Timeline of the case study:

2011–2017

Content of the case study:

The long process of negotiations for exports of dragon fruit (pitahaya) from fruit fly free places of production was carried out by the two relevant agencies of the countries involved: Agencia de Regulación y Control Fito y Zoosanitario (AGROCALIDAD) Ministerio de Agricultura y Ganadería, and USDA-APHIS. The negotiations were driven by strong interest from growers to open international markets to dragon fruits from Ecuador. Therefore, stakeholders involved in the process also included dragon fruit (*Hylocereus undatus* (Haworth)) growers' and exporters' associations. As the consequence of the negotiations, a work plan was signed by APHIS and AGROCALIDAD stating that dragon fruit could be exported to the United States of America (USA) from fruit fly free production sites that maintained specific monitoring systems and from authorized fruit collection centres. On 21 September 2017, USDA-APHIS authorized the imports of dragon fruit from Ecuador. It is worth noting that in 2016, 830 tons were exported to other destinations; however, with the opening of the USA market and according to recent estimates, exports could increase to an estimated 8 000 tons per annum.

◆ **The following ISPMs were successfully implemented:**

- ISPM 10 (*Requirements for the establishment of pest free places of production and pest free production sites*)
- ISPM 26 (*Establishment of pest free areas for fruit flies (Tephritidae)*)
- ISPM 37 (*Determination of host status of fruit to fruit flies (Tephritidae)*).

Mitigating pest risk through the use of PFPP and PFPS (ISPM 10) has proved to be a viable option for opening export markets.

The future goal of the stakeholders involved is to maintain and expand to other areas the fruit fly free places and sites of production.

References:

Vilatuña, J. 2018. AGROCALIDAD, Ecuador. *Pest Control Newsletter*, 90: 34–35. Available at https://www-pub.iaea.org/books/iaeabooks/12326/Insect-Pest-Control-Newsletter-No-90-January-2018 (last accessed 29 September 2018).

Dragon fruit production areas in Ecuador

IV – ERADICATION CASE STUDIES

Case study 13, Eradication

Eradication of the cactus moth (*Cactoblastis cactorum*) from two islands off the coast of the Yucatán Peninsula, Mexico

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Timeline of the case study:

2006–2007

Content of the case study:

Stakeholders involved:

- Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria (SENASICA), Mexico.
- Joint FAO/IAEA Division International Atomic Energy Agency
- USDA Center for Plant Health Science and Technology (CPHST)
- North American Plant Protection Organization (NAPPO).

Cactus moth (*Cactoblastis cactorum* (Berg)) is an invasive species with the potential to cause devastating socio-economic effects on the commercial production of prickly pear (*Opuntia*) cactus as well to arid ecosystems in Mexico.

An extended outbreak of the cactus moth was detected in 2006 in Isla Mujeres and Isla Contoy on the Yucatán Peninsula in Mexico. The National Plant Protection Organization of Mexico SENASICA, the state plant protection committee with the assistance of the USDA Agricultural Research Service (USDA-ARS), and other collaborators including the Joint FAO/IAEA Division and NAPPO, reacted promptly to eradicate the outbreaks by delimiting the infestation and by population suppression using an IPM approach. The state plant protection committee, with strategic and financial support from the federal government SENASICA, executed the eradication campaign. This included pheromone traps, stripping of infested *Opuntia* cactus, removal of egg sticks, and the limited use of insecticide. By intensifying these activities and integrating SIT, the outbreaks were officially declared eradicated in 2009. Sterile moths were shipped weekly from the rearing laboratory of USDA-ARS in Tifton, Georgia, Gainesville, United States of America.

SENASICA maintains a surveillance system in strategic high-risk sites to provide early detection of any possible incursion of the cactus moth. Surveillance networks for early detection of invasive insect pests is critical for cost-effective eradication of outbreaks. Future plans are to maintain the cactus moth surveillance network operating at high-risk points of entry.

Eradication of the cactus moth from the two islands prevented spread of the pest to mainland Yucatán, Mexico, and further north to the commercial *Opuntia* cactus production areas and the arid ecosystems where cactus is a major component of the ecosystem.

The following ISPMs were implemented successfully:

- ISPM 8 (*Determination of pest status in an area*)
- ISPM 9 (*Guidelines for pest eradication programmes*)
- ISPM 29 (*Recognition of pest free areas and areas of low pest prevalence*).

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© A. Bello, SENASICA SAGARPA Mexico

Cactus moth outbreaks in Mujeres Island and Contoy Island at the Peninsula of Yucatán Mexico

© I. Baez, Photos & Design

Cactus moth (Cactoblastis cactorum) *on its prickly pear* (Opuntia) *cactus host*

Case study 14, Eradication

Mediterranean fruit fly (*Ceratitis capitata*) eradication from the Dominican Republic

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Timeline of the case study:

2015–2017

Content of the case study:

The presence of the Mediterranean fruit fly (*Ceratitis capitata* (Wiedmann)) in the Dominican Republic was officially reported in March 2015. The pest had already spread to 2 053 km^2 in the eastern part of the country, constituting a major outbreak. An immediate ban to most exports of fruits and vegetables was imposed by trading partners, causing a loss of over USD 40 million for the remaining nine months of 2015.

As an emergency response, the Government, through its Ministry of Agriculture, established the Moscamed Programme in the Dominican Republic (Moscamed-RD), providing the required financial and operational support to carry out all required surveillance and eradication activities. International organizations including the IAEA, FAO, USDA, Organismo Internacional Regional de Sanidad Agropecuaria (OIRSA) and Instituto Interamericano de Cooperacion para la Agricultura (IICA) made joint efforts with the Ministry of Agriculture against the medfly outbreak. An IPM approach based on area-wide SIT was used to eradicate the pest. A technical advisory committee of experts provided oversight throughout the eradication campaign. Official eradication was announced in July 2017 after six fly generations of zero catches. The Dominican Republic is now on the list of countries that have successfully eradicated the Mediterranean fruit fly and has substantially strengthened its fruit fly surveillance system and emergency response capacity.

The establishment of the medfly in the Dominican Republic would have had devastating effects on horticultural production and exports and would have constituted a high pest risk for the entire Caribbean Region and neighbouring mainland countries. The experience of the Dominican Republic has proved that the availability of surveillance networks for early detection of invasive species is a critical phytosanitary measure to prevent pest introductions.

As the follow up, the Dominican Republic is establishing a national fruit fly programme with an assigned annual budget to maintain the gained expertise, manage native fruit flies, and maintain the surveillance and response capacities for invasive fruit flies and other pests.

The following ISPMs were successfully implemented:

- ISPM 4 (*Requirements for the establishment of pest free areas*)
- ISPM 8 (*Determination of pest status in an area*)
- ISPM 9 (*Guidelines for pest eradication programmes*)
- ISPM 26 (*Establishment of pest free areas for fruit flies (Tephritidae)*).

References:

FAO/IAEA. 2017. *Guideline for packing, shipping, holding and release of sterile flies in area-wide fruit fly control programmes*. 2nd edn. J.L. Zavala-López & W.R. Enkerlin, eds. Rome, FAO. 140 pp.

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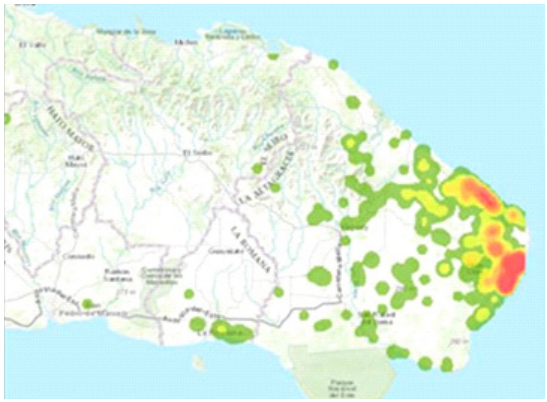
© F. Martinez Pujols, Moscamed Programme Dominican Republique

Above: Packing of sterile medflies before field release



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Left: Location of the Mediterranean fruit fly outbreak in the Dominican Republic

V - CASE STUDIES ON PEST MANAGEMENT PRACTICES (PMP) AND USE OF A SYSTEMS APPROACH

Case study 15, PMP

Sterile insect release for area-wide management of codling moth (*Cydia pomonella*) in British Columbia, Canada

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Timeline of the case study:

1992–present

Content of the case study:

Stakeholders involved and their role:

- Regional districts – the Sterile Insect Release (SIR) programme is serviced by representatives of four local government regional districts that advocate on behalf of the programme, establish bylaws defining the programme's structure and activities, and facilitate the collection of parcel and property value taxes.
- Growers – are responsible for developing sustainable pest management plans for their orchards that integrate SIR (otherwise known as SIT) with other measures, as required, cooperate with SIR programme staff in monitoring activities, and support the programme through parcel tax payments.
- Residential property owners – in the participating regional districts pay a small property tax to support the programme. Property owners with pome fruit trees are responsible for preventing the proliferation and spread of pests, including codling moths (*Cydia pomonella* (*L.*)), and must allow access to their property by programme staff to monitor codling moth infestations.
- Packing houses – assist growers in understanding codling moth biology and methods (including SIR) to deal with the insect. Fruit handlers are responsible for sanitizing fruit bins and containers.
- Fruit tree retailers – may support the programme by volunteering to participate in host tree registry, advising buyers of fruit trees of the need to prevent infestation, and on methods of pest management.
- Government scientists – with both the federal and provincial governments provide technical advice on SIT, orchard pest management, and future directions for the programme.

The codling moth is a key pest of apples and pears in western North America and in most regions of the world where pome fruit is grown. The larval stage burrows into the fruit and renders it unmarketable. Concerns over unacceptably high rates of codling moth damage and an overreliance on pesticides led researchers at the Agriculture and Agri-Food Canada's Summerland Research and Development Centre in British Columbia to investigate the use of SIT to eradicate the pest. Research conducted from 1962–1982 resulted in the development of effective mass-rearing and release technologies and concluded with a successful pilot project. Encouraged by the results of the pilot project, growers in the Okanagan Valley lobbied government officials at all levels to assist in conducting a cost–benefit analysis for implementing an SIT-based eradication programme for codling moth, developing a strategic plan, outlining a funding stream and enacting legislation to establish and empower a board of directors to oversee the programme. The codling moth SIR programme was finally approved and implemented in 1992, with the first sterile moths being released in the spring of 1994.

The Okanagan-Kootenay Sterile Insect Release (SIR) Program changed its mission in 1998 from eradication to area-wide pest management, largely because the technique proved ineffective in urban areas with large numbers of widely scattered apple and pear trees and because of difficulties in enforcing other management practices to a level that would support eradication. The stated mission of the programme is now to reduce the use of pesticides and support local fruit producers by providing a cost-effective, sustainable and transparent public programme – informed by the best available data and technical expertise – to mitigate the threat of codling moth to the local pome fruit industry and to create a healthier environment for local

communities. Between 1995 and 2015, wild codling moth populations were reduced by 94 percent across all areas of the programme and the amount of pesticide used against the moth by 96 percent. A 2014 cost–benefit analysis of the programme determined that for every CAD 1 spent on the programme there was CAD 2.50 in benefits to producers and the region's communities.

The following ISPMs were successfully implemented:

- ISPM 6 (*Surveillance*)
- ISPM 8 (*Determination of pest status in an area*).

References:

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Dyck, V.A., Graham, S.H. & Bloem, K.A. 1993. Implementation of the sterile insect release programme to eradicate the codling moth, *Cydia pomonella* (L.) (Lepidoptera: Olethreutidae), in British Columbia, Canada. In: *Management of insect pests: nuclear and related molecular and genetic techniques*. Proceedings of the IAEA/FAO International Symposium, 19–23 October 1992, Vienna, Austria, pp. 285–298. STI/PUB/909. Vienna, IAEA.

SIR The Program. n.d. https://www.oksir.org (last accessed 29 September 2018).

Codling moth mass-rearing facility in Osoyoos, British Columbia, Canada, with weekly production capability of 14.5 million sterile moths

© Okanagan-Kootenay Sterile Insect Release (SIR) Program, British Columbia, Canada;

Public relations material used to engage the local community in programme support

Case study 16, Systems approach

Hass avocado from Mexico – non-host status to fruit fly pests and a systems approach

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Timeline of the case study:

1994–1997

Content of the case study:

To be able to export Hass avocado (*Persea americana* Mell.) from Michoacán in Mexico to the United States of America (USA), the requisite was to demonstrate non-host status to three fruit fly species (*Anastrepha* spp.) and absence of three avocado seed weevils (*Conotrachelus* spp.) and the avocado branch borer (*Copturus aguacatae* (Kissinger)). A research protocol was prepared by a binational Mexico–USA team of scientists. Through a host status determination, the Hass avocado produced in Mexico was classified as a non-host of three fruit fly species of quarantine concern to the USA. In 1994, Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria (SENASICA) presented the experimental results to USDA which were validated and accepted. After a series of scientific and public hearings, in 1997 the rule allowing imports of Hass avocado from Mexico into the USA was published in the Federal Register of the USA.

Once the rule for import of avocado to the USA was published, a work plan was prepared to implement a systems approach where the non-host status remained the central pest mitigation measures. The systems approach was implemented in 1997 under the supervision of SENASICA, Mexican inspectors and the oversight of USDA Plant Protection and Quarantine (PPQ). That same year, the first shipments of Hass avocado crossed the Mexico–USA border. Initially, fruits could be exported to 13 USA states for four months (Enkerlin *et al.*, 1993). Eventually, the whole of the USA for the entire 12 months of the year was opened to Hass avocado imports from Mexico as a result of additional research (Aluja *et al.*, 2004).

In 2017, over one million tonnes of avocado were exported from Michoacán, Mexico to the USA with a value of over USD 1.5 billion as a result of the science-based evidence derogation of the quarantine that was in place for over 80 years.

The following ISPMs were successfully implemented:

- ISPM 35 (*Systems approach for pest risk management of fruit flies (Tephritidae)*)
- ISPM 37 (*Determination of host status of fruit to fruit flies (Tephritidae)*).

References:

Aluja, M., Díaz-Fleisher, F. & Arredondo, J. 2004. Non-host status of commercial *Persea americana* cultivar 'Hass' to *Anastrepha ludens, Anastrepha obliqua, Anastrepha serpentina*, and *Anastrepha striata* (Diptera: Tephritidae) in Mexico. *Journal of Economic Entomology*, 97: 293–309.

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Gutiérrez-Ruelas, J.M., Santiago Martínez, G., Villaseñor Cortes, A., Enkerlin, W.R. & Hernández López, F. 2013. Los programas de moscas de la fruta en México: Su historia reciente. Talleres de S y G Editores. Mexico City. 89 pp.

Photos taken on 3 June, 2017 shows an avocado orchard and a producer displaying an avocado, the so-called "green gold", at Avo Hass, one of the eight avocado packing plants in Uruapanat, in the state of Michoacan, Mexico. Michoacan produced nearly 1.5 million tons of avocado in 2016, according to the federal government's annual agricultural records. (Xinhua/David de la Paz; www.NEWS.CN.)

Case study 17, PMP and systems approach

Thailand mango to Japan – suppression of oriental fruit fly (*Bactrocera dorsalis*) and guava fruit fly (*B. correcta*) using a combined MAT and SIT approach with postharvest treatment

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Timeline of the case study:

2000–2005

Content of the case study:

Two tephritid species, namely the oriental fruit fly (*Bactrocera dorsalis* (Hendel)) and the guava fruit fly (*Bactrocera correcta* Bezzi), are considered to be the key insect pests of fruit production in Thailand, causing yield loss and quality degradation. At the request of the mango farmers, the Department of Agricultural Extension (DOAE) with support from IAEA and FAO implemented an area-wide integrated fruit fly management programme which included MAT and SIT for population suppression. The integrated approach has been effective in controlling fruit flies by reducing damage from over 80 percent before programme implementation to an average of less than 3.6 percent in Ratchaburi Province and from 42.9 percent to 15.5 percent in Pichit Province. This preharvest suppression, combined with a postharvest treatment based on vapour heat, has opened the possibility for export of mango produced in these selected pilot areas to some of the most stringent and lucrative markets such as Japan.

Population suppression of fruit fly pests using an area-wide IPM approach including MAT and SIT, proved to be a cost-effective approach for reducing fruit fly infestations in mango. Plans include the expansion of the IPM approach to other mango production areas in Thailand.

The following ISPMs were successfully implemented:

- ISPM 22 (*Requirements for the establishment of areas of low pest prevalence*)
- ISPM 30 (*Establishment of areas of low pest prevalence for fruit flies (Tephritidae)*)
- Annex 3 (Phytosanitary procedures for fruit fly (Tephritidae) management (2015)) to ISPM 26.

References:

Sutantawong, M., Orankanok, W., Enkerlin, W.R., Wornoayporn, V. & Caceres, C. 2004. The sterile insect technique for control of the oriental fruit fly, *Bactrocera dorsalis* (Hendel), in mango orchards in Ratchaburi Province, Thailand. In: B.N. Barnes, ed. Proceedings of the 6th International Symposium on Fruit Flies of Economic Importance, 6–10 May 2002, Stellenbosch, South Africa, pp. 223–232. Irene, South Africa, Isteg Scientific Publications.

Release of sterile flies in mango orchards in Pichit Province

Case study 18

Incident command system management structure for emergency programmes

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Timeline of the case study:

The incident command system (ICS) was developed in the United States of America (USA) in the 1970s and is now used throughout USA state and federal programmes for emergency response, including eradication programmes for exotic fruit flies and other invasive insects and plant pests such as the European cherry fruit fly (*Rhagoletis cerasi* (L.)) and spotted lanternfly (*Lycorma deliculata* (White)).

Content of the case study:

The incident command system was initially developed to address problems of poor communication, coordination and resource utilization between different agencies responding to wildfires in California and Arizona. However, it has since evolved into a component of the National Incident Management System (NIMS) in the USA, where it is the management system of choice for all emergency situations, ranging from active shootings and oil spills to disease prevention and eradication of new invasive insect pests. It has also acted as a pattern for similar approaches internationally.

The incident command system is a standardized approach to the command, control and coordination of emergency response, providing a common organizational framework and unambiguous lines of authority and responsibility within which responders from multiple agencies can be effective. Every incident or event regardless of size requires that certain management functions be performed. The problem must be identified and assessed, a plan to deal with it developed and implemented, and the necessary resources procured and paid for.

The organization of ICS is built around five major functions:

- **COMMAND**. Has overall responsibility for managing the incident; sets objectives and priorities based on direction from agency/programme directors; assesses staffing needs and establishes Sections and delegates authority to Section Chiefs as necessary to meet the needs of the situation.
- **PLANNING.** Develops the action plan to accomplish the objectives; collects and evaluates information; tracks resources assigned to the incident.
- **OPERATIONS**. Provides technical and tactical expertise; conducts operations to carry out the plan; directs the use of all resources.
- **LOGISTICS**. Provides support to meet incident/operational needs, including personnel, equipment, supplies, transportation, facilities and all others resources and services.
- **FINANCE/ADMINISTRATION**. Monitors costs related to the incident; provides accounting, procurement, time recording, and cost analyses.

In a small incident, all of these activities may be handled by one person, the Incident Commander. If the needs grow, sections and people can be added to match the complexities and demands of a particular incident as determined by the Command centre.

https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/sa_ics/ct_incident_command_system

Section 9: Bibliography and Additional Resources

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INTERNATIONAL STANDARDS FOR PHYTOSANITARY MEASURES (ISPMs) DIRECTLY RELATED TO PFAs, PFPPs, PFPSs AND ALPPs

Pest Free Areas, Places and Sites of Production

ISPM 1. *Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade* (adopted in 1993, revised in 2006).

ISPM 4. *Requirements for the establishment of pest free areas* (adopted in 1995).

ISPM 5. *Glossary of phytosanitary terms* (updated as needed).

ISPM 6. *Surveillance* (adopted in 1997, revised 2018).

ISPM 8. *Determination of pest status in an area* (adopted in 1998).

ISPM 9. *Guidelines for pest eradication programmes* (adopted in 1998).

ISPM 10. *Requirements for the establishment of pest free places of production and pest free production sites* (adopted in 1999).

ISPM 14. *The use of integrated measures in a systems approach for pest risk management* (adopted in 2002).

ISPM 26. *Establishment of pest free areas for fruit flies (Tephritidae)* (adopted in 2006, revised in 2011, 2014 and 2015).

ISPM 27. *Diagnostic protocols for regulated pests* (adopted in 2006).

ISPM 28. *Phytosanitary treatments for regulated pests* (adopted in 2007).

ISPM 29. *Recognition of pest free areas and areas of low pest prevalence* (adopted in 2007).

AREAS OF LOW PEST PREVALENCE

ISPM 1. *Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade* (adopted in 1993, revised in 2006).

ISPM 5. *Glossary of phytosanitary terms* (updated as needed).

ISPM 6. *Surveillance* (adopted in 1997, revised in 2018).

ISPM 8. *Determination of pest status in an area* (adopted in 1998).

ISPM 14. *The use of integrated measures in a systems approach for pest risk management* (adopted in 2002).

ISPM 22. *Requirements for the establishment of areas of low pest prevalence* (adopted in 2005).

ISPM 27. *Diagnostic protocols for regulated pests* (adopted in 2006).

ISPM 28. *Phytosanitary treatments for regulated pests* (adopted in 2007).

ISPM 29. *Recognition of pest free areas and areas of low pest prevalence* (adopted in 2007).

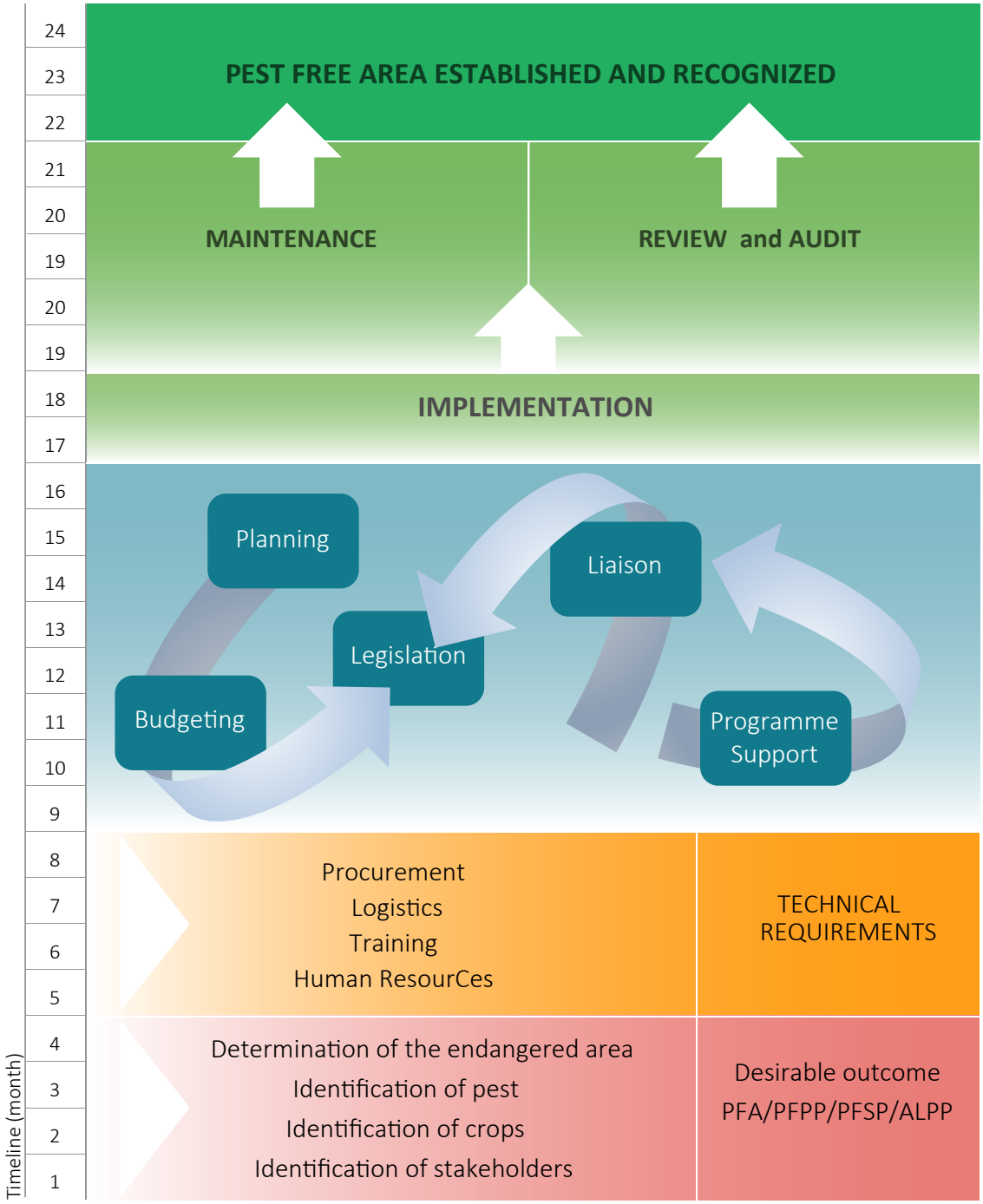
ISPM 35. *Systems approach for pest risk management of fruit flies (Tephritidae)* (adopted in 2012, ink amendments in 2018 to incorporate ISPM 30)[1].

ISPM 37. *Determination of host status of fruit to fruit flies (Tephritidae)* (adopted in 2016).

[1] ISPM 30 (*Establishment of areas of low pest prevalence for fruit flies (Tephritidae)*) (adopted in 2008, revoked and incorporated as an annex to ISPM 35 in 2018)

Section 10: APPENDIXES

APPENDIX 1: EXAMPLE OF A STRATEGIC MAP – PFA IMPLEMENTATION



APPENDIX 2: TYPICAL LOGICAL FRAMEWORK MATRIX AND WORKPLAN PROCEDURE FOR ESTABLISHING AND MAINTAINING AN ALPP AND EVENTUALLY A PFA

The strategic plan developed as part of a project design phase is typically known as a "logical framework matrix" (LFM). The LFM contains a detailed work plan. This work plan procedure can be used for establishing and maintaining PFAs and ALPPs. The example shown below is for implementing integrated pest management practices for pest control when establishing and maintaining an ALPP and eventually a PFA.

Logical framework matrix (LFM)

Project Objective

To increase international market access for Moroccan citrus based on the establishment of a Mediterranean fruit fly area of low pest prevalence in the Souss Valley by integrating environmental friendly methods, such as the sterile insect technique.

Logical Framework matric (LFM)

	Design Element	Indicator:	Means of verification	Assumptions:
Outcome	Increased international market access for citrus form the Souss Valley benefitting producers and exporters and reduced losses to the Mediterranean fruit fly, and insecticide use in Souss Valley benefitting rural communities and the environment.	1. Area of low pest prevalence for the Mediterranean fruit fly in citrus orchards increased from the current 5 000 ha to the whole Souss Valley (50 000 ha) by the end 2018. 2. Fruit infestation levels and insecticide use data.	1. Periodic reports on the gradual increase of the area of low pest prevalence 2. Ministry of Agriculture statistics and information from grower association	1. Good management of projects and collaboration among stakeholders. 2. Financial resources from ONSSA, ORMVA-MS and Maroc Citrus provide the mechanism through which the Mediterranean fruit fly suppression programme is implemented
Output	1. Project Management Team Operational	Meetings of the project team	Periodic reports	The project is approved for implementation
	2. Exotic fruit fly preventive early warning system strengthened and rapid response capacity established.	1. Number of ONSSA plant protection officers trained on early detection and rapid response measures against exotic fruit flies. 2. Surveillance systems implemented in key ports of fresh fruit entry	Periodic report on the outcomes of the exotic fruit fly preventive surveillance system	1. Availability of resources 2.Staff trained remain in institution performing duties
	3. Medfly mass rearing unit built, equipped and operating.	1. Mass rearing facility completed and equipped by end of 2017 2. Production of at least 100 million sterile males by the end of 2017	1. Periodic reports on the progress of the mass rearing construction. 2. Weekly reports on the number of sterile males produced.	1. Equipment and materials delivered on the time with the desired specification 2. Staff trained remain in institution performing duties
	4. Medfly Area- wide Sterile Insect Techniques Suppression Programme implemented and operating in the Souss valley	Organizational structure and implementation of an independently managed Medfly Suppression Programme completed by mid-2016. 2. Field operations organization working full capacity by the end of 2018.	Weekly report of the outcomes of the surveillance and control activities.	1.Equipment and materials delivered on time with the desired specification 2. Staff trained remain in institution performing duties

	Design Element	Indicator:	Means of verification	Assumptions:
Activity	1.1 Confirming/Setting-up project team (CP, CP team in MS, PMO/TO)			
	1.2 Conducting project review meetings			
	1.3 Updating project work plan			
	1.4 Preparing and submitting PPARs (every six months)			
	1.5 IAEA Field Monitoring			
	2.1 Develop and enforce a National Action Plan Against Exotic Fruit Flies			
	2.2 Establish capacity and carry out simulation exercises to detect and suppress hypothetical incursions of exotic fruit flies			
	3.1 Establish organization structure and staff to build, equip and operate the mass rearing facility and to work as a coordinated mass-rearing team.			
	3.2 Develop the capacity to construct, equip and operate the mass rearing unit, including quality control activities			
	3.3 Construct a mass rearing unit with capacity for 200 million sterile males per week			
	3.4 Procure Minor equipment and supplies for mass rearing facility			
	3.5 Acquire, transport and install the irradiator (Gamacell-220)			
	4.1 Establish organizational			
	4.2 Carry out capacity building for surveillance and control of medfly populations			
	4.3 Carry out capacity building for pupae handling and aerial releases including quality control			
	4.4 Procure equipment and supplies for surveillance and control of medfly population, including aerial releases of sterile flies			

Work plan (GANTT chart)

		2016				2017				2018			
	Budget	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1.1 Confirming/Setting-up project team (CP, CP team in MS, PMO/TO)													
1.2 Conducting project review meetings													
1.3 Updating project work plan													
1.4 Preparing and submitting PPARs (every six months)													
1.5 IAEA Field Monitoring													
2.1 Develop and enforce a National Action Plan Against Exotic Fruit Flies													
2.1.1 IEM to train local staff in exotic fruit fly taxonomy and identification	5 000			■	■								
2.1.2 SV To visit countries carrying out emergency response actions	6 000	■	■										
2.1.3 Staff working in the system	24 000	■	■	■	■								
2.1.5 IEM to help developing the National Action Plan	5 000			■	■								
2.1.4 SV to visit countries carrying out emergency response actions	6 000					■	■						
2.16 Staff working in the system	24 000					■	■	■	■				
2.17 Staff working in the system	24 000									■	■	■	■
2.2 Establish capacity and carry out simulation exercises to detect and suppress hypothetical incursions of exotic fruit flies													
2.2.1 EM for national training course to carry out exercise to detect and suppress incursions of exotic fruit flies	5 000			■	■								
2.2.2 Traps and attractants to carry out the simulation exercise	20 000			■	■								
3.1 Establish organization structure and staff to build, quip and operate the mass rearing facility and to work as a coordinated mass-rearing team.													
3.1.1 Staff to build and operate the mass rearing unit	180 000	■	■	■	■								
3.1.2 Staff to build and operate the mass rearing unit	180 000					■	■	■	■				
3.1.3 Staff to build and operate the mass rearing unit	180 000									■	■	■	■

		2016				2017				2018			
	Budget	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
3.2 Develop the capacity to construct, equip and operate the mass rearing unit, including quality control activities													
3.2.1 Two visit of expert to evaluate progress and advise in construction of mass rearing unit	10 000	■	■										
3.2.2 Leaders of mass rearing unit in Morocco visiting large scale mass rearing facilities	5 400	■	■	■	■								
3.2.4 Expert in situ to train in how to construct, equip and operate a mass rearing unit	150 000	■	■	■	■								
3.2.3 Leaders of mass rearing unit in Morocco visiting large scale mass rearing plants	6 000					■	■	■	■				
3.2.5 Expert in situ to train in how to construct, equip and operate the mass rearing unit	150 000					■	■	■	■				
3.2.6 Two professionals to be trained in a large scale mass rearing plant	10 800					■	■						
3.2.7 Two professionals to be trained in a large scale mass rearing plant	10 800									■	■		
3.3 Construct a mass rearing unit with capacity for 200 million sterile males per week													
3.3.1 Construction of the mass rearing unit with capacity for 200 million sterile males per week	2 800 000	■	■	■	■								
3.4 Procure Minor equipment and supplies for mass rearing facility													
3.4.1 Procurement of the equipment for the mass rearing unit	200 000	■	■	■	■								
3.4.2 Procurement of minor equipment to support that acquired by Morocco	56 000		■	■	■								
3.5 Acquire, transport and install the irradiator (Gamacell-220)													
3.5.1 Installation of Gamacell -200 irradiator in the mass rearing unit	300 000		■	■	■								
4.1 Establish organizational structure and staff for field activities to work as a coordinated team													
4.1.1 Staff to carry out field activities	60 000	■	■	■	■								
4.1.2 Staff to carry out field activities	120 000					■	■	■	■				
4.1.3 Staff to carry out field activities	120 000									■	■	■	■
4.2 Carry out capacity building for surveillance and control of medfly populations													
4.2.1 IEM to organize a training course in Souss for the Staff of the medfly suppression programme in surveillance and control of medfly	5 000					■	■						
4.2.2 SV of key stakeholders to large scale area-wide SIT projects	6 000					■	■						
4.2.3 Two FE to be trained in large scale area-wide SIT project	10 800					■	■	■	■				
4.2.4 Two FE to be trained in large sale area-wide SIT projects	10 800									■	■	■	■

		2016				2017				2018			
	Budget	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
4.3 Carry out capacity building for pupae handling and aerial releases including quality control													
4.3.1 IEX to organize a training course for the staff working in Souss valley in aerial sterile male releases	5 000							■	■				
4.3.2 Two FE to be trained in large sale SIT programmes carrying out aerial male sterile releases	10 800					■	■	■	■				
4.3.3 Two FE to be trained in large scale SIT projects carrying out sterile male aerial releases	10 800									■	■	■	■
4.4 Procure equipment and supplies for surveillance and control of medfly population, including aerial releases of sterile flies													
4.4.1 Supplies and minor equipment for field operations	57 400					■	■	■	■				
4.4.3 Procurement of equipment and supplies for field operations	200 000					■	■	■	■				
4.4.2 Supplies and minor equipment for field operations	50 000									■	■	■	■
4.4.4 Procurement of equipment and supplies for field operations	200 000									■	■	■	■

Source: IAEA

CP= xxxxx, MS= xxxxx, ONSSA= xxxxx, ORMVA-MS= xxxxx, PMO/TO= xxxxx, SIT= sterile insect technique

APPENDIX 3: TYPICAL TECHNICAL AND BUDGET WORK PLAN FOR ESTABLISHING AND MAINTAINING A PFA

Strategic planning SIT-ERADICATION (PFA)

AREA	BLOCKS	TIME (YEARS)									
		1	2	3	4	5	6	7	8	9	10
	BL-I										
	BL-II										
	BL-III										

PREPARATION	SUPPRESSION	ERADICATION	MAINTENANCE-PFA
• PR • Surveillance • Training • Capital Cost (Infraestructure,equipment)	• PR • Surveillance • Bait spray (ground, aerial) • Bait Stations • Fruit Stripping	• PR • Surveillance • Baitspray (ground, aerial) • Bait Stations • Sterile Flies • Fruit Stripping	• Surveillance • Quarentine • Emergency Plan

SIT= sterile insect technique, PR = public relations.

Eradication activities, programme phases and costs (USD MN)

COST ITEMS	TOTAL BLOCK I (15%)										
	P	S	ERAD			MAINT					T
	1	2	3	4	5	6	7	8	9	10	
Fruit Sampling											
Trapping											
Ground Bait Spray											
Aerial Bait Spray											
Bait Station											
SIT Release											
Quarantine											
Post-Harvest											
Emergency Action Plan											

COST ITEMS	TOTAL BLOCK II (35%)										
	P	S	ERAD			MAINT					T
	1	2	3	4	5	6	7	8	9	10	
Fruit Sampling											
Trapping											
Ground Bait Spray											
Aerial Bait Spray											
Bait Station											
SIT Release											
Quarantine											
Post-Harvest											
Emergency Action Plan											

COST ITEMS	TOTAL BLOCK III (50%)										
	P	S	ERAD			MAINT					T
	1	2	3	4	5	6	7	8	9	10	
Fruit Sampling											
Trapping											
Ground Bait Spray											
Aerial Bait Spray											
Bait Station											
SIT Release											
Quarantine											
Post-Harvest											
Emergency Action Plan											

Capital Cost Sterile Fly Factory, Quarantine Stations, Release Centers	USD 50 MN
Public Relations	8% Operational Cost
Training	2% Operational Cost
R and D	5% Operational Cost
Administration	10% Operational Cost

P= PRE *S= SUP* *ERAD = ERADICATION* *MAINT= MAINTENANCE* *T= TOTAL*

MN = million, PRE = pre-suppresion or -eradication, SUP = suppression.

Total costs in targeted area eradication & PFA

COST ITEMS	TOTAL AREA			
	TOTAL BLOCK I (15%)	TOTAL BLOCK II (35%)	TOTAL BLOCK III (50%)	USDMN
Fruit Sampling				
Trapping				
Ground Bait Spray				
Aerial Bait Spray				
Bait Station				
SIT Release				
Quarantine				
Post-Harvest				
Emergency Action Plan				
Capital Cost				
Subtotal				
Public Relations	8% Operational Cost			
Training	2% Operational Cost			
R and D	5% Operational Cost			
Administration	10% Operational Cost			
Subtotal				
GRAND TOTAL				

MN= million.

Summary costs per year and total cost of intervention SIT-ERADICATION/PFA

YEAR	1	2	3	4	5	6	7	8	9	10	Total
Cost/Year											
Cumulative											

SIT= sterile insect technique.

IPPC

IPPC The International Plant Protection Convention (IPPC) is an international plant health agreement that aims to protect cultivated and wild plants by preventing the introduction and spread of pests. International travel and trade are greater than ever before. As people and commodities move around the world, organisms that present risks to plants travel with them.

Organization

- There are over 183 IPPC contracting parties.
- Each contracting party has a national plant protection organization (NPPO) and an Official IPPC contact point.
- 10 regional plant protection organizations (RPPOs) have been established to coordinate NPPOs in various regions of the world.
- IPPC liaises with relevant international organizations to help build regional and national capacities.
- The Secretariat is provided by the Food and Agriculture Organization of the United Nations (FAO)

Did you read this?

We would appreciate your feedback through a fast and easy survey here:
https://www.surveymonkey.com/r/theippcguideonpfas.
Your responses will help the IPPC Secretariat and the IPPC Commission on Phytosanitary Measures (CPM) Implementation and Capacity Development Committee (IC) strengthen this and other training resources.

International Plant Protection Convention

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ISBN 978-92-5-131764-8
9 789251 317648
CA5844EN/1/10.19