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CAMEROON BIOSECURITY PROJECT

Development and Institution of a National Monitoring and Control System (Framework) for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS)

TRAINING MANUAL

ON PEST RISK ANALYSIS (INCLUDING LMO RISK ANALYSIS) - DEFINITIONS, USAGE & MANAGEMENT APPROACHES FOR CAMEROON

This Training Manual has been produced with the support of UNEP/ GEF and the Government of Cameroon via the Ministry of Environment, Protection of Nature and Sustainable Development

Under the Supervision of:

Project Component Three Taskforce (MINESUP)

&

The Biosecurity Project Coordination Unit (MINEPDED)

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ACRONYMS AND ABBREVIATIONS

CABI	Centre for Agriculture and Bioscience International
CBD	Convention on Biological Diversity
CBP	Cameroon Biosecurity Project
CPM	Commission on Phystosanitary Measures
GEF	Global Environment Facility
GMOs	Genetically Modified Organisms
IAS	Invasive Alien Species
IMPM	Institut de Recherches Médicales et d'Etudes des Plantes Médicinales
IPPC	International Plant Protection Convention
IRAD	Institute of Agricultural Research for Development
ISPM	International Standards for Phytosanitary Measures
LANAVET	Laboratoire National Vétérinaire (National Veterinary Laboratory)
LMOs	Living Modified Organisms
MINADER	Ministry of Agriculture and Rural Development
MINCOMMERCE	Ministry of Commerce
MINEPDED	Ministry of Environment, Protection of Nature and Sustainable Development
MINEPIA	Ministry of Livestock, Fisheries and Animal Industries
MINFOF	Ministry of Forests and Wildlife
MINRESI	Ministry of Scientific Research and Innovation
MINSANTE	Ministry of Public Health
MINESUP	Ministry of Higher Education
MINT	Ministry of Transport
NBSAP	National Biodiversity Strategy and Action Plan
PRA	Pest Risk Analysis
UNEP	United Nations Environment Programme
WTO	World Trade Organization

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EXECUTIVE SUMMARY

The Government of Cameroon, Ministry of Environment, Protection of Nature and Sustainable Development (MINEPDED), is the executing agency for the Cameroon Biosecurity Project (CBP) entitled: '*Development and institution of a National Monitoring and Control System for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS)*'. One of the activities under the CBP is to develop a training manual and conduct a training of trainers on Pest Risk Analysis.

The International Plant Protection Convention (IPPC) advocates pest risk analysis as 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 phytosanitary measures to be taken against it.

Through trade pathways, introduced pests and diseases (mainly quarantine plant pests and animal diseases) can have major implications for farmers and countries that either produce for export or plan to export. Cameroon has an obligation to protect its local agriculture by ensuring total exclusion of importation of products from areas affected by pests and disease or by making importation conditional to a series of precautionary measures.

MINEPDED through the CBP is building capacity for Pest Risk Analysis that is to enhance delivery of those responsible at the operational level in Cameroon by developing a training material in the form of a manual to guide training in Pest Risk Analysis for Cameroon

INTRODUCTION

Cameroon is party to the Convention on Biological Diversity (CBD) which is focused on the conservation of biodiversity, sustainable use of its components, and equitable sharing of benefits derived from genetic resources. The CBD is a general, flexible framework that commits countries that are party to it to develop national mechanisms for implementation of the principles inscribed in the Convention.

As an international structure the CBD supports national implementation of the principles with the aim to promote continued international co-operation whilst ensuring the biodiversity principles it advocates. The CBD notes that as part of international co-operation; trade is one of the activities with an immediate impact on biodiversity. Thus, as countries implement trade agreements and strive to satisfy the needs of their populaces, the CBD obliges parties to manage the effects on biodiversity of trade and consumption within their jurisdiction "regardless of where [those] effects occur" (Article 4(b)).

Cameroon has recognised the challenges in promoting systematic risk-based approaches for the prevention of biological invasions. Importation points are particularly vulnerable to entry of pests, diseases, invasive alien species and living modified organisms (collectively referred to as biological organisms) that can compromise the integrity of the Cameroon biodiversity and economy. To address this the Ministry of Environment, Protection of Nature and Sustainable Development (MINEPDED) is building capacity of those responsible at the operational level to assess the potential risks of biological organisms and institute appropriate management measures in the form of a Training Manual for Cameroon in this area.

This Training Manual provides an overview of the key elements of Pest Risk Analysis (PRA) from initiation, assessment, management and communication as a basis for trainers to deliver modules to those responsible at the operational level to implement.

RATIONALE FOR THE MANUAL

Based on global good practice and existing national initiatives, the CBP has produced a report outlining the current biosecurity profile through trade and other activities, identifying the main pathways for species introduction in the country (MINEPED, 2012). The report (MINEPED, 2012) highlights the main risk pathways for which specific risks are to be quantified using risk analysis methods to enable implementation of appropriate and effective risk management options. Furthermore, the CBP has produced a report on the formulation of risk management

strategies for biological invasion risk pathways in Cameroon (MINEPDED, 2015). This Training Manual draws out the information in these reports and complements it with international best practises largely from the IPPC online training course for PRA and the FAO guidelines for PRA to help build awareness and capacity levels among key agencies and stakeholders in Cameroon.

OBJECTIVES OF THE TRAINING MANUAL

Overall Objective:

The overall objective of the CBP project Component 2 is to strengthen national capacities in order to prevent and control the introduction, establishment and spread of Invasive alien species (IAS) and the management of living modified organisms (LMOs) through the implementation of a risk-based decision making process.

The Training Manual thus serves to specifically provide requisite tools and capacity building guidance to assist those responsible at the operational level to assess, management and communicate pest risks in Cameroon.

EXPECTED LEARNING OUTCOMES:

The Training Manual should serve to deliver the following learning outcomes:

a) Risk identification and analysis is adequately undertaken in Cameroon
b) Risk assessment conducted by Cameroon officials/ experts meets national and international requirements
c) PRA outputs are appropriately communicated to relevant stakeholders in Cameroon.

COURSE STRUCTURE

The written training modules and the accompanying PowerPoint presentations provide a basis for training. The modules are designed to be interactive as possible with exercises (this enhances sharing of expertise, building teams and ensuring a productive learning environment). An indicative course programme is provided in Annex 12.1 to be adapted as seen appropriate. It is recommended where possible to provide on-site learning at an inspection point to enable hands-on learning.

The suggested delivery time should be determined in accordance with the participants' level of understanding, the training needs and available resources. The delivery can be two to

three days with a minimum of two if the group size is small and a limited number of exercises (maximum 2 per module) are delivered. It is recommended that more exercises would need to be developed as those provided are only examples.

The course is structured in ten core modules, namely:

- Module 1: Introduction to PRA, LMO and IAS and National and International Requirements
- Module 2: Overview of the PRA
- Module 3: Initiation
- Module 4: Pest Categorisation
- Module 5: Risk and Probability of Entry
- Module 6: Risk and Probability of Establishment and spread
- Module 7: Overall Assessment of Risk and uncertainty
- Module 8: Introduction to Impacts and Assessment of Potential Economic Consequences
- Module 9: Pest Risk Management
- Module 10: Pest Risk Communication

MODE OF DELIVERY

The mode of delivery will depend largely on the background and experience of the trainers, and the participants (level of expertise, experience with different learning approaches, etc.).The course delivery modes will include lectures (Powerpoint Presentations) group and plenary discussions, group exercises and take home readings. It is recommended however that the delivery includes/ considers

- Knowledge sharing: Everybody as something to share and nobody knows everything.
- Context: In as much as possible examples from Cameroon and the region should be used. Notably application to the international arena is also of value.
- Participation in the course helps to capacitate decision makers but should not be considered absolute, there will be more elements to decision making to be considered in the event of an audit
- Time management: The delivery should allow for interaction but not all matters can be addressed within one course and thus it should be noted that other avenues for soliciting feedback are to be considered.

RESOURCE REQUIREMENTS

The minimum requirements for the delivery of the course include trainers (at least two) and a venue (and other logistics) with the following amenities/ facilities:

- A laptop computer and LCD Projector with pointer
- One or more flip charts and pens (if no chart holders then non-destructive adhesive to enable sticking to the wall is an alternative)
- Sticky notes
- Printing and photocopy facilities
- Relevant Literature

PRE-TRAINING EVALUATION

Purpose: To gather relevant information on the trainees to the training and to assess the level of awareness and knowledge of trainees prior to the training.

Format: Trainees fill registration form and the pre-course survey.

Expected outcomes: Profile of the participant's established and, baseline of level of awareness and knowledge established.

A pre-training evaluation is done to establish the level of understanding of the participants to enable the trainers gauge the depth of content that needs to be delivered. The participants fill out a pre-training evaluation form or are administered a questionnaire,which serves to provide the trainers with their profiles, level of awareness and knowledge.

Given optimal conditions the pre-evaluation can be delivered prior to the training over mail (e.g. a week before) if possible so that the trainers have ample time to re-adjust their presentations.

If the pre-evaluation test is delivered at the start of the course, the Trainers should have examples and flexibility in rearranging the presentations. A strategy to bring the participants to the same level is to provide them with reading material before the sessions.

A sample of a Pre-training evaluation test is given in Annex 10.2.

POST TRAINING ASSESSMENT

This course can be offered as both a training of trainers (ToT) and a direct training for those responsible at the operational level to conduct a PRA. If it is required that the course is conducted as a ToT then a post training assessment to gauge the capacity for delivery of the material post training may be of relevance and a typical assessment is provided in Annex 10.4.

By preference the trainers should develop an assessment mechanism either through the exercise participation or a written evaluation to determine the level of understanding gained by the participants.

THE LAYOUT OF THE TRAINING MANUAL

The Modules of the Manual are structured to enable potential trainers plan and customize the delivery according to their needs. For each module the purpose, suggested delivery time, expected outcomes, exercises (some adapted for Cameroon and others borrowed from international best practise) and where available literature for further reading is indicated.

OBJECTIVES AND CONTEXT OF THE MANUAL

The broad objective of the manual is to deliver a course that would serve relevant officials and stakeholders in Cameroon to build training of trainer capabilities for the three pillars of PRA.

Specifically, the manual is intended to achieve the following:

a. Establish a basic understanding of LMOs and invasive alien species (IASs) in the national and international context with reference to risk analysis and requirements of relevant institutions and standards.
b. Build conceptual frameworks of information requirements for risk analysis.
c. Elaborate risk analysis methodologies and their application relevant to Cameroon.
d. Present experiences and enhance skills for similar training to be provided to peers.

KEY DEFINITIONS

For purposes of a common understanding the terms and concepts used in PRA definitions are adopted primarily from the CPB glossary of terms and from international organisations such as the International Plant Protection Convention (IPPC), Sanitary and Phytosanitary Standards (SPS) and Centre for Agricultural and Biosciences International (CABI). In delivery of the trainings, the trainers are encouraged to ensure that the participants understand the key terms of PRA and provide illustrations where necessary.

Alien species is a species which threaten ecosystems, habitats or other species". Alien refers to a species occurring outside its normal distribution.

Analysis is the process of breaking a complex topic or substance into smaller parts in order to gain a better understanding of it.

Assessment is the determination of quantitative or qualitative value of risk related to a concrete situation and a recognized threat.

Assessment endpoint. This is the qualitative or quantitative expression of a specific factor with which a risk may be associated as determined through an appropriate risk assessment.

Biological diversity is the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which this includes diversity within species, between ecosystems.

Biological organisms we refer to insects, weeds and plants, animals and nematodes, and living modified or genetically modified organisms or products thereof.

Biological resources are genetic resources, organisms or parts thereof, populations and other biotic components of ecosystems with actual or potential use or value for humanity.

Biotechnology is any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific uses (CBD).

Biosafety is the avoidance of risk to human health and safety and to the conservation of the environment, as a result of the use for research and commerce of infectious or genetically modified organisms". It engages the policy, regulation, and management to control risks associated with use of modern biotechnologies.

Biosafety protocol (Cartagena Protocol on Biosafety (CPB)) is an internationally agreed protocol set up to protect biological diversity from the potential risks posed by the release of genetically modified organisms. It establishes a procedure for ensuring that countries are provided with the information necessary to make informed decisions before agreeing to the import of such organisms into their country (FAO glossary)

Biosecurity is a strategic and integrated approach that encompasses policies and regulatory frameworks that analyse and manage risks in the sector of food safety, animal life and health, and plant life and health, including associated environmental risk. It is a holistic concept of direct relevance to the sustainability of agriculture and food production, food safety and the protection of the environment, including biodiversity and covers the introduction of plant pests, animal pests and diseases and zoonoses, the introduction and release of genetically modified organisms and their products, and the introduction and management of invasive alien species and genotypes". (FAO Expert Consultation)

Convention on Biological Diversity (CBD) is the international treaty governing the conservation and use of biological resources around the world that has also called for the establishment of rules to govern the international movement of nonindigenous living organisms and genetically modified organisms.

Ecosystem a dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit.

Export is the intentional trans-boundary movement of LMO(s) and or IAS out of the territory of Cameroon, for a purpose to be specified.

Genetic material is any material of plant, animal, microbial or other origin containing functional units of heredity.

Genetic resources are genetic material of actual or potential use.

Genetically modified organism is any organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology.

Living modified organism is any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology.

Modern biotechnology the application of

a) In vitro nucleic acid techniques, including recombinant deoxyribonucleic acid (DNA) and direct injection of nucleic acid into cells or organelles" or

b) "Fusion of cells beyond the taxonomic family that overcome natural physiological reproductive or recombination barriers and that are not techniques used in traditional breeding and selection" (CPB).

Habitat is place or type of site where an organism or population naturally occurs".

Import is mean the intentional trans-boundary movement of LMO(s) and or IAS into the territory of Cameroon, for a purpose to be specified.

Indicators are key metrics that allow estimating risk probability, risk impact, and risk control actions. (a) They provide researchers, risk assessors, and risk managers a common set of tools for approaching risk issues, (b) Provide insights into emerging environmental impacts, and (c) Help judge the effectiveness of past, present and future environmental policy decisions.

International Plant Protection Convention is an international convention which promulgates, regulates and manages rules regarding the protection of crop plants.

Invasive Alien Species (IAS) are alien species whose introduction and/or spread threatens biological diversity (Ref).

Organism is any biological entity, including micro-organisms, cellular or non-cellular, capable of replication or of transferring genetic material, including viruses, viroids, and animal and plant cells in culture.

Pathways are the means by which IAS and LMOs are transported from one location to another either naturally or manmade.

A parasitoid is an organism that spends a significant portion of its life history attached to or within a single host organism in a relationship that is essentially parasitic. Unlike a true parasite, however, it ultimately sterilizes or kills, and sometimes consumes, the host. Parasitoids are more useful in biological control of pests.

A pest is "a plant or animal detrimental to humans or human concerns (as agriculture or livestock production);" alternative meanings include organisms that cause nuisance and epidemic disease associated with high mortality (specifically: plague). In its broadest sense, a pest is a competitor of humanity. The term "plant pest" has a very specific definition: it is

any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products. Plants may be considered pests if they are invasive.

Groups of Pests

a) **Insects and mites**: Arthropods or small animals likely to cause damage to plants and animals of economic importance.
b) **Nematodes**: Eel worms which directly or indirectly damage economic plants and animals. These may indirectly provide avenues of entry to pathogenic microorganisms that may even lead to greater damage than the nematodes themselves.
c) **Weeds**: Any plant growing out of place. An economically important plant such as maize, is considered a weed if it is found growing, unplanted, in a cassava farm, and vice-versa.
d) **Fungi**: A fungus is a microorganism, belonging to any of the many botanic groups (e.g. pythiaceae) which causes disease in plants, humans and animals.
e) **Bacteria**: A very ubiquitous microorganism belonging to a wide range of families, causing disease in plants, humans and animals.
f) **Viruses**: A microorganism too small to see with a light microscope which infects plants, animals and humans. Viruses are particles with no life of their own. They take advantage of the nuclear apparatus of their host to replicate and multiply. Viruses can be identified only with the use of an electronic microscope.

Pest risk analysis is a form of risk analysis conducted by regulatory plant health authorities in a country to identify the appropriate phytosanitary measures required to protect plant resources against new or emerging pests and regulated pests of plants or plant products. Pest risk analysis is defined by International Plant Protection Convention (IPPC) to be “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.

Predators are organisms involved in a biological interaction where a predator (an organism that is hunting) feeds on its prey (the organism that is attacked). Usually, the predator kills and feeds on the prey.

Quarantine is the process of confining an exotic organism or its products within protected structures or environments until all experimentation has been carried out to determine that the organism or its products will not pose any threat to the environment.

Responsible person at operational level this is an individual assigned responsibilities to conduct an audit as delegated by an authority.

Risk is the combination of the magnitude of the consequences of a hazard, if it occurs, and the likelihood that the consequences will occur" (where hazard = potential of an organism so cause harm to human health or the environment). Potential and level of exposure are essential for existence of risk.

Risk assessor a certified individual who conducts on-site investigations to determine the existence, nature, severity, and location of hazards in an environment and the provision of a written report explaining the results of the investigation and options for reducing the hazards.

Spillage is any unintentional release of IAS and or LMOs during transport through or into the territory.

Transit is the intentional trans-boundary movement of LMO(s) and other commodities through the territory of Cameroon, avoiding any intentional release, use, disposal or handling of LMO(s) and IAS within Cameroon.

MODULE 1: INTRODUCTION TO PRA, LMO AND IAS AND NATIONAL AND INTERNATIONAL

1.1. REQUIREMENTS

Purpose: To enhance the understanding of the three basic principles of Pest Risk Analysis (PRA) that is assessment, management and communication; and, set a common understanding of the National status and international requirements.

Suggested delivery time: 90mins

Format: PowerPoint presentation followed by a plenary discussion

Expected Outcomes: By the end of the session, trainees will be able to:

- Appreciate the role of PRA in ensuring Cameroon and how national legislation feeds into international obligations
- Broadly appreciate the three pillars of PRA
- Have a detailed understanding the pest status including LMOs and IAS and challenges requiring management in Cameroon

1.2. PRINCIPLES OF PRA

1.2.1. Pest Risk Analysis

Pest Risk Analysis is the process of evaluating biological and or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it (Glossary of phytosanitary terms, ISPM No. 5). It is a science-based process that provides rationale for implementing phytosanitary measures for a specified area.

Pests should be defined in the context of **direct** (causing disease and destruction), **indirect** (through competition, or by harming those species which are beneficial to plants, such as earthworms or pollinators), **quarantine** (of potential economic importance to a specific area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled) and or **non-quarantine** (presence in plants or planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of an importing contracting party).

PRA is generally a desktop exercise conducted to evaluate and manage risk from specific pests and internationally traded commodities. It identifies and assesses risks to agricultural and horticultural crops, forestry and the environment from plant pests. The outputs of a PRA would include list of regulated pests, lists of prohibited plants and plant products and guidance to and or identification of appropriate management options.

PRAs are initiated based on three main premises, the **pest** (what is the pest, its known ability to establish and spread and level of destruction), the **pathway** (the means of transport/ transmission) and or the **policy** (what guidelines for phytosanitary procedures are practised and whether or not these need updating and or review).

The three principles of PRA are then to be elaborated as they set the basis for the detailed process and apply to each of the three premises of PRA (pest, pathway and policy):

- **Pest Risk Assessment**: A three step process that serves to categorize individual pests; assess the probability of introduction and spread and the potential economic consequences of the introduction and spread.
- **Pest Risk Management**: The evaluation and selection of options to reduce the risk of introduction and spread of a pest [ISPM No. 11].To achieve an appropriate level of protection, governments must balance measures to counter assessed risk, against obligations to minimise negative trade effects. The pest risk management interventions aim to ensure the decisions will be well-informed, transparent and neutral.
- **Pest Risk Communication:** Communication in PRA is intended to reconcile the views of scientists, stakeholders, politicians, etc. in order to achieve a common understanding of the pest risks and develop credible pest risk management options. Communication is not a discrete stage of PRA but continuous throughout the process.

1.3. LEGAL CONTEXT

Cameroon is party to several international agreements and hosts significant wealth with regards to biodiversity. The table 1 gives an indication of international agreements relevant to trans-boundary movement of commodities and the national obligations that member countries such as Cameroon are expected to do. An additional remarks column is provided to elaborate and or illustrate what Cameroon has done with regards the agreement from ratification to implementation measures.

Specific agreements i.e. Sanitary and Phytosanitary Standards (SPS) Agreement and the IPPC provide the international framework for safe and fair trade - on the one hand liberalizing trade to promote economic welfare for all countries, but at the same time creating a structure around how countries should implement measures to protect their territories from the introduction of pests and diseases. While the SPS Agreement is a trade agreement that makes provisions for protecting health (in our case, plant health), the IPPC is a plant protection agreement that makes provisions for safe trade. Both agreements contain several

key provisions that give countries rights and obligations. The agreements require that measures must be technically justified (through risk assessment) or harmonized (based on international standards). The principles of transparency, equivalence, non-discrimination (and national treatment), regionalization, appropriate level of protection (and consistency), and least trade-restrictive measures further underscore the need for risk analysis within the framework of the SPS Agreement and the IPPC.

The Commission on Phytosanitary Measures (CPM) is the governing body for the IPPC and works by consensus to review global plant protection needs. The CPM sets the annual work programme and develops and adopts International Standards for Phytosanitary Measures (ISPMs) which are promoted by provision of technical assistance and information exchange. The ISPMs are clustered into guidance documents that relate to specific issues (e.g. surveillance, pest reporting, inspection), country guidance (e.g. treatments for regulated pests) and or general guidance (e.g. terms, pest lists).

Examples of PRA specific ISPMs include:

- ISPM No. 2 - Framework for pest risk analysis, revision for approval by CPM in March 2007
- ISPM No. 3 - Guidelines for the export, shipment, import and release of biological control agents and other beneficial organisms, 2005
- ISPM No. 11 - Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms, 2004
- ISPM No. 21 - Pest risk analysis for regulated non-quarantine pests

The Convention on Biological Diversity (CBD) and the Cartagena Protocol on Biosafety (CPB) - intersect with the IPPC and the SPS Agreement. Specifically, invasive alien species (under the CBD) and LMOs (under the CPB) may fall under the scope of the IPPC when those organisms act as plant pests. In cases where either an invasive alien species or an LMO meets the definition for a pest under the IPPC, then IPPC processes apply, including the application of International Standards for Pest Management (ISPM). In particular, the IPPC is recognized by all of the agreements as the authoritative source for guidance on conducting risk analysis for plant pests. Thus, pest risk analysis methods described in ISPMs No. 2 and 11 (and in this text) can also be used to analyse risks associated with invasive alien species and LMOs. The conduct of risk analysis for these organisms supports the aims of the IPPC (protecting plant health), the CBD (protection of biological diversity) and the CPB (concerned with the safe trans-boundary movement of LMOs).

1.4. BIOSECURITY:

Biosecurity has been defined within the context of the Cameroon Biosecurity Project as a strategic and integrated approach that encompasses the policy and regulatory frameworks (including instruments and activities) that analyse and manage risks in the sectors of food safety, animal and plant life, human health, and the associated environment. Biosecurity covers the introduction of plant pests, animal pests and diseases, zoonoses, the introduction and release of genetically modified organisms (GMOs) and their products, and the introduction and management of invasive alien species and genotypes. *Biosecurity is the protection of biodiversity from all biological threats from all pathways into and within the country*.

Biosecurity encompasses the prevention, early detection and rapid response, eradication, control, mitigation and other management activities such as risk analysis for all types of invasive species (pests, diseases, weeds, invasive animals and other organisms), as well as the management and control of living modified organisms (LMOs), of which biosafety risk analysis is the subject of a separate risk analysis manual.

The term Biosecurity should not be confused with **Biosafety** which is defined as all measures taken to prevent Modified Living Organisms (LMOs) from causing harm to humans, livestock and the environment.

(*Note to the Trainer:* At this point participants should be asked to note that there is a difference between the terms biosecurity and biosafety in English and the fact that both terms are translated into French as “Biosécurité”)

1.5. INVASIVE ALIEN SPECIES

Invasive Alien Species (IAS) as are organisms that occur outside their normal distribution and whose introduction and/or spread threatens biological diversity (GIASI, CBG)

When alien species were introduced, some 10-15% of them were reportedly harmful to the target ecosystems and habitats or species living therein as the alien species grow and spread and sometimes preying on native species of the target area. IAS have been known to be a major direct cause of biodiversity loss, which pose serious hazards to ecosystem services, human health and sustainable development.

IAS also impact on country economies and development. The costs required to manage IAS, to eradicate, reduce their rate of spread is substantial. Invasive alien species that pose high

risk on agriculture or the environment can be rejected by importing countries. To access international markets biological /agricultural products need to meet certain quality standards. This requires inspection which adds to the management cost.

1.6. THE GLOBAL BIODIVERSITY STRATEGY AND ACTION PLAN

Strategic documents such as the Global Biodiversity Strategy and Action Plan and its national implementing modality (National Biodiversity Strategy and Action plan (NBSAP) are key elements of a functional Biosecurity risk analysis framework.

The NBSAP II of 2012 for Cameroon informs decision making by the establishing the national biodiversity protection goals and assessment end points. The goals and assessment end-point are further cascaded into sector policy documents for environment, natural resources, health, and agriculture and livestock development.

The NBSAP II of 2012 elaborates the following biodiversity goals for Cameroon:

i. The country's biodiversity resources constitute the nation's natural heritage with intrinsic values and consequently should be used sustainably to the benefit of its people and improve their livelihoods;
ii. The traditional knowledge and practices of indigenous and local communities should be respected, preserved, maintained, and used with the prior informed consent of the holders of such knowledge and practice.

And the ensuing assessment endpoints are that:

a) by 2020, all sources of coastal and marine pollutants should be effectively controlled to reduce pollution and mitigate its impact on the ecosystem;
b) by 2020 the use of alternative energy should have increased and significantly reduced pressure on fuel wood;
c) by 2020, at least 50% of grazer populations have developed the capacity to reduce overgrazing;
d) by 2020 at least 25% of sites degraded by droughts or floods are rehabilitated within the semi-arid ecosystem;
e) by 2020 wetlands of great significance should be under management plans and at least 10% of degraded fresh water catchment areas and riparian zones restored and protected.

1.7. NATIONAL MECHANISM FOR REGULATION OF BIOLOGICAL ORGANISMS

Cameroon does not have a Law specific for regulation of biological organisms. Such a law would ensure production, use, sale, and distribution of biological organisms which are likely to pose a threat to the environment are regulated within a biosecurity framework.

Table 1 International Obligations and National Implementations for PRA in Cameroon

S. No	Convention Treaty	National obligations	Remarks
1	The Convention on Biological Diversity, 1992 **Main objective** (i) conservation of biological diversity (or biodiversity); (ii) sustainable use of its components; (iii) fair and equitable sharing of benefits arising from genetic resources	**Article 6**: Each member state is required to have a National Biodiversity Strategic Action Plan (NBSAP) and to prepare national biodiversity strategy or equivalent instrument and mainstream the same in to state planning.	Signed :14-06-1992 Ratification:19-01-1994 Party : 17-01-1995 NBSAP II prepared in 2012 and makes reference to both LMOs and IAS management Cameroon is drafting a Biosecurity Law at present. All matters on biosafety are however addressed by the Biosafety regulations which are found in the Biotechnology Law
2	The Cartagena Protocol on Biosafety, 2000 **Main objective** To ensure safe handling, transport and use of living modified organisms (LMOs) Source of LMOs are: modern biotechnology that may have adverse effects on biological diversity, therefore require presence of adequate level of protection Products from LMOs be dealt with on precautionary principle	**Article 8.** Parties to establish mechanisms to regulate manage and control any risks arising from LMO and biotechnology which may have effect on environment and biodiversity and human health **Article 19:** Parties to put in to consideration of modality setting out procedure in advance informed agreement in safe transfer, handling safe use of LMO resulting from biotechnology that may cause adverse effect on conservation and sustainable use of biological biodiversity. **Article 15:** Risk assessments undertaken pursuant to the Protocol shall be carried out in a scientifically sound manner, in accordance with Annex III and taking into account recognized risk assessment techniques.	Date of Signature: 9th Feb,2001 Date of ratification: 20th Feb,2003 Entry in to Force: 11th September, 2003 Confined field trials for insect protected and roundup ready resistance as a stack in cotton are on-going
3	The Basel Convention on the Control of Trans-boundary Movements of hazardous wastes within Africa, 1991 **Main Objective** Control of Transboundary Movements of Hazardous	**Article 4:** Provides for an overall reduction of waste creation. Parties are encouraged to keep wastes within their boundaries. Parties are prohibited from exporting covered wastes to, or import covered waste from, non-parties to the convention.	Date of Signature: 9th February, 2001

S. No	Convention Treaty	National obligations	Remarks
	Wastes and their disposal .It aims at reducing toxic materials movement from one country to another.	The convention criminalizes all illegal hazardous waste traffic. **Article 12:** Parties are directed to adopt a protocol that establishes liability rules and procedures that are appropriate for damage that comes from the movement of hazardous waste across borders.	
4	The Bamako Convention on the Ban of the Import into Africa and the Control of Trans-boundary Movements of Hazardous wastes within Africa, 1991 **Main Objective** Ban of import of hazardous waste into Africa (this includes ban of radioactive waste) which had been exempted in Basel Convention. It further prohibits transboundary waste within Africa It complements Basel Convention which was not effective to ban waste to Africa.	**Article 4:** All parties are required to take legal and administrative measures to ensure no hazardous waste is imported in to Africa or no transboundary waste within African countries. Any import is declared illegal and criminal act. Parties have the following duties • Forward information on any hazardous import activity • Cooperate to ensure no import of waste from non-contracting to contracting parties. **Article 5** Each party is required to designate a competent focal point responsible for (i) reporting any transit to the secretariat (ii) a body authority to act as a dump watch to coordinate between government and non-governmental bodies **Article 6:** Sets a Trans boundary Movement and Notification Procedures	Date of Ratification: 21st December 1995 Date of Entry into force: 22nd April 1998
5	The Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), 1973 **Main Objective** To protect endangered plants and animals	Articles III and IV Provide for restriction and Control and regulation of specimen of species Export and import of some specimen require permits	Date of Signature: 5th June 1981 Entry into force: 3rd September 1981 Most recent notification of trade notification is that of 15th March 2016 indicating functionality of the process. Cameroon has designated competent Ministries/ agencies for both Fauna and Flora.

S. No	Convention Treaty	National obligations	Remarks
6	The Convention on Migratory Species (CMS) (Bonn Convention), 1979 **Main objective** Protection of endangered migratory species of wild animals and their habitats. the protection is against threats such as hunting, shrinkage of breeding areas	**Article III Sub Article 4** • to conserve or restore the habitats of species that are in danger • to prevent , remove, compensate for the adverse effects of activities that endanger or impede migration • control introduction of exotic species **Article III sub article 5** Prohibit taking of animals	Date of Signature 1st November 1983
7	The Stockholm Convention on Persistent Organic Pollutants (POPs), 2001 **Main objective** The treaty aims to eliminate or restrict the production and use of persistent organic pollutants (POPs).	**Article 3:** Each party is required to take Measures to reduce or eliminate releases from intentional production and import of persistent organic pollutants. **Article 5:** Each party is required to take Measures to reduce or eliminate releases from unintentional production of POPs **Article 6:** Each party is required to take Measures to reduce or eliminate releases from stockpiles and wastes **Article 7:** Each party shall prepare Implementation plans by Developing and endeavour to implement a plan for the implementation of its obligations under the Convention; **Article 9:** Each Party shall facilitate or undertake the exchange of information relevant to reduction or elimination of the production, use and release of persistent organic pollutants; information on alternative POPs and their risks; **Article 10:** Each party has a duty for Information dissemination to its policy and decision makers regarding POPs **Article 11:** Parties at their national and international level shall encourage and undertake Research, development and monitoring of POPs	

S. No	Convention Treaty	National obligations	Remarks
		Article 12: Parties to provide technical assistance when so requested (developed economy vis a viz economies in transition)	
8	Oil Pollution Preparedness Response (OPCR), 1990 **Main Objective** Providing an international framework for international co-operation/co-ordination in fighting incidents and threats of marine pollution from Oil pollution	**Article 3:** Requires each country to ensure a ship flying its flag to have on board a shipboard oil pollution emergency plan Offshore units under country jurisdiction have oil pollution emergency plans, **Article 4:** The Article sets a requirement to the country with a ship flying its flag a duty to report without delay any event on their ship or offshore unit involving a discharge or probable discharge of oil: Any discharge of oil at sea is required to be reported.	Date of Ratification 2006
9	International Plant Protection Convention (IPPC) 1951 **Main Objective** To prevent introduction & spread of pests of plant and plant products across national boundaries. The convention further promotes fair and safe trade and protect plant life. It covers a wide range of plants & protects them from a wide range of pests	The IPPC guides its national or regional plant protection organizations to make information on regulated pests available to the contracting parties and present pest reporting, pest status and pest free area. **Article IV:** Each party is to create a National Organization for Plant Protection which will deal with inspection of growing plants, inspection of consignment of plants, disinfestation or disinfection of consignments of plants, issuance of certificate of phytosanitary condition, information and research and investigation. **Article V:** Each party to issue phytosanitary certificate; Parties should not to set and require phytosanitary measures/requirements inconsistent with those set out in the convention. **Article VI:** (1) Each party is conferred with full authority to regulate entry of plants and plant products by exercising powers to prescribe restrictions, prohibit importation, inspect	Cameroon has designated competent Ministries/ agencies responsible for Agriculture, Science, Technology and Innovation, Fauna and Flora that handle matters of the IPPC

S. No	Convention Treaty	National obligations	Remarks
		and detain, treat and restrict or refuse entry or list pests which are prohibited. (2) Each party further undertakes not to interfere with international trade in Exercise Of Its Powers In Article VI(1) above therefore undertakes to observe Article VI(2) during exercise of powers under Article VI(1). **Article VII and Article VIII:** Parties undertake to have international cooperation	
10	Sanitary and Phytosanitary (SPS) Agreement Under the World Trade Organisation, 1995 **Main Objective** To cover human, animal or plant from some health risks.	Sets Standards for Sanitary and Phytosanitary measures.	Cameroon member of WTO since 13 December 1995 and a member to GATT from 3 May 1963
11	The World Organization for Animal Health 1924 (Office International des Epizooties(OIE)) It is an independent Organization, not one of the UN systems. **Main Objective** To provide for control of epizootic diseases and control the spread thereof, it is aimed at coordination, support promotion and control of animal diseases.	The Organization has entered in to Agreements with several organizations including WTO on SPS, Agreement with WHO and Agreement with FAO. Agreement with WTO,1998 **Article 1:** Provides for mutual cooperation between WTO and OIE when implementing SPS for questions of mutual interests **Article 2:** Provides for OEI to be invited by WTO on all matters of SPS **Article 7:** exchange of information **Article 5:**Organic Statutes Of The Office International Des Epizooties provides for each member to notify the OEI in the following on requirement of notifications by government on some diseases : 1. *By telegram, notification1 of the first cases of rinderpest or foot and mouth disease observed in a country or an area hitherto free from the infection.* *2. At regular intervals, bulletins prepared according to a model*	Cameroon has designated competent Ministries/ agencies responsible for Agriculture, Science, Technology and Innovation, Livestock and Health that handle matters of the OIE

S. No	Convention Treaty	National obligations	Remarks
		adopted by the Committee, giving information on the presence and distribution of the following diseases: *Rinderpest, Rabies, Foot and mouth disease, Glanders* *Contagious pleuropneumonia, Dourine, Anthrax, Swine fever* *Sheep pox,* *The list of diseases to which either of the foregoing provisions applies may be revised by the Committee, subject to the approval of the Governments.* *The Governments shall inform the Office of the measures adopted by them to control epizootics, especially such measures enforced at their own frontiers to protect their territory against imports from infected countries. As far as possible they shall furnish information in reply to inquiries sent to them by the Office.* Immediate notifications and follow-up reports submitted by Country / Territory • Members notifying exceptional epidemiological events current in their territory six-monthly reports stating the health status of OIE-listed diseases in each Country / Territory. • Annual reports providing health information and information on the veterinary staff, laboratories and vaccines, etc. • The OIE WAHIS-Wild presents status of wild animal diseases that are not OIE-listed	
12	Convention on the International Maritime Organization (IMO), 1948 (N:B It has been amended several times to cover more objectives The Convention establishes International Maritime	IMO has the following related conventions for prevention of marine pollution. • *International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties*	Cameroon has designated competent Ministries/ agencies responsible for Environment, Fisheries, Maritime Sciences, Science, Technology and Innovation, Fauna and Flora that handle matters

S. No	Convention Treaty	National obligations	Remarks
	Organization (IMO) which establishes Marine Environment Protection Committee whose main objectives are: **<u>Main Objective</u>** To protect marine environment and ecosystem The following regulations have been developed to cover objectives of the treaty • *Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983)* • *Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983)* • *Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into force 1 July 1992)* • *Prevention of Pollution by Sewage from Ships (entered into force 27 September 2003)* • *Prevention of Pollution by Garbage from Ships (entered into force 31 December 1988)* • *Prevention of Air Pollution from Ships (entered into force 19 May 2005)*	*(INTERVENTION), 1969* • *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (LC), 1972 (and the 1996 London Protocol)* • *International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), 1990* • *Protocol on Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC-HNS Protocol)* • *International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS), 2001* • *International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004* • *The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009* The convention has further developed guidelines on several aspects to protect marine environment, the developed guidelines cover the following some of which are under the above mentioned conventions: • Pollution preparedness • Blast water management • Biofouling • Anti biofouling system Guidance for minimizing the transfer of invasive aquatic species as biofouling (hull fouling) for recreational craft (MEPC.1/Circ. 792) provides guidance to minimize biofouling for recreational craft less than 24 metres in length.	of the IMO.

S. No	Convention Treaty	National obligations	Remarks
		Guidance for evaluating the 2011 guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species (MEPC.1/Circ.811) identifies the types of performance measures that could help to assist in evaluating the different recommendations in the Guidelines.	

Note to Trainer: The trainer should take elaborate the relationships and the independence of the different instruments i.e. the IPPC, the CPB and how these are implemented using the national regulatory processes. The trainers should present an update of the national and international status for LMO risk analysis and PRA. The concept of biosecurity should be explained to emphasise circumstances where LMOs and IASs can be considered pests and subjected to PRA.

1.8. RECOMMENDED READING:

i. MINEPDED (2013). The Current Biosecurity Profile from Trade and other Activities of Cameroon. Report submitted to MINEPDED under the UNEP/GEF Cameroon Biosecurity Project: Development and Institution of a National Monitoring and Control System (Framework) for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS). Yaoundé, Cameroon.

ii. CBD A TOOLKIT to facilitate Parties to achieve Aichi Biodiversity Target 9 on invasive alien species (Prototype). Global Invasive Alien Species Information Partnership (GIASI) Partnership Secretariat of the Convention on Biological Diversity

iii. The Convention on Biological Diversity (1992) https://www.cbd.int

iv. The Cartagena Protocol on Biosafety (2000) https://www.cpb.int

v. The National Biodiversity Strategy and Action Plan (2012).

vi. The International Convention on Plant Protection (1951) https://www.ippc.int

vii. Prime Minister's Office (2012). Decree N°. 2005/0771/PM of 6 April 2005, fixing modalities of plant quarantine operations. Yaounde, Cameroon

viii. Republic of Cameroon (2012). National Biodiversity Strategy and Action Plan-Version-II MINEPDED. Yaounde, Cameroon

ix. Republic of Cameroon (2003). Law N°.2003/006 of 21 April 2003, to lay safety regulations governing modern biotechnology in Cameroon. Yaounde, Cameroon

x. Republic of Cameroon (2000). Law N°. 2001/014 of 23 July 2001 relating to seed activity, Yaounde, Cameroon

xi. Republic of Cameroon (1996). Law N°. 96/12 of 5 August 1996, relating to Environmental Management. Yaounde, Cameroon

xii. Republic of Cameroon (2012). National Biodiversity Strategy and Action Plan – Version II – MINEPDED. Yaounde, Cameroon.

xiii. FAO/WHO Codex Alimentarius Commission (CAC, 1963) - www.codexalimentarius.net

xiv. WHO, (2004) IPCS Risk Assessment Terminology. Part 2: IPCS Glossary of Key Exposure Assessment Terminology. World Health Organization (WHO). Available at http://www.inchem.org/documents/harmproj/harmproj/harmproj1.pdf (access January 2017).

xv. MINEPDED (2015). List of major invasive species in Cameroon. Report prepared by John Mauremootoo (John@InspiralPathways.com) and Augustine Bokwe (v_cefai2002@yahoo.co.uk) under the supervision of The Project Component 4 Interministerial Task Team (Task team institutions: MINRESI, MINEPDED, MINEPIA, MINADER), as part of the Cameroon Biosecurity Project. MINEPDED, P.O. Box 320, Yaoundé, Cameroon to MINEPDED under the UNEP/GEF Cameroon Biosecurity Project: Development and Institution of a National Monitoring and Control System (Framework) for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS). Yaoundé, Cameroon.

MODULE 2: OVERVIEW OF THE PRA

Purpose: To detail the PRA process, its components and the roles and responsibilities for implementation.

Suggested delivery time: 1-2hrs

Format: PowerPoint presentation followed by a plenary discussion and exercise

Expected Outcomes: By the end of the session, trainees will be able to:

- Define what a PRA is and the rationale for this.
- Identify who is responsible for the PRA
- Establish, the temporal, institutional and geographic scope of a PRA

2.1. RISK ANALYSIS

Risk analysis is the overall process of using evidence to assess the threat posed by a non-native species, evaluate management options and communicate the results to inform decision making (as in ISPM No. 5). It generally comprises of hazard identification (initiation), risk assessment, risk management and risk communication.

Risk analysis is a structured, science based process that helps provides the rationale for implementing management measures. It is also used to manage uncertainty, helping decisions to be made when scientific information is incomplete. Evidence used to complete risk analysis can be qualitative or quantitative using evidence ranging from published scientific literature, to grey literature, to expert judgement.

Risk is always a combination of likelihood of occurrence and impact and increases as the two elements also increase. Figure 1 gives a brief demonstration of how this can be assessed by answering the question, how likely an event is to happen, and how much of an effect it would have. Thus, if an event cannot occur it cannot have an impact and there is no risk and if an event is likely to occur but it will have no impact then there is no risk.

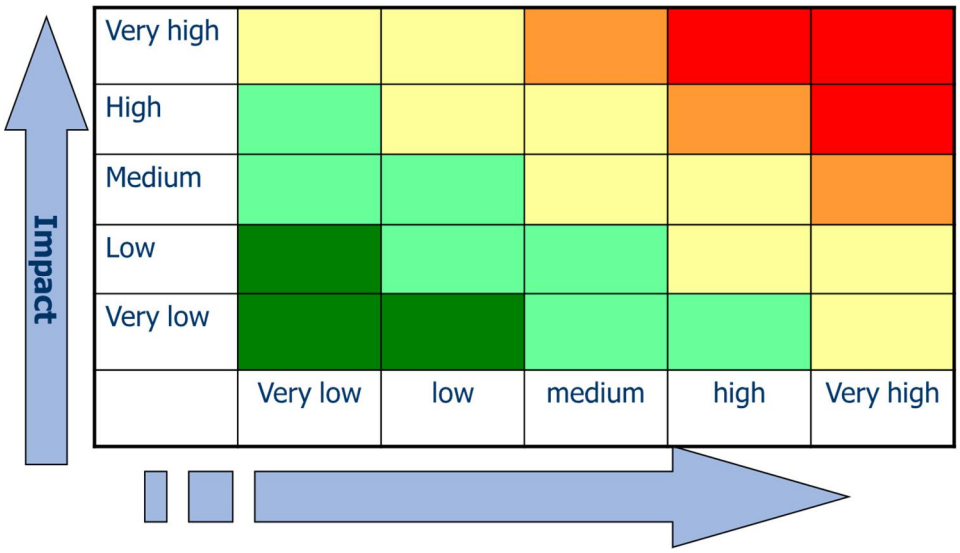


Figure 1 Likelihood of adverse effect or risk

Note to Trainer: The trainers should elaborate the concept of risk and principles of a risk analysis i.e. (risk assessment, risk management and risk communication) and how this relates to environmental and human safety taking reference from the CBD, NBSAP and CPB (Annex III). The basic element of risk should be elaborated i.e. probability, a source and an adverse effect.

2.2. PRA AND ITS RATIONALE

The participants should be introduced to the two categories of plant pests i.e. direct pests (that cause feed on and cause disease see Fig 2) and indirect pests (that injure and expose plants to pests). Examples of pests should be presented to demonstrate this. The MINEPDED 2015 report on biological invasions by John Mauremootoo and Augustine Bokwe is a good source of information for examples.

Figure 2 Illustration of how direct pests where the harm is inflicted on the plant causing damage or disease

PRA is conducted to support decision making that addresses environmental and human safety without compromise to trade. PRA identifies and assesses risks to agricultural and horticultural crops, forestry and the environment from plant pests. PRAs solicit and contribute information to lists of regulated pests including plants and animals they are associated with to identify appropriate management options.

A brief outline of the PRA steps to be detailed in the subsequent modules should be done here in the overview.

2.3. STEPS IN PRA

2.3.1. PRA Initiation

Initiation of a PRA may be due to the premises of pest, pathway and or policy.

- **Pest initiated PRA** may arise in the following situations:
  - an emergency arises on discovery of an established infestation or an outbreak of a new pest within a PRA area
  - an emergency arises on interception of a new pest on an imported commodity
  - a new pest risk is identified by scientific research
  - a pest is introduced into an area
  - a pest is reported to be more damaging in an area other than in its area of origin
  - a pest is repeatedly intercepted
  - a request is made to import an organism (including LMOs and or IAS)
  - an organism is identified as a vector for other pests
  - an organism is genetically altered in a way which clearly identifies its potential as a plant pest.

- **Pathway Initiated PRA**: The need for a PRA of a specific pathway may arise in the following situations:
  - International trade is initiated in a commodity not previously imported into the country (usually a plant or plant product, including LMOs) or a commodity from a new area or new country of origin
  - New plant species are imported for selection and scientific research purposes
  - A pathway other than commodity import is identified (natural spread, packing material, mail, garbage, passenger baggage, etc.).

- **Policy Initiated PRA** will most frequently arise in the following situations:
    - A national decision is taken to review phytosanitary regulations, requirements or operations
    - A proposal made by another country or by an international organization is reviewed
    - A new treatment or loss of a treatment system, a new process, or new information impacts on an earlier decision
    - A dispute arises on phytosanitary measures

At the end of the initiation exercise, the pests and pathways of concern and the PRA area should have been identified. Relevant information has been collected and pests have been identified as possible candidates for phytosanitary measures, either individually or in association with a pathway.

2.3.2. Pest Risk Assessment

The process for pest risk assessment can be broadly divided into three interrelated steps: categorization followed by assessment of the probability of introduction and spread and finally the assessment of potential economic consequences (including environmental impacts).

Generally, the steps are sequential but it is not essential to follow a particular sequence. Pest risk assessment needs to be only as complex as is technically justified by the circumstances.

2.3.3. Pest Risk Management

The conclusions from pest risk assessment are used to decide whether risk management is required and the strength of measures to be used. Since zero-risk is not a reasonable option, the guiding principle for risk management should be to manage risk to achieve the required degree of safety that can be justified and is feasible within the limits of available options and resources. Pest risk management (in the analytical sense) is the process of identifying ways to react to a perceived risk, evaluating the efficacy of these actions, and identifying the most appropriate options. The uncertainty noted in the assessments of economic consequences and probability of introduction should also be considered and included in the selection of a pest management option.

2.4. TEMPORAL, INSTITUTIONAL AND GEOGRAPHIC SCOPE OF PRA

PRA is a desktop study that focuses on providing responses a soon as possible to provide decision makers with a potential solution to deal with a pest. Thus PRA does not and should not seek to develop research questions, but benefit from the existing body of research and information available. Thus PRA takes advantage of the existing expertise and databases available such as that of CABI and GIASI.

2.5. RESPONSIBILITY FOR PEST RISK ANALYSIS

The administrative set-up for PRA in Cameroon hosts PRA in the Ministry of Agriculture and Rural Development (MINADER). Other ministries with responsibilities for PRA include the Ministries of Livestock and Health, the trainers can run an exercise or discuss in plenary how PRA is conducted and draws on information from other players.

At the international level, the IPPC advocates for countries to establish a National Plant Protection Organisations (NPPOs) which in the case of Cameroon is MINADER. To ensure there is management beyond the borders of Cameroon Regional Plant Protection Organisations (RPPO) and trading blocs such as the European Union (EU), ECCAS, SAARC, EAC, ECOWAS all institute standards and requirements for PRA.

An example of an NPPO which is the national Plant Protection Advisory Committee under the Ministry Responsible for Agriculture (thus not an independent entity) in Tanzania is elaborated below that can be compared with the set up in Cameroon. The NPPO for Tanzania is supported by legislation being constituted by an Act of Parliament No 13 of 1997 on Plant Protection, that Minister responsible for Agriculture then developed Regulations for the NPPO.

Composition and Operational procedures: The National Plant Protection Advisory Committee (NPPAC) consist of members namely – One representative from the relevant Department of the Government and or Ministries or Departments responsible for agriculture; health; environment; natural resources; justice; and finance. Additionally members are drawn from Governmental or quasi-governmental institutions responsible for environmental management; pesticides research; agricultural research; commodity standards control; and pharmaceuticals and poisons control; and one officer from a relevant University department for Agriculture.

The NPPAC may co-opt non-voting members who can be the head of the division responsible for plant protection of the Ministry responsible for Agriculture of the

Revolutionary Government of Zanzibar[1]; international organizations responsible for plant protection research and extension; and international organizations responsible for environmental management; one representative from private sector associations of — plant protection substances manufacturers, importers and distributors; plant protection substances consumers; and promoters of safe use of plant protection substances.

Functions of the NPPAC: The Committee (a) coordinate plant protection activities of its sub-committees; maintains a system of collaboration with any national or international body or person dealing with plant protection; consider and endorse reports from the NPPAC sub-committees; propose to the Minister areas in plant protection legislation which require revision or updating as may be deemed necessary from time to time; perform such other incidental or consequential activities necessary for carrying out the functions assigned to it under the Act or Regulations.

Sub-Committees; The NPPAC has five substantive sub-committees with an option to create other ad hoc committees as the need arises. The sub-committees are (a) the Pesticides Approval and Registration Technical Sub-Committee ; (b) the Biological Control Agents Sub-Committee ;(c) the Plant Quarantine and Phytosanitary Services Sub-Committee (PQPS); and (d) the Outbreak Pests Sub-Committee.

Exercise: IAS, LMOS AND PESTS IN CAMEROON

Fill the table with organisms known to you in Cameroon that you know to be pests, IAS and or LMOs by providing the following information:

- Common or scientific name
- The taxonomic group the organism belongs to
- Which region of Cameroon it occurs
- The potential impact/ effect on the level of economy, social and or environmental damage that can be caused by the organism
- What the potential introduction pathways were used for it to get to that region.

[1]Tanzania is a two state solution and Agriculture is non-union matter

Name	Taxa	Region	Impact (Economic/ Social/ Environmental)	Introduction Pathway
Paracoccus marginatus (Papaya Mealy bug)	Parasitoid	West Africa	Estimates indicate that 85% of papaya farms in infested regions have been devastated by P. marginatus causing average yield losses of 65% and shrinking the papaya orchards to 380 ha. Export earnings for the papaya industry havedropped significantly and 1700 people in the sector have lost their jobs	The white fly is a vector for the parasitoid

Note to trainer: During the exercise, participants could be guided to existing pest lists and literature sources that allow them to draw their experience on how pests are defined and what the adverse effect or impact of the pest can be warranting the PRA. The discussion should highlight that not all pests are subjected to PRA dependent on available resources (expertise and time), need for the PRA and socio-economic impact.

2.6. RECOMMENDED READING

i. Global Invasive Alien Species Information Partnership (GIASI) Partnership Secretariat of the Convention on Biological Diversity

ii. Centre for Agricultural and Bioscience International (CABI) https//www.cabi.org

iii. MINEPDED, (2015). Report on the Review of Biosecurity Agencies, Guidelines and Procedures. Consultant Report prepared under the UNEP/GEF Cameroon Biosecurity Project “Development and Institution of a National Monitoring and Control System (Framework) for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS)” as part of Cameroon Biosecurity Project.

iv. MINEPDED (2014). Decision-making Process to address Established Biological Invasions in Cameroon Report submitted to MINEPDED under the UNEP/GEF Cameroon Biosecurity Project: Development and Institution of a National Monitoring and Control System (Framework) for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS). Yaoundé, Cameroon.

MODULE 3: INITIATION

Purpose: To detail the triggers that initiate a PRA.

Suggested delivery time: 1hr

Format: PowerPoint presentation followed by a plenary discussion

Expected Outcomes: By the end of the session, trainees will be able to:

- Understand the pathways that allow pests to enter and establish in Cameroon
- Identify pests of concern for Cameroon and the means they are able to establish and spread
- Get an overview of Policy changes that may require a PRA

At the initiation stage of a PRA the reason for conducting the analysis, the identity of the pest and or pathways being analysed and the area in relation to which the analysis is conducted (the pest risk analysis area) is provided. Notably the reasons can be multiple and interrelated i.e., there could be a new pest identified in literature from investigation of pathways.

The PRA output should facilitate a phytosanitary decision-making on the arrival of a pest. The level of detail in a pest risk analysis will be limited (a) by the amount and quality of information available, (b) the tools available, and (c) time available before a decision is required.

PRA could be simple or complex determined by the circumstances to support a phytosanitary decision and provide the necessary technical justification to defend the phytosanitary measures to put in place. Nevertheless, a PRA should be based on sound science, be transparent and consistent with other pest risk analyses conducted.

3.1. PREMISES FOR INITIATING A PRA

3.1.1. Pest Initiated PRA

The IPPC defines a pest as “any species, strain or biotype of plant, animal, or pathogenic agent, injurious to plants or plant products.” In applying these initiation points to the specific case of plants as pests, it is important to note that the plants concerned should satisfy this definition. Pests directly affecting plants satisfy this definition. In addition, many organisms indirectly affecting plants also satisfy this definition (such as weeds/invasive plants). The fact that they are injurious to plants can be based on evidence obtained in an area where they occur. In the case of organisms where there is insufficient evidence that they affect plants indirectly, it may nevertheless be appropriate to assess on the basis of available pertinent

information, whether they are potentially injurious in the PRA area by using a clearly documented, consistently applied and transparent system. This is particularly important for plant species or cultivars that are imported for planting.

3.1.2. Pathway Initiated PRA

A list of pests likely to be associated with a pathway (e.g. carried by the commodity) may be generated by any combination of official sources, databases, scientific and other literature, or expert consultation. It is preferable to prioritize the listing, based on expert judgement on pest distribution and types of pests. If no potential quarantine pests are identified as likely to follow the pathway, the PRA may stop at this point.

An example of a Pathway Initiated PRA from a study on onions from Argentina to Jamacia by Samuel Wilson (2014) is used to demonstrate: The Agency requesting the PRA was aware of information on organisms associated with onions in Argentina to have pests of quarantine importance. Without mitigation, these pests would be introduced into Jamaica through importation of commercially produced onions. Pests of quarantine importance included the insect *Nacpactus leucoloma* (White fringe beetle); the nematode *Ditylenchus dipsaci* (the stem and rootnematode); the mite *Aceria tulipae* K.; the virus Onion Dwarf Yellow Virus (ODYV) and the following pathogens: The bacterium, *Burkholderia cepacia*; five pathogenic fungi, *Botryotina fuckeliana*, *Sclerotium cepivorum*, *Colletotrichum circinans*, *Peronospora destructor*, *Phytophthora cryptogea* and *Pythium irregulare*.

This pathway-initiated pest risk assessment, was called in response to a request by Argentina to export onions to Jamaica. This Pest Risk Analysis was warranted in order to examine the potential phytosanitary risks associated with the importation of onion into Jamaica and would play a major role in the decision making process as to whether this product will be allowed into the country.

The PRA area was the entire Island of Jamaica. The PRA also noted that there was no previous risk analysis for onions entering Jamaica from Argentina. A risk assessment was however done for onions (*Allium cepa*) from Costa Rica, which included consideration of one of the pests. On this basis the Risk analysts proceeded to conduct the PRA for Jamaica.

3.1.3. Policy Initiated PRA

Policy initiated PRA occurs at various levels as may be deemed necessary. An example for review at the International Level is with ISPM 11 where the inclusion of LMOs was made to the risk analysis framework following an analysis by the Invasive species group in 2001.

Note to trainer: The trainers can draw from various literature of relevance to Cameroon for examples of Pests of quarantine importance that would cause initiation of a PRA including the MINEPDED 2015 report by Dr John Mauremootoo and Augustine Bokwe.

Exercise:

The participants are provided with the supplier country information in the form of a letter from Sunrise Flower imports. In the letter the participants will notice that some important information is missing may ask the trainer about this. The point of the exercise is to guide how and why there may be a need to request further information and can initiate a discussion in groups and or the plenary to that effect.

Dear NPPO Officer,

We are a newly incorporated company set up to import cut flowers. I would like to check the import requirements to begin shipping monthly volumes of a variety of cut flower species from a major production facility in East Africa. Under a recently negotiated agreement, our supplier will airfreight high quality cut flowers to a distribution centre in Yaounde. There will be a maximum of three days between cutting the flowers in the East African country and distributing the flowers from our distribution centre in Yaounde. The flowers imported will be of top quality since they can be transported in environmentally controlled conditions, ideal for their well-being. You may be familiar with our sister company Sunrise Citrus Production (SCP) who is also based in Yaounde, indeed we will be sharing the same distribution site, close to the SCP production area, which has a good record of close cooperation with the NPPO.

To guide the discussions the participants will discuss the following questions:

- What is the potential Initiation point if (source of the product)?
- What are possible Pathway(s) of concern?
- What would be the Pest(s) of concern?
- Where is the product to be distributed – this will define the PRA area
- Have there been any other PRA in the area and whether these have been on the same or related product and if there were any recommendations?

The exercise should conclude with recommendations on the need for a PRA and if so what the scope of this should be.

3.2. RECOMMENDED READING

i. IPPC (1951). International Plant Protection Convention- www.ippc.int

ii. ISAAA 2013 Annual Report Executive Summary, Global Status of Commercialized Biotech/GM Crops: 2013 ISAAA Brief 46-2013, Retrieved 28 April 2017

iii. MINEPDED (2015). Report on the formulation of risk management strategies for biological invasion pathways in Cameroon. Consultant Report prepared under the UNEP/GEF Cameroon Biosecurity Project "Development and Institution of a National Monitoring and Control System (Framework) for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS)" as part of the Cameroon Biosecurity Project. Yaoundé, Cameroon.

iv. OIE-World Organisation for Animal Health (1924). www.oie.int

v. CBD A TOOLKIT to facilitate Parties to achieve Aichi Biodiversity Target 9 on invasive alien species (Prototype). Global Invasive Alien Species Information Partnership (GIASI) Partnership Secretariat of the Convention on Biological Diversity

vi. Pathway-initiated pest risk analysis on onion bulbs (*Allium Cepa*) from Argentina to Jamaica. A report prepared for the Plant Quarantine/Produce Inspection Branch, Ministry of Agriculture & Fisheries, Jamaica by Samuel Wilson (2014).

vii. ISPM 11 (2004) PRA for Quarantine Pests including Analysis of Environmental Risks and Living Modified Organisms. Rome, IPPC, FAO.

viii. Mary Megan Quinlan, Nick M. Pasiecznik and Soetikno S. Sastroutomo (2001): Assessing environmental risks of invasive species using ISPM 11: where to start. SECTION 4: Pest Risk analysis including Analysis of Environmental Risk. Invasive alien speciesand the IPPC framework.https://www.ippc.int/largefiles/adopted.../en/ISPM_11_2001_En_2004-03-09.pdf

ix. ISPM 1. 2006. Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade. Rome, IPPC, FAO.

x. ISPM 2. 2007. Framework for Pest Risk Analysis. Rome IPPC, FAO

xi. ISPM 3. 2005. Guidelines for the export, shipment, import and release of biological control agents and other beneficial organisms. Rome, IPPC, FAO.

xii. ISPM 5. Glossary of phytosanitary terms. Rome, IPPC, FAO.

xiii. ISPM 5 Supplement 2. 2003. Guidelines on the understanding of potential economic importance and related terms including reference to environmental considerations. Rome, IPPC, FAO.

xiv. ISPM 14. 2002. The use of integrated measures in a systems approach for pest risk management. Rome, IPPC, FAO.

xv. ISPM 21. 2004. Pest risk analysis for regulated non-quarantine pests. Rome, IPPC, FAO.

xvi. WTO. 1994. Agreement on the Application of Sanitary and Phytosanitary Measures. Geneva, World Trade Organization.

MODULE 4: PEST RISK ASSESSMENT

Purpose: To detail the PRA elements and go through the process systematically.

Suggested delivery time: 1- 1.5 days

Format: PowerPoint presentation followed by a plenary discussion and exercises

Expected Outcomes: By the end of the session, trainees will be able to:

- Categorise pests for PRA.
- Establish risks of entry of pest into the PRA area
- Establish risk of establishment of the pest in the PRA area
- Identify and elaborate the potential social and economic consequences of entry and establishment of pests in the PRA area
- Provide recommendations and conclusions based on the PRA

Pest risk assessment follows a three-step process of characterisation/categorisation, establishment of likelihood/ probability of causing harm and how, and the consequences of the harm caused.

Note to trainer: This a relatively long module and thus it is suggested that the delivery is broken down into five presentations to cover the three steps.

4.1. 4A PEST CATEGORISATION

Step 1: Pest categorization – this initial step identifies whether the pest(s) to be analysed meet the criteria warranting quarantine. Reference is to be made to existing information such as the CBP Black and White lists of priority invasive species and management approaches for Cameroon and other relevant documentation from the Phytosanitary authority. 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 [ISPM No. 5, 2006] is considered a quarantine pest. Generally, pests of concern are those with potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled. Categorization provides an opportunity to eliminate a pest from analysis at an early stage in the PRA process thus avoiding unnecessary in-depth examination.

Pest categorisation examines for each pest whether the criteria in the definition for a quarantine pest are satisfied, it enables elimination of an organism or organisms from

consideration before in-depth examination is done thus saving resources. Categorisation includes the identity of the pest, presence or absence in the PRA area, regulatory status, potential for establishment and spread in PRA area and potential for economic consequences (including environmental consequences) in the PRA area.

The taxonomic unit for **identification** of pests is generally the species. The use of a higher or lower taxonomic level should be supported by scientifically sound rationale. In the case of levels below the species, this should include evidence demonstrating that factors such as differences in virulence, host range or vector relationships are significant enough to affect phytosanitary status. In cases where a vector is involved, the vector may also be considered a pest to the extent that it is associated with the causal organism and is required for transmission of the pest.

Presence or absence in the PRA enables the risk assessor determine the impact of the pest. ISPM No.5 of 2006 indicates that “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” should be categorised as a quarantine pest. The presence or absence is considered in terms of complete absence; presence; present and not widely distributed; or present and widely distributed.

As the PRA is largely a desk top exercise when addressing presence or absence credible sources of information should be consulted. Such sources include:

- Scientific publications or databases – such as the World Pest Database, the IAS specialist group, the GMO Compass and others
- Pest records – these can be national, regional and or international
- Pest reports
- Data from surveys
- Specimens
- ISPM No. 6:(Guidelines for surveillance)
- ISPM No. 8:(Determination of pest status in an area)

The sources should present evidence to support the conclusion that the pest could become established or spread in the PRA area. The PRA area should have ecological/climatic conditions including those in protected conditions suitable for the establishment and spread of the pest and where relevant, host species (or near relatives), alternate hosts and vectors should be present in the PRA area.

It is also advisable to study whether there is a regulatory regime for the quarantine pest. ISPM No. 5 of 2006 advocates for “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”. If the pest is an LMO then the Biosafety regulations are to be applied and if it is an IAS then the appropriate Phytosanitary measures should be considered. Phytosanitary measure may include eradication and/or containment in the infested area(s); systematic surveillance in the endangered area(s); measures related to controls on movement into and within the protected area(s), including measures applied at import. All measures applied should be non-discriminatory, transparent and technically justified; mandatory (all persons involved are legally bound to perform the actions required); established or recognized by the NPPO under appropriate legislative authority; performed, managed, supervised or, at a minimum, audited or reviewed by the NPPO [ISPM No. 5, 2006].

To categorise a quarantine pest its potential to establish and spread is key, thus the PRA should outline the ecological and/or climatic conditions that may be suitable for the pest; the availability of host species (or near relatives), alternate hosts, and/or suitable habitats for the and the presence and or absence of vectors if vectors are required for spread of the pest? Centre for Agriculture and Biosciences International (CABI) has a comprehensive database on pests spread that can be presented to the trainees. An example of the banana weevil spread across the world (*Cosmopolites sordidus*) given in Fig 3 below.

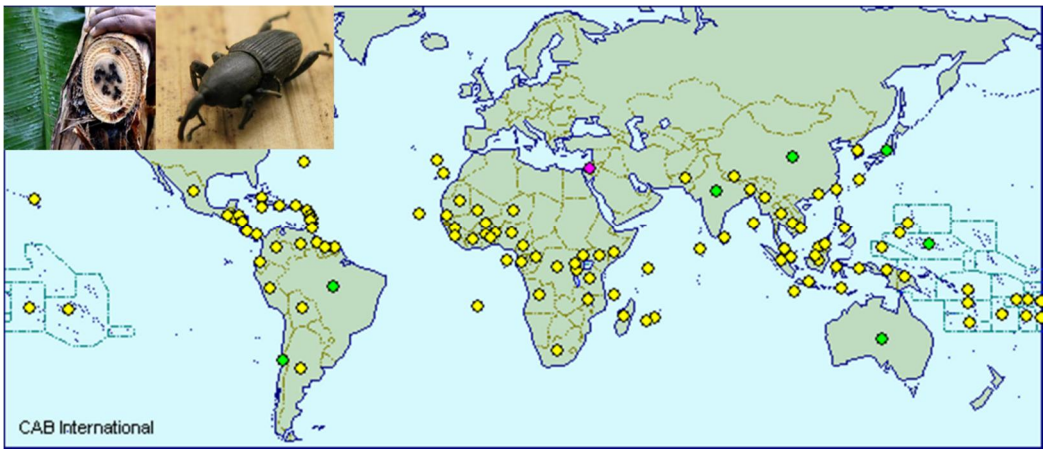


Figure 3: Global spread of the banana weevil

There should be clear indications that the pest is likely to have an unacceptable economic impact (including environmental impact) in the PRA area.

If it has been determined that the pest has the potential to be a quarantine pest, the PRA process should continue. If a pest does not fulfil all of the criteria for a quarantine pest, the

PRA process for that pest may stop. In the absence of sufficient information, the uncertainties should be identified and the PRA process should continue.

When reporting the categorisation of pests the information could be tabled as proposed below:

Table 2: Proposed layout for reporting on categorisation of pest warranting a PRA

Pest identity	**Geographic distribution**	**Plant part affected**	**Follows the pathway (Yes/ No)**	**Regulatory status**	**References**
Scientific name and taxonomic position	Presence / absence and distribution in the exporting and importing countries	Leaves, stems, shoots, fruits, roots, etc.	Probability of the pest being associated with the pathway under assessment	Note any existing regulations in the exporting and importing countries	Record all references

Note to trainers: An exercise could be developed from one of the pests known to Cameroon for trainees to fill out a table in this manner

Once a pest has been categorised as a quarantine pest the trainers could go further to require the trainees to organise the pest information to establish the criteria as listed in the module, Table 3 gives an example of hypothetical information for two pests as an illustration.

Table 3: Pest categorisation data for two known pests

Pest Identity	**Present in Pathway (Yes/ No)**	**Present in PRA area (Yes/ No)**	**Regulated in PRA area (Yes/ No)**	**Potential for establishment and spread (Yes/ No)**	**Potential for consequences (Yes/ No)**	**Quarantine Pest (Yes/ No)**
Erwinia herbicola (Löhnis) Dye Black rot of grain	Yes	Yes	No	N/A	N/A	No
Pseudomonas syringae pvpanici (Elliot) Young et al . Bacterial brown stripe	Yes	No	No	Yes	Possible	Yes

4.2. 4B: RISK AND PROBABILITY OF ENTRY

Step 2: Assessment of pest entry, establishment and spread - assessing the likelihood of pest entry requires assessment of each of the pathways with which a pest may be associated, from its origin to its establishment in the PRA area. In a PRA initiated by a specific pathway, often an imported commodity or goods associated with an imported commodity, e.g. packing materials, the probability of pest entry is evaluated for that specific pathway. In a PRA initiated for a specific pest, all probable pathways are evaluated for the individual pest. Information required to establish likelihood of establishment in the area, the pest biology, its life cycle, hosts and/ or habitat needs, diseases epidemiology, together with characteristics of the abiotic environment affecting survival such as temperature, precipitation and where relevant soil type influencing its geographic range limit need to be considered. The environmental conditions under which the pest does not survive are also important to understand. Conditions in the PRA area can then be compared with conditions in areas where the pest survives, and in areas where the pest is known not to be able to survive, so as to assess the likelihood that the pest will establish in the pest risk analysis area. Computer simulation models can be used to inform assessments of likelihood of establishment.

The PRA can be qualitative which is a non-numerical, descriptive, highly adaptable and is most commonly used, despite challenges of consistency in the methods. In such cases one would read conclusions such as 'the pest is highly likely to be present on fresh fruit imported from...' or such as 'the pest is expected to have negligible effects on market sales'. PRA can also be quantitative whereby the information is presented numerically, it's measurable, assigning values to variables though the challenge is on obtaining data or defending selection of values for variables. Expression of the risk when the PRA is quantitative is such as "there is an 85% chance of losses equalling or exceeding 1.2 million bushels per annum".

Identification of pathways for a PRA initiated by a pest: All relevant pathways should be considered. They can be identified principally in relation to the geographical distribution and host range of the pest. Consignments of plants and plant products moving in international trade are the principal pathways of concern and existing patterns of such trade will, to a substantial extent, determine which pathways are relevant. Other pathways such as other types of commodities, packing materials, persons, baggage, mail, conveyances and the exchange of scientific material should be considered where appropriate. Entry by natural means should also be assessed, as natural spread is likely to reduce the effectiveness of phytosanitary measures.

Pathways can be categorised as man-made (human-assisted) pathways – e.g. with host plant /host commodity; with soil associated with imported nursery stock or contaminating seeds and grain (commodities). They can also be as a result of forms of transport, commodities, or associated products e.g. with wood packaging (associated products) or in shipping containers /rail cars (transport). Natural pathways or spread are such as terrestrial dispersal via wind or water.

Probability of the **pest being associated with the pathway at origin:** The probability of the pest being associated, spatially or temporally, with the pathway at origin should be estimated. Factors to consider are:

- Prevalence of the pest in the source area
  Occurrence of the pest in a life-stage that would be associated with commodities, containers, or conveyances
- Volume and frequency of movement along the pathway
- Seasonal timing
- Pest management, cultural and commercial procedures applied at the place of origin (application of plant protection products, handling, culling, roguing, grading).

If the pest is considered to be transported then the **probability of survival during transport or storage** should be considered looking at:

- Speed and conditions of transport and duration of the life cycle of the pest in relation to time in transport and storage
- Vulnerability of the life-stages during transport or storage
- Prevalence of pest likely to be associated with a consignment
- Commercial procedures (e.g. refrigeration) applied to consignments in the country of origin, country of destination, or in transport or storage.

Risk and Probability of entry can also be considered when assessing **pest survival under existing pest management procedures** (including phytosanitary procedures) applied to consignments against other pests from origin to end-use that can be evaluated for effectiveness against the pest in question. The probability that the pest will go undetected during inspection or survive other existing phytosanitary procedures should be estimated.

Furthermore entry is assessed for **probability of transfer to a suitable host** by considering:

- Dispersal mechanisms, including vectors to allow movement from the pathway to a suitable host
- Whether the imported commodity is to be sent to a few or many destination points in the PRA area
- Proximity of entry, transit and destination points to suitable hosts
- Time of year at which import takes place
- Intended use of the commodity (e.g. for planting, processing and consumption)
- Risks from by-products and waste.

Some uses are associated with a much higher probability of introduction (e.g. planting) than others (e.g. processing). The probability associated with any growth, processing, or disposal of the commodity in the vicinity of suitable hosts should also be considered.

In selection of the PRA method dependent on the following criteria a qualitative or quantitative approach can be taken:

- Urgency of the issue
- Seriousness of the issue
- Availability of resources & expertise
- Availability of data
- Needs of the NPPO
- Sensitivity of the issue

Note to trainer: In elaborating this module implications of trade are a key element and thus the probability associated with a particular pathway and the ability of the pest to establish should be emphasised. The exercise using WTO agreements should be used to highlight the challenges of the PRA (particularly if done using quantitative methods) which has to deliver timely recommendations so as not to jeopardise trade relations in some cases.

Exercise:

The Fig 4 illustrates the growth in trade of cut flowers by reflecting Gross Domestic Product (GDP) and the value of this over fifty years in the UK. It is evident that trade has influenced GDP as can be demonstrated by the marketing of cut flowers in the United Kingdom. The United Kingdom imports cut flowers and the amounts increase annually, in 1991 the import value was 50,475 tonnes and this doubled in 10 years as in 1998 the import value was 102,884 tonnes. The Sources of cut flowers include: Argentina, Australia, Brazil, China, Colombia, Costa Rica, Denmark, Dominica, France, Germany, Guatemala, Hungary, India,

Israel, Italy, Japan, Kenya, Kuwait, Mexico, Netherlands, New Zealand, Norway, Portugal, Romania, Singapore, South Africa, Spain, Sri Lanka, Sweden, Taiwan, Thailand, Togo, USA, Zimbabwe

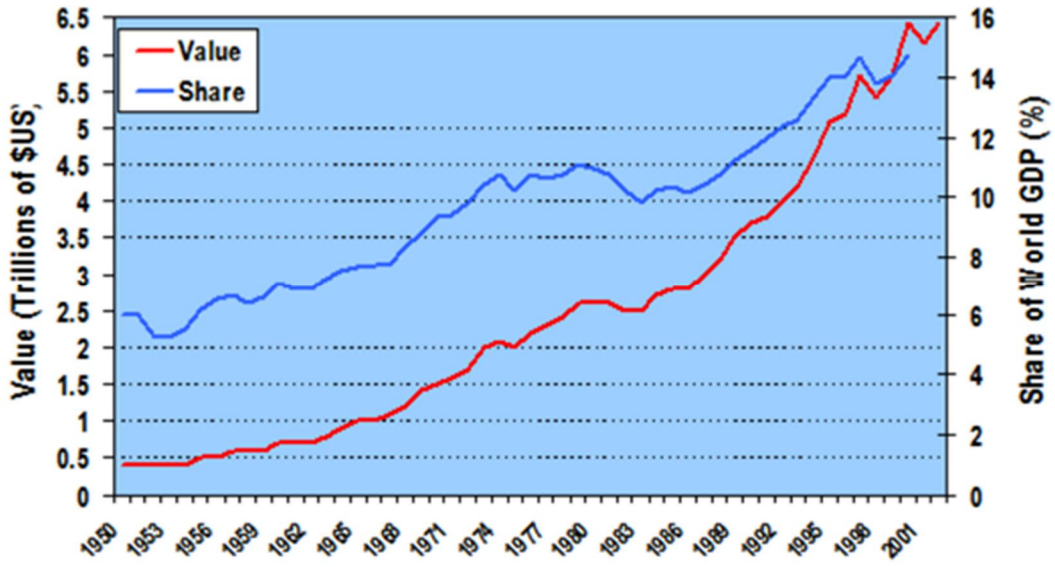


Figure 4WTO data http://people.hofstra.edu/geotrans/eng/ch5en/conc5en/worldexports.html

The trainer should request the trainees to answer the following questions on this brief information in groups or in plenary using an identified pest(s):

i. What would be a potential pathway for pests to enter the UK?
ii. How would the pest(s) be associated with the cut flowers before export?
iii. What conditions would enable the pest(s) to survive during transport?
iv. What measures could be put in place to minimise survival of the pest during transport?
v. What should a quarantine inspector consider when examining the flowers on arrival in the UK?
vi. What conditions would facilitate transfer to a suitable host in the UK?
vii. What would be an estimated loss in GDP value would occur if the cut flowers were quarantined for two consecutive years 1992-1995 due to pest(s) in the UK?

4.3. 4C: RISK AND PROBABILITY OF ESTABLISHMENT AND SPREAD

Pest establishment is defined as the perpetuation, for the foreseeable future, of a pest within an area after entry (ISPM 5, 2007). When assessing the likelihood and magnitude of pest spread, the pest's ability to disperse from a point of introduction to new areas within the PRA area is assessed. The assessment should consider pest population dynamics (life cycle, host range, epidemiology, survival etc.) should be obtained from the areas where the pest currently occurs and the natural mobility of the pest and take into account potential spread via wind, water, soil, seed and pollen, and insect, fungal or nematode vectors as well as spread via human activities such as movement of host material.

The situation in the PRA area can then be compared with that in the areas where it currently occurs (taking account also of protected environments such as glass- or greenhouses) and expert judgement used to assess the probability of establishment. Case histories concerning comparable pests can be considered. Examples of the factors to consider are:

- Availability, quantity and distribution of hosts in the PRA area
- Environmental suitability in the PRA area
- Potential for adaptation of the pest
- Reproductive strategy of the pest
- Method of pest survival
- Cultural practices and control measures.

In considering probability of establishment, it should be noted that a transient pest (see ISPM No. 8: Determination of pest status in an area) may not be able to establish in the PRA area (e.g. because of unsuitable climatic conditions) but could still have unacceptable economic consequences (see IPPC Art. VII.3).

In the case of plants to be imported, the assessment of the probability of establishment concerns the unintended habitats.

When assessing for availability of **suitable hosts, alternate hosts and vectors** in the PRA area one should consider:

- Whether hosts and alternate hosts are present and how abundant or widely distributed they may be
- Whether hosts and alternate hosts occur within sufficient geographic proximity to allow the pest to complete its life cycle

- Whether there are other plant species, which could prove to be suitable hosts in the absence of the usual host species
- Whether a vector, if needed for dispersal of the pest, is already present in the PRA area or likely to be introduced
- Whether another vector species occurs in the PRA area.

The taxonomic level at which hosts are considered should normally be the “species”. The use of higher or lower taxonomic levels should be justified by scientifically sound rationale.

Suitability of environment for establishment need also to be addressed and thus factors in the environment (e.g. suitability of climate, soil, pest and host competition) that are critical to the development of the pest, its host and if applicable its vector, and to their ability to survive periods of climatic stress and complete their life cycles, should be identified. It should be noted that the environment is likely to have different effects on the pest, its host and its vector. This needs to be recognized in determining whether the interaction between these organisms in the area of origin is maintained in the PRA area to the benefit or detriment of the pest. Distribution and abundance of an organism that cannot regulate its body temperature is largely determined by climate. The probability of establishment in a protected environment, e.g. in glasshouses, should also be considered.

Where available **climatic modelling systems** may be used to compare climatic data on the known distribution of a pest with that in the PRA area. There are international databases that can be solicited for information such as CLIMEX (this has 30 years data from 3000 locations but is not open access), GARP and BIO-CLIM.

Where applicable, **practices employed during the cultivation/production** of the host crops should be compared to determine if there are differences in such practices between the PRA area and the origin of the pest that may influence its ability to establish.

Pest control programs or *natural enemies* already in the PRA area which reduce the probability of establishment may be considered. Pests for which control is not feasible should be considered to present a greater risk than those for which treatment is easily accomplished. The availability (or lack) of suitable methods for eradication should also be considered.

Additional characteristics of the pest affecting the probability of establishment that may be important for consideration are:

- *Reproductive strategy of the pests and method of pest survival* - Characteristics, which enable the pest to reproduce effectively in the new environment, such as parthenogenesis/self-crossing, duration of the life cycle, number of generations per year, resting stage etc., should be identified.
- *Genetic adaptability* - Whether the species is polymorphic and the degree to which the pest has demonstrated the ability to adapt to conditions like those in the PRA area should be considered, e.g., host-specific races or races adapted to a wider range of habitats or to new hosts. This genotypic (and phenotypic) variability facilitates a pest's ability to withstand environmental fluctuations, to adapt to a wider range of habitats, to develop pesticide resistance and to overcome host resistance.
- *Minimum population needed for establishment* - If possible, the threshold population that is required for establishment should be estimated.

Note to trainer: The trainer can introduce an example at this point to illustrate the concepts. An example of bird flu has been presented below to incite discussion amongst the trainees. There are no right or wrong answers, it is only a discussion to contextualise the understanding.

Exercise:

An internet news source (See Fig 5) has published a story of Bird Flu outbreak in Cameroon. As the NPPO you are required to provide the government with information on how to handle this situation to ensure minimal stress to the population. In consultation with a multidisciplinary team you confirm that the bird flu did enter the country through a poultry consignment at Douala. You task the experts to provide you with further information to ascertain how severe the issue may be by asking the following questions:

- Apart from the poultry what are the alternate Hosts for the virus?
- How adaptable is the virus?
- What is the vector and are there alternates?
- Under what climatic conditions does the virus best thrive?
- What cultural practices would enhance spread and establishment?
- Are there control mechanisms?
- Any other factors that would enhance management of the outbreak?

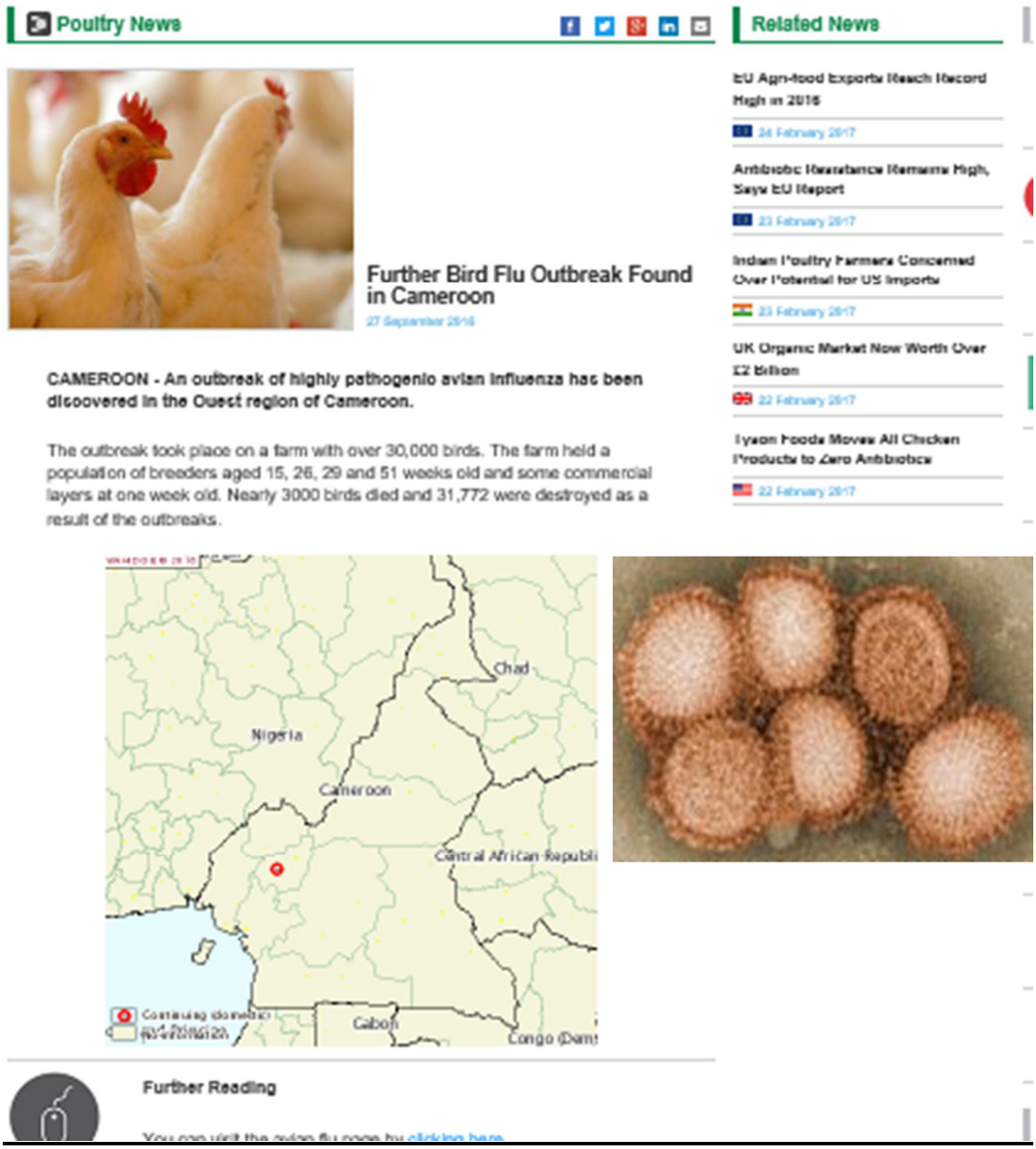


Figure 5 Internet media article on Bird flu outbreak in Cameroon

4.3.1. Probability of spread after establishment

A pest with a high potential for spread may also have a high potential for establishment, and possibilities for its successful containment and/or eradication are more limited. In order to estimate the probability of spread of the pest, reliable biological information should be obtained from areas where the pest currently occurs. The situation in the PRA area can then be carefully compared with that in the areas where the pest currently occurs and expert judgement used to assess the probability of spread. Case histories concerning comparable pests can usefully be considered. Examples of the factors to consider are:

- Suitability of the natural and/or managed environment for natural spread of the pest
- Presence of natural barriers
- The potential for movement with commodities or conveyances
- Intended use of the commodity
- Potential vectors of the pest in the PRA area
- Potential natural enemies of the pest in the PRA area.

In the case of plants to be imported, the assessment of spread concerns spread from the intended habitat or the intended use to an unintended habitat, where the pest may establish. Further spread may then occur to other unintended habitats.

The information on probability of spread is used to estimate how rapidly a pest's potential economic importance may be expressed within the PRA area. This also has significance if the pest is liable to enter and establish in an area of low potential economic importance and then spread to an area of high potential economic importance. In addition it may be important in the risk management stage when considering the feasibility of containment or eradication of an introduced pest.

Certain pests may not cause injurious effects on plants immediately after they establish, and in particular may only spread after a certain time. In assessing the probability of spread, this should be considered, based on evidence of such behaviour.

The overall probability of introduction should be expressed in terms most suitable for the data, the methods used for analysis, and the intended audience. This may be quantitative or qualitative, since either output is in any case the result of a combination of both quantitative and qualitative information. The probability of introduction may be expressed as a comparison with that obtained from PRAs on other pests.

Exercise – Probability of Establishment and Spread

In order to estimate the probability of establishment of a pest (one should be selected from the MINEPDED report on Black and White Lists), reliable biological information (life cycle, host range, epidemiology, survival etc. in the areas where the pest presently occurs) should be obtained. The situation in the PRA area can then be compared with that in the areas where the pest currently occurs, taking account also of protected environments such as glass- or greenhouses, and expert judgement used to assess the probability of establishment. Use the information provided to answer the following questions:

1. Availability of suitable hosts, alternate hosts and vectors in the PRA area

- What plant species are hosts for the pest? Are hosts and alternate hosts present in the PRA area? How abundant or widely distributed are they? Do they occur in discrete locations or are they distributed contiguously over a wide area? In the case of non-parasitic plants that are pests, suitable habitats may be considered instead of hosts.

- Are some hosts preferred or more susceptible than others? (mature vs. young hosts, healthy vs. stressed hosts, etc)

- In the absence of the usual host species, does the pest have the ability to use new hosts? (host specificity / adaptability)

- Do suitable hosts and alternate hosts occur near ports of entry or major destinations? Do they occur within sufficient geographic proximity to allow the pest to complete its life cycle?

- Does the pest have an active, directed host searching capability?

- Is a vector required for dispersal of the pest, and if so, is it already present in the PRA area or likely to be introduced? Do other potential vectors occur in the PRA area?

Availability of hosts	
Important assumptions	

2. Suitability of environment

- What is the pest's current distribution? Is there evidence of successful introductions in other world regions?

- Are suitable climatic conditions available in the PRA area? Are there any known climatic factors limiting establishment of the pest? Where applicable, consider the climatic factors required for initiation of different life cycle stages (e.g. emergence,

mating, egg laying, etc). Consider also the possibility of establishment in a protected environment, e.g. in glasshouses.

- Are suitable climatic conditions available for the host(s) and vector(s) to complete their life cycles in the PRA area? Will the interaction between the pest, host(s) and vector(s) in the area of origin be possible to maintain in the PRA area?

- Are there other abiotic factors that could affect pest establishment? (e.g. soil type, topography, environmental pollution)

Climatic modelling systems may be used to compare climatic data on the known distribution of a pest with that in the PRA area, though models are not necessary to complete this part of the PRA.

Suitability of environment	
Important assumptions	

3. Cultural practices and control measures

- Are there any cultural practices or control measures that could affect pest establishment? Where possible, practices employed during the cultivation / production of the host crops should be compared in the area of origin and the PRA area, to determine if there are similarities or differences.

- Are there natural enemies that could affect pest establishment?

- Is control or eradication possible once the pests is introduced and established? Pests for which control or eradication is not feasible may present a greater risk than those for which treatment is easily accomplished.

Cultural practices and control measures	
Important assumptions	

4. Other characteristics of the pest affecting the probability of establishment

- Will the pest be able to reproduce in the PRA area? How many generations are possible? Are there reproductive strategies that might confer an advantage? Consider characteristics such as parthenogenesis / self-crossing, duration of the life cycle, number of generations per year, resting stage, etc.
- Is the species polymorphic? Does it have a demonstrated ability to adapt to new habitats or hosts? Genotypic (and phenotypic) variability facilitates a pest's ability to withstand environmental fluctuations, to adapt to a wider range of habitats, to develop pesticide resistance and to overcome host resistance.
- Is there a threshold population required for establishment?
- Is there a requirement for alternate hosts, dormancy or vectors which make establishment more or less likely?

Other characteristics affecting establishment	
Important assumptions	

5. Summary of the probability of establishment

In summary, what is the anticipated final distribution of the pest relative to its hosts' distribution in the PRA area?

Probability of establishment	
Important assumptions	
Sources of Uncertainty	

Points for discussion:

- What additional information would be useful for completing this section and where might it be obtained?
- What is the value of qualitative vs. quantitative information in this section?
- What are some of the climatic models that could be used to estimate the pest's range in the PRA area? What are the advantages and disadvantages of using climatic models instead of manual climate matching with maps and data?

4.4. 4D: POTENTIAL ECONOMIC CONSEQUENCES

The impact assessment for PRA is to determine pest impact in regions where pest occurs already, not whether the pest causes major, minor or no damage or if it causes damage frequently or infrequently.

Requirements described in this step indicate what information relative to the pest and its potential host plants should be assembled, and suggest levels of economic analysis that may be carried out using that information in order to assess all the effects of the pest, i.e. the potential economic consequences. Wherever appropriate, quantitative data that will provide monetary values should be obtained. Qualitative data may also be used. Consultation with an economist may be useful. This aspect of the PRA relates as much as possible, to biotic and abiotic effects.

When assessing economic consequences it is important to consider effect of pest-induced changes on:

- Producer profits resulting from changes in production costs, yields and prices
- Crop losses or crop failure resulting in loss of customers
- Quantities demanded or prices paid for commodities by domestic and international customers

In many instances, detailed analysis of the estimated economic consequences is not necessary if there is sufficient evidence or it is widely agreed that the introduction of a pest will have unacceptable economic consequences (including environmental consequences). In such cases, risk assessment will primarily focus on the probability of introduction and spread. It will, however, be necessary to examine economic factors in greater detail when the level of economic consequences is in question, or when the level of economic consequences is needed to evaluate the strength of measures used for risk management or in assessing the cost-benefit of exclusion or control.

In order to estimate the potential economic importance of the pest(**Pest effects**), information should be obtained from areas where the pest occurs naturally or has been introduced. This information should be compared with the situation in the PRA area. Case histories concerning comparable pests can usefully be considered. The effects considered may be direct or indirect.

The basic method for estimating the potential economic importance of pests in this section also applies to:

- Pests affecting uncultivated/unmanaged plants
- Weeds and/or invasive plants
- Pests affecting plants through effects on other organisms.

In the case of plants to be imported for planting, the long-term consequences for the intended habitat may be included in the assessment. Planting may affect further use or have a harmful effect on the intended habitat.

Environmental effects and consequences considered should result from effects on plants. Such effects, however, on plants may be less significant than the effects and/or consequences on other organisms or systems. For example, a minor weed may be significantly allergenic for humans or a minor plant pathogen may produce toxins that seriously affect livestock. However, the regulation of plants solely on the basis of their effects on other organisms or systems (e.g. on human or animal health) is outside the scope of this standard. If the PRA process reveals evidence of a potential hazard to other organisms or systems, this should be communicated to the appropriate authorities which have the legal responsibility to deal with the issue.

Direct pest effects are considered through assessing/ understanding known or potential host plants (in the field, under protected cultivation, or in the wild); types, amount and frequency of damage; crop losses, in yield and quality; biotic factors (e.g. adaptability and virulence of the pest) affecting damage and losses

- Abiotic factors (e.g. climate) affecting damage and losses
- Rate of spread
- Rate of reproduction
- Control measures (including existing measures), their efficacy and cost
- Effect on existing production practices
- Environmental effects.

In the case of the analysis of environmental risks, examples of **direct pest effects** on plants and/or their environmental consequences that could be considered include:

- Reduction of keystone plant species
- Reduction of plant species that are major components of ecosystems (in terms of abundance or size), and endangered native plant species (including effects below species level where there is evidence of such effects being significant)
- Significant reduction, displacement or elimination of other plant species.

The estimation of the area potentially endangered should relate to these effects.

For identification and characterization of the **indirect effects** of the pest in the PRA area, or those effects that are not host-specific, the following are examples that could be considered:

- Effects on domestic and export markets, including in particular effects on export market access. The potential consequences for market access which may result if the pest becomes established, should be estimated. This involves considering the extent of any phytosanitary regulations imposed (or likely to be imposed) by trading partners
- Changes to producer costs or input demands, including control costs
- Changes to domestic or foreign consumer demand for a product resulting from quality changes
- Environmental and other undesired effects of control measures
- Feasibility and cost of eradication or containment
- Capacity to act as a vector for other pests
- Resources needed for additional research and advice
- Social and other effects (e.g. tourism).

In the case of the analysis of environmental risks, examples of indirect pest effects on plants and/or their environmental consequences that could be considered include:

- Significant effects on plant communities
- Significant effects on designated environmentally sensitive or protected areas
- Significant change in ecological processes and the structure, stability or processes of an ecosystem (including further effects on plant species, erosion, water table changes, increased fire hazard, nutrient cycling, etc.)
- Effects on human use (e.g. water quality, recreational uses, tourism, animal grazing, hunting, fishing)
- Costs of environmental restoration.

Effects on human and animal health (e.g. toxicity, allergenicity), water tables, tourism, etc. could also be considered, as appropriate.

Analysis of economic consequences: In practice, economic consequences are expressed with **time**, and may concern one year, several years or an indeterminate period. Various scenarios should be considered. The total economic consequences over more than one year

can be expressed as net present value of annual economic consequences, and an appropriate discount rate selected to calculate net present value.

Other scenarios could concern whether the pest occurs at one, few or many points in the PRA area and the expression of potential economic consequences will depend on the rate and manner of spread in the PRA area. The rate of spread may be envisaged to be slow or rapid; in some cases, it may be supposed that spread can be prevented. Appropriate analysis may be used to estimate potential economic consequences over the period of time when a pest is spreading in the PRA area. In addition, many of the factors or effects considered above could be expected to change over time, with the consequent effects of potential economic consequences. Expert judgement and estimations will be required.

Notably, most of the direct effects of a pest, and some of the indirect effects will be of a commercial nature, or have consequences for an identified market. These effects, which may be positive or negative, should be identified and quantified. The following may usefully be considered:

- Effect of pest-induced changes to producer profits that result from changes in production costs, yields or prices
- Effect of pest-induced changes in quantities demanded or prices paid for commodities by domestic and international consumers. This could include quality changes in products and/or quarantine-related trade restrictions resulting from a pest introduction.

Analytical techniques: There are analytical techniques which can be used in consultation with experts in economics to make a more detailed analysis of the potential economic effects of a quarantine pest. These should incorporate all of the effects that have been identified. These techniques may include:

Partial budgeting - this will be adequate if the economic effects induced by the action of the pest to producer profits are generally limited to producers and are considered to be relatively minor

Partial equilibrium - this is recommended if, there is a significant change in producer profits, or if there is a significant change in consumer demand. Partial equilibrium analysis is necessary to measure welfare changes, or the net changes arising from the pest impacts on producers and consumers

General equilibrium - if the economic changes are significant to a national economy, and could cause changes to factors such as wages, interest rates or exchange rates, then general equilibrium analysis could be used to establish the full range of economic effects.

The use of analytical techniques is often limited by lack of data, by uncertainties in the data, and by the fact that for certain effects only qualitative information can be provided.

Some of the direct and indirect effects of the introduction of a pest determined will be of an economic nature, or affect some type of value, but not have an existing market which can be easily identified. As a result, the effects may not be adequately measured in terms of prices in established product or service markets. Examples include in particular environmental effects (such as ecosystem stability, biodiversity, amenity value) and social effects (such as employment, tourism) arising from a pest introduction. These impacts could be approximated with an appropriate non-market valuation method. More details on environment are given below.

If quantitative measurement of such consequences is not feasible, qualitative information about the consequences may be provided. An explanation of how this information has been incorporated into decisions should also be provided.

Application of this standard to environmental hazards requires clear categorization of environmental values and how they can be assessed. The environment can be valued using different methodologies, but these methodologies are best used in consultation with experts in economics. Methodologies may include consideration of “use” and “non-use” values. “Use” values arise from consumption of an element of the environment, such as accessing clean water, or fishing in a lake, and also those that are non-consumptive, such as use of forests for leisure activities. “Non-use” values may be subdivided into:

- Option value (value for use at a later date)
- Existence value (knowledge that an element of the environment exists)
- Bequest value (knowledge that an element of the environment is available for future generations).

Whether the element of the environment is being assessed in terms of use or non-use values, methods exist for their valuation, such as market-based approaches, surrogate markets, simulated markets, and benefit transfer. Each has advantages, disadvantages and situations where it is particularly useful.

The assessment of consequences may be either quantitative or qualitative and in many cases, qualitative data is sufficient. A quantitative method may not exist to address a situation (e.g. catastrophic effects on a keystone species), or a quantitative analysis may not be possible (no methods available). Useful analyses can be based on non-monetary valuations (number of species affected, water quality), or expert judgement, if the analyses follow documented, consistent and transparent procedures.

Economic impact is described in ISPM No. 5 Glossary of phytosanitary terms, Supplement No. 2: Guidelines on the understanding of potential economic importance and related terms.

Wherever appropriate, the output of the assessment of economic consequences described should be in terms of a monetary value. The economic consequences can also be expressed qualitatively or using quantitative measures without monetary terms. Sources of information, assumptions and methods of analysis should be clearly specified.

Exercise:

Thrips palmi is an EU quarantine pest with a wide range of commercial hosts including Aubergines, Cucumbers, Sweet peppers and several ornamentals. The insect is a vector for plant viruses such as the Melon spotted wilt virus and Watermelon silver mottle virus. A farmer growing Chrysanthemum in a glasshouse discovered the insect in the glass house in April of 2000 and initiated treatments to control the spread. Although not damaging to the farmers crop there are many other glasshouses nearby with cucumbers, aubergines and peppers. The management costs (treatments and labour) are depicted in graph (see Fig 6).

The management costs did not affect sales however, the farmer now needed to incur additional production costs in the form of Pesticide spray, Soil fumigation (methyl bromide), Treated compost, and Plastic sheeting which caused additional labour. His margin thus fell by between 13 and 18%.

The trainees should answer the following questions:

i. What less costly measures could be implemented to prevent establishment of the pest or its movement to glasshouses where it could have done damage?
ii. What were the extra costs to the farmer?

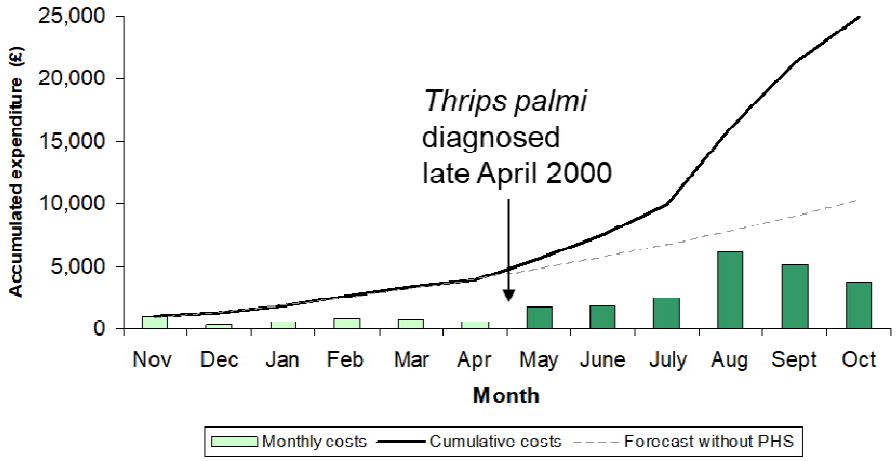


Figure 6: Costs associated with management of *Thrips palmi* in a Chrysanthemum glasshouse

Note to the trainer: It is useful to draw out of the discussion the importance of use of available resources in this case biological and financial & Economic data, and ensuring that the tools for these are understood (models). The discussion should also capture the limitations of conducting such an analysis due to the rare instance of economists & biologists working together, the need to assess impacts with little information (in this case the mechanisms to prevent entry to the other glasshouses is not known); quantification of environmental impacts (as the glasshouse is a controlled environment); scaling up from local to national impacts and modelling changes in impacts over time

4.5. 4E: OVERALL ASSESSMENT OF RISK AND UNCERTAINTY

Step 3: Assessment of potential consequences resulting from pest entry, establishment and spread. The potential impacts that can potentially result from a pest's introduction and spread are to be identified, described and, as much as possible, quantified. The assessment of the impacts should focus on economic, environmental and or social aspects considering the impacts in areas where the pest is already present, and in areas where it has spread to inform on potential consequences. Impacts reported from invaded areas are recognized as the best indicator of potential impacts in the PRA area. For environmental impacts, if the pest has not previously spread then the absence of any environmental impact in the area of pest origin should not be interpreted to mean that no environmental impact should be expected in the PRA area. This is because environmental impacts are difficult to predict and a lack of impact in the origin is not a good predictor that there will be no impacts in regions where a pest is introduced.

Recognising that risk is a combination of likelihood and consequences, the results of steps 2 and 3 are combined to provide an overall estimation of pest risk.

Very often there is a lack of data necessary to reach secure conclusions, and thus PRA can be relatively subjective. It is important to understand the premises under which decisions are made using data and information from a PRA as estimates and extrapolations may be made from real situations where the pest occurs to a hypothetical situation in the pest risk analysis area. In other situations, it is necessary to use historical data to forecast potential future events.

It is important to document the areas of and the degree of uncertainty in the PRA, and to indicate where expert judgement has been used. This is enables transparency and may contribute to identifying and prioritizing research needs.

As a result of the pest risk assessment, all or some of the categorized pests may be considered appropriate for pest risk management. For each pest, all or part of the PRA area may be identified as an endangered area. A quantitative or qualitative estimate of the probability of introduction of a pest or pests, and a corresponding quantitative or qualitative estimate of economic consequences (including environmental consequences), have been obtained and documented or an overall rating could have been assigned. These estimates, with associated uncertainties, are utilized in the pest risk management stage of the PRA.

Exercise:

Using the attached sheet on a quarantine pest for Cameroon i.e. *Trioza erytreae* consider the following and fill out the PRA table provided below:

SCENARIO: The Plant Quarantine Organisation of Cameroon (MINADER) has received a request to import a new variety of oranges from Europe for multiplication and propagation in in the country. Production of citrus fruits in Cameroon is on the rise and farmers are increasing growing large areas of tangerines, lemons, limes in considerable quantity and the market is growing. Citrus production in Cameroon, was estimated at just over 5 million tons in2017, with an export value of 45 million USD.

A PRA has been initiated to determine the risk to Cameroon's citrus industry presented by the potential importation of cuttings from the Mediterranean. A preliminary review of pests in the country of origin focussed concern on citrus greening bacterium.

Using the pest facts sheet provided for *Trioza erytreae* complete as much of the Pest Risk Assessment Summary Table below as possible. Furthermore, identify further information that is required to complete the Pest Risk Assessment.

Stage 1 initiation	
Initiation Point	How do the cuttings enter Cameroon?
PRA area	What is the anticipated distribution area?
Pest Risk Assessment	
Pest Identity	
Pest type	
Presence in PRA area	Yes/ No Provide some remarks if applicable
Does it meet the definition of a quarantine pest	Yes/ No
Type(s) and volumes of pathways	
Probability of entry	

Probability of establishment	
Probability of spread	
Overall probability of introduction and spread	
Sources of uncertainity	
Potential direct economic consequences	
Potential direct environmental consequences	
Potential indirect economic consequences	
Potential indirect environmental consequences	
Sources of uncertainty	
Overall risk	
Overall uncertainty	
Acceptability of overall risk	

Missing information.

Note to trainer: The aim of the exercise is to draw out the overall understanding of the course from the trainees and thus the table may or may not be completed by the one example given due to the available information. The exercise should try to encourage trainees to seek additional information and apply the knowledge gained from all the modules to fill out the table to the best possible level such that a recommendation on whether the PRA is needed or not can be reached.

4.6. RECOMMENDED READING

i. Morse, L.E., J.M. Randall, N. Benton, R. Hiebert, and S. Lu. 2004. An Invasive Species Assessment Protocol: Evaluating Non-Native Plants for Their Impact on Biodiversity. Version 1. Nature Serve, Arlington, Virginia

ii. UNEP/CBD/BS/AHTEG-RA&RM/5/INF/1 (2014). Revised training manual on risk assessment of living modified organisms UNEP/CBD/BS/COP-MOP/7/1.

iii. Mark C. Andersen, Heather Adams, Bruce Hope, and Mark Powell (2004): Risk Assessment for Invasive Species. Risk Analysis, Vol. 24, No. 4 pp 787-793.

iv. FAO, IPPC, Pest Risk Analysis Training Instructor Manual

v. MINEPDED (2012) a. Training Manual: Introduction to the integrated management of biological invasions using the principles of the ecosystem approach.

vi. MINEPDED (2014). The quantification of the social, cultural, economic, environmental and biological impact of priority invasive species in Cameroon. Report submitted to MINEPDED under the UNEP/GEF Cameroon Biosecurity Project: Development and Institution of a National Monitoring and Control System (Framework) for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS). Yaoundé, Cameroon

vii. MINEPDED (2013). The Current Biosecurity Profile from Trade and other Activities of Cameroon. Report submitted to MINEPDED under the UNEP/GEF Cameroon Biosecurity Project: Development and Institution of a National Monitoring and Control System (Framework) for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS). Yaoundé, Cameroon.

viii. SCBD (2016). Guidance on Risk Assessment of Living Modified Organisms and Monitoring in the Context of Risk Assessment

ix. UNEP/CBD/BS/COP-MOP/7/INF/6 (2014). Training Manual on Risk Assessment of Living Modified Organisms in the context of the Cartagena Protocol on Biosafety- http://bch.cbd.int/cpb_art15/training.shtml Pyeongchang, Korea, October 2014.

x. Van Eenennaam (2013). GMOs in animal agriculture: time to consider both costs and benefits in regulatory evaluations. Journal of Animal Science and Biotechnology, 4:37. http://www.jasbsci.com/content/4/1/37

xi. WTO's SPS Agreement. Article 5 addressing appropriate level of sanitary or phytosanitary protection. Article 3 of the SPS Agreement recognizes the standards, guidelines and recommendations set by IPPC, OIE and Codex Alimentarius Commission- http://www.wto.org/int

xii. MINEPDED (2013). The Current Biosecurity Profile from Trade and other Activities of Cameroon. Report submitted to MINEPDED under the UNEP/GEF Cameroon

Biosecurity Project: Development and Institution of a National Monitoring and Control System (Framework) for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS). Yaoundé, Cameroon

xiii. MINEPDED (2015). Black and white lists of priority invasive species and management approaches for Cameroon. Report prepared by John Mauremootoo (John@InspiralPathways.com) and Augustine Bokwe (v_cefai2002@yahoo.co.uk) under the supervision of The Project Component 4 Interministerial Task Team (Task team institutions: MINRESI, MINEPDED, MINEPIA, MINADER), as part of the Cameroon Biosecurity Project. MINEPDED, P.O. Box 320, Yaoundé, Cameroon to MINEPDED under the UNEP/GEF Cameroon Biosecurity Project: Development and Institution of a National Monitoring and Control System (Framework) for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS). Yaoundé, Cameroon.

MODULE 5: PEST RISK MANAGEMENT

Purpose: To enable trainees to understand the broad principles and practises of pest risk assessment and management

Suggested delivery time: 1- 2 hrs

Format: PowerPoint presentation followed by a plenary discussion and exercises

Expected outcomes: By the end of the session, trainees will be able to:

- Identify the information needs and premises for conduct of a risk assessment (source, likelihood and consequences)
- Categorise the levels of containment and confinement for pests, LMOs and IAS and their feasibility in Cameroon
- Identify roles and responsibilities for pest, LMOs and IAS risk assessment and management.

For quarantine pests, pest risk management is the process of evaluation and selection of options to reduce the risk of introduction and spread of the pest. Conclusions from the pest risk assessment are used to support decisions regarding the level of risk presented by the pest. If a pest is judged to present an unacceptable risk then phytosanitary measures should be identified that will reduce the risk to an acceptable level. Phytosanitary measures should accord with IPPC principles of necessity, managed risk, minimal impact, transparency, harmonization, non-discrimination and technical justification.

The principle of "**managed risk**" (ISPM No. 1: Principles of plant quarantine as related to international trade) states that: "Because some risk of introduction of a quarantine pest always exists, countries generally agree to a policy of risk management when formulating phytosanitary measures." In implementing this principle, countries adecision on the **level of risk** is acceptable is agreed.

Overall risk is determined by the examination of the outputs of the assessments of the probability of introduction and the economic impact. If the risk is found to be unacceptable, then the first step in risk management is to identify possible phytosanitary measures that will reduce the risk to, or below an acceptable level. Measures are not justified if the risk is already acceptable or must be accepted because it is not manageable (as may be the case with natural spread). The Competent authority may decide that a low level of monitoring or audit is maintained to ensure that future changes in the pest risk are identified.

Appropriate measures should be chosen based on their effectiveness in reducing the probability of introduction of the pest. The choice should be based on the following considerations, which include several of the Principles of plant quarantine as related to international trade (ISPM No. 1):

- *Phytosanitary measures shown to be cost-effective and feasible* - The benefit from the use of phytosanitary measures is that the pest will not be introduced and the PRA area will, consequently, not be subjected to the potential economic consequences. The cost-benefit analysis for each of the minimum measures found to provide acceptable security may be estimated. Those measures with an acceptable benefit-to-cost ratio should be considered.
- *Principle of "minimal impact"* - Measures should not be more trade restrictive than necessary. Measures should be applied to the minimum area necessary for the effective protection of the endangered area.
- *Reassessment of previous requirements* - No additional measures should be imposed if existing measures are effective.
- *Principle of "equivalence"* - If different phytosanitary measures with the same effect are identified, they should be accepted as alternatives.
- *Principle of "non-discrimination"* - If the pest under consideration is established in the PRA area but of limited distribution and under official control, the phytosanitary measures in relation to import should not be more stringent than those applied within the PRA area. Likewise, phytosanitary measures should not discriminate between exporting countries of the same phytosanitary status. This principle also applies to: pests affecting uncultivated/unmanaged plants; weeds and/or invasive plants and pests affecting plants through effects on other organisms.

If any of these become established in the PRA area and if official control is applied, then phytosanitary measures at import should not be more stringent than the official control measures.

The major risk of introduction of plant pests is with **imported consignments** of plants and plant products, but (especially for a PRA performed on a particular pest) it is necessary to consider the risk of introduction with other types of pathways (e.g. packing materials, conveyances, travellers and their luggage, and the natural spread of a pest).

Common measures applied to traded commodities aim to prevent or reduce original infestation in the crop; to ensure the area or place of production is free from the pest and where necessary prohibit commodities. The measures are applied to pathways, usually

consignments of a host, from a specific origin and should be as precise as possible as to consignment type (hosts, parts of plants) and origin so as not to act as barriers to trade by limiting the import of products where this is not justified. Combinations of two or more measures may be needed in order to reduce the risk to an acceptable level. The available measures can be classified into broad categories which relate to the pest status of the pathway in the country of origin.

For consignments measures may include any combinations of the following:

- *Inspection* or testing for freedom from a pest or to a specified pest tolerance; sample size should be adequate to give an acceptable probability of detecting the pest
- *Prohibition* of parts of the host
- *A pre-entry or post-entry quarantine system* - this system could be considered to be the most intensive form of inspection or testing where suitable facilities and resources are available, and may be the only option for certain pests not detectable on entry
- *Specified conditions of preparation* of the consignment (e.g. handling to prevent infestation or re-infestation)
- *Specified treatment of the consignment* - such treatments are applied post-harvest and could include chemical, thermal, irradiation or other physical methods
- Restrictions on end use, distribution and periods of entry of the commodity.

Measures may also be applied to restrict the import of consignments of pests. The concept of consignments of pests may be applied to the import of plants considered to be pests. These consignments may be restricted to species or varieties posing less risk.

Preventing or reducing infestation in the crop could be managed through treatment of the crop, field, or place of production

- Restriction of the composition of a consignment so that it is composed of plants belonging to resistant or less susceptible species
- Growing plants under specially protected conditions (glasshouse, isolation)
- Harvesting of plants at a certain age or a specified time of year
- Production in a certification scheme. An officially monitored plant production scheme usually involves a number of carefully controlled generations, beginning with nuclear stock plants of high health status. It may be specified that the plants be derived from plants within a limited number of generations.

Pest Risk Management for areas, place or site of production or crop may include:

- Requirements for pest-free area status as described in ISPM No. 4.
- Pest-free place of production or pest-free production site as described in ISPM No. 10
- Inspection of crop to confirm pest freedom.

Additional management measures for pest risk include:

- Containment or eradication, supported by suppression and surveillance, in the PRA area after entry of the pest particularly if natural spread of a pest includes movement of the pest by flight, wind dispersal, transport by vectors such as insects or birds and natural migration. If the pest is entering the PRA area by natural spread, or is likely to enter in the immediate future, phytosanitary measures may have little effect.
- Measures for human travellers and their baggage could include targeted inspections, publicity and fines or incentives. In a few cases, treatments may be possible.
- Contaminated machinery or modes of transport (ships, trains, planes and road transport) could be subjected to cleaning or disinfestation.

Risk management measures for **imported commodities** include careful surveillance to try and detect the entry of the pest as early as possible, eradication programmes to eliminate any foci of infestation and/or containment action to limit spread.

For plants to be imported, where there is a high level of uncertainty regarding pest risk, it may be decided not to take phytosanitary measures at import, but only to apply surveillance or other procedures after entry (e.g. by or under the supervision of the NPPO).

If no satisfactory measure to reduce risk to an acceptable level can be found, the final option may be to **prohibit importation** of the relevant commodities. This should be viewed as a measure of last resort and should be considered in light of the anticipated efficacy, especially in instances where the incentives for illegal import may be significant.

Risk management includes the consideration of appropriate compliance procedures. The most important of these is export certification (see ISPM No. 7: Export certification system). The issuance of phytosanitary certificates (see ISPM No. 12: Guidelines for Phytosanitary Certificates) provides official assurance that a consignment is “considered to be free from the quarantine pests specified by the importing contracting party and to conform with the current phytosanitary requirements of the importing contracting party.” It thus confirms that the specified risk management options have been followed. An additional declaration may be

required to indicate that a particular measure has been carried out. Other compliance measures may be used subject to bilateral or multilateral agreement.

The result of the pest risk management will be either that no measures are identified which are considered appropriate or the selection of one or more management options that have been found to lower the risk associated with the pest(s) to an acceptable level.

It is noted that the communication of risks associated with environmental hazards is of particular importance to promote awareness.

5.1. MONITORING AND REVIEW OF PHYTOSANITARY MEASURES

The principle of “modification” states: “As conditions change, and as new facts become available, phytosanitary measures shall be modified promptly, either by inclusion of prohibitions, restrictions or requirements necessary for their success, or by removal of those found to be unnecessary” (ISPM No. 1: Principles of plant quarantine as related to international trade).

Thus, the implementation of particular phytosanitary measures should not be considered to be permanent. After application, the success of the measures in achieving their aim should be determined by monitoring during use. This is often achieved by inspection of the commodity on arrival, noting any interceptions or any entries of the pest to the PRA area. The information supporting the pest risk analysis should be periodically reviewed to ensure that any new information that becomes available does not invalidate the decision taken.

In considering the management of environmental risks, it should be stressed that phytosanitary measures are intended to account for uncertainty and should be designed in proportion to the risk. Pest risk management options should be identified, taking account of the degree of uncertainty in the assessment of economic consequences, probability of introduction, and the respective technical justification of those options. In this respect, the management of risks to the environment caused by plant pests does not differ from the management of other plant pest risks.

Exercise:

Pest risk management is a process of determining appropriate management options to reduce the risks identified in the pest risk assessment to an acceptable level.

Scenario:

A country on the opposite side of the world from yours has a successful tomato growing industry. The country's NPPO has contacted your NPPO and requested your country's import requirements for their tomatoes. Your country does not currently have import requirements for tomatoes so you reply to the other country asking them for information about the pests they have on tomatoes and their associated agricultural production systems. The letter you receive in reply is as follows:

> Dear NPPO,
>
> Our tomato industry is one of the best in the world at producing low cost, high quality product. Our climate is perfectly suited to large scale outdoor production of tomatoes that are hand picked, packaged and refrigerated for maximum quality and freshness. Our tomato industry is formed from a co-operative of many small to medium growers that maintain their own production management systems but share large scale packaging and refrigeration facilities. We have a number of pests that affect our tomato production but our scientists tell us that only one of these pests is not already established in your country - the tomato fruit beetle, *Dispictus tomatocus*.
>
> We look forward to hearing from you soon and shipping our first consignment of delicious tomatoes to your country.
>
> Regards

Information about the country suggests that they do produce large volumes of low cost tomatoes but the quality of the tomatoes is not always consistent, suffering from mechanical damage, varying ripeness, inconsistent size or shape, and pest injury and contamination.

Information about the tomato fruit beetle, *Dispictus tomatocus*, indicates that the adults lay their eggs on mature or nearly mature fruit. Symptoms of infestation only become apparent several days later once the larvae begin to move under the skin of the tomato. Larvae mature within 15 days unless the weather is cooler than normal and the larvae go into a dormant stage surviving for up to 6 months.

You have completed a risk assessment which concludes that the tomato fruit beetle risk associated with imported fresh tomatoes is unacceptable. You proceed to Stage 3 of the PRA process to consider potential mitigation measures which would lower the level of overall risk to an acceptable level.

When all the risk management options have been identified for a particular risk or group of risks, they should each be evaluated to ensure they will mitigate the risk to the desired level either alone or in combination with other measures. At the same time it is also useful to evaluate each option to ensure they are feasible or applicable to the context in which they are to be applied.

For the scenario described above, identify potential risk management options from the list developed in today's group discussion. Analyse these options against the criteria listed in the table below. Note what type of information would be required to complete the risk management stage of this PRA and potential sources for that information.

Table 4Risk management options for import of tomatoes

Potential management options	**Effectiveness**	**Efficiency**	**Reproducibility**	**Cost effectiveness**	**Potential adverse consequences**	**Costs**	**Indirect impacts**

5.2. RECOMMENDED READING

i. MINEPDED, 2015. Report on the formulation of risk management strategies for biological invasion pathways in Cameroon. Consultant Report prepared under the UNEP/GEF Cameroon Biosecurity Project "Development and Institution of a National Monitoring and Control System (Framework) for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS)" as part of the Cameroon Biosecurity Project. Yaoundé, Cameroon.

ii. Traynor, PL, Adair, D and R Irwin. (2001). A Practical Guide to Containment. Greenhouse research with transgenic plants and microbes. ISB. Virginia Tech. http://www.isb.vt.edu

iii. MINEPDED (2014), Report on Contingency Plans with Emergency Response exercises for biological invasions in Cameroon. Report submitted to MINEPDED under the UNEP/GEF Cameroon Biosecurity Project: Development and Institution of a National Monitoring and Control System (Framework) for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS). Yaoundé, Cameroon.

MODULE 6: PEST RISK COMMUNICATION

Purpose: To enhance the understanding of packaging information for decision making and factors that influence.

Suggested delivery time: 1- 2 hrs

Format: PowerPoint presentation followed by a plenary discussion and exercises

Expected outcomes: By the end of the session, trainees will be able to:

- Establish basic principles on delivering messages for communication of risk
- Identify stakeholder needs for communication
- Acknowledge need for strategy in communication
- Under complex dynamics in delivery of messages and the consequences for management and decision making

Effective risk communication is an integral and essential part of any risk analysis programme. Whether the problem calls for care, crisis or consensus communication, there are no prescriptive answers; what works in some cases is inappropriate or ineffective in other cases. Risk communication is a broad field that seeks to integrate scientific knowledge with social values, and the approaches, objectives and outcomes of risk communication will be as varied as the risks themselves. Nonetheless, risk analysis experience in other disciplines can provide a useful paradigm for risk communication applied in pest risk analysis (see Box 15.3). In short, these rules state that risk communicators should plan their efforts, be honest, involve the public and work to develop a reputation as being trustworthy. By including risk communication as part of the normal routine of pest risk analysis programmes, NPPOs can ensure that their risk management and decision making will be fair, more positively received by affected groups and more effectively implemented in the long run. The identification of particular interest groups and their representatives should comprise a part of an overall risk communication strategy. This risk communication strategy should be discussed and agreed upon between risk assessors and managers early in the process to ensure two-way communication. This strategy should also cover who should present information to the public, and the manner in which it will be done. Decisions on risk communication, including what, whom and how, should be part of an overall risk communication strategy. Risk communication is most effective if undertaken in a systematic way, and generally starts with the gathering of information on the risk issue of concern. Therefore the risk manager and risk assessor must be able to briefly and clearly summarize what this issue encompasses, at an early stage, in order to elicit interest and stakeholder input. Communication must then continue throughout the entire process. Once available information has been used to fully identify the hazards, and decide on and assess the

appropriate risks, then the preparation and dissemination of this information is required. This will be followed by further discussion with stakeholders, leading to corrections, amendments and additions as appropriate, resulting in the final risk assessment and risk analysis reports.

6.1. DOCUMENTATION

The IPPC and the principle of “transparency” (ISPM No. 1: Principles of plant quarantine as related to international trade) require that countries should, on request, make available the rationale for phytosanitary requirements. The whole process from initiation to pest risk management should be sufficiently documented so that when a review or a dispute arises, the sources of information and rationale used in reaching the management decision can be clearly demonstrated.

- The main elements of documentation are:
- Purpose for the PRA
- Pest, pest list, pathways, PRA area, endangered area
- Sources of information
- Categorized pest list
- Conclusions of risk assessment
- Probability
- Consequences
- Risk management - options identified and selected
- The phytosanitary situation in a country changes, a new country is created, or political boundaries have changed.

Risk managers should be concerned about plant and animal pests as well as effects of Living Modified Organisms and Alien Invasive Species in the environment. Hence risk analysis and risk assessment should be integrated with human health and the environment. There are advantages for this integration.

a) Cohesive advice to risk managers and a consistent message to stakeholders
b) Interdependence of human and ecological health
c) Provision of sentinel organisms for potential human impacts
d) Improved scientific quality and efficiency
e) Proper consideration of the environment
f) Integration, the environment, and risk assessment

Exercise: Stakeholder Consultation

Pest risk communication does not begin at the conclusion of the pest risk management stage. It is an ongoing, two-way process which occurs before, during and after the PRA is completed. Pest risk communication takes many forms, including personal communications, face-to-face informal gatherings, written correspondence, formal presentations or structured consultations. Each stage has its purpose, audience and challenges.

In this exercise, each group will assume the role of a particular party in this scenario, i.e., the NPPO, the importer, or a domestic producer, and will consider the situation from that point of view. After 30 minutes' preparation time, the groups will reconvene for a public meeting, at which the NPPO will present its PRA, the proposed response to the current interception and a proposed new import requirement for cut flowers from Africa. The importer and domestic producer groups will ask questions and present their points of view on this issue.

Group 1: NPPO representatives

You are a phytosanitary official in the NPPO of Cameroon. You have completed your PRA and have identified possible mitigation measures (or sequence of measures) which will provide satisfactory protection to deal with the pest in question, and have drafted revised import regulations to prevent future introductions on this pathway. IPPC member countries are obligated to publish phytosanitary requirements and share information on pests and regulations.

Prepare to inform stakeholders of new import requirements resulting from the PRA that has just been completed. Be ready to answer questions which will arise.

Group 2: Importers of cut flowers in Cameroon

You have traditionally imported cut flowers from another African country without phytosanitary restrictions for several years. You have a customer who is buys large orders of cut flowers from this particular African country. You have been informed that the NPPO is conducting a PRA and will inform you of revised import requirements shortly.

What are your questions for the NPPO? Do you have concerns regarding restrictive import requirements? What will be the impact on your business if import restrictions are put in place?

Group 3: Domestic producers' association

You are members of a large domestic producers' association with interests in a wide range of agricultural and horticultural products in Cameroon. Your members own and operate farming operations that employ many hundreds of people and produce food and plant products for sale on the domestic and export market. What are your concerns in this situation? What is your position with respect to the decision your NPPO is taking?

Prepare to present your arguments to your NPPO in defence of your position. Explain your position. Identify others who support this position.

Points for Discussion:

- Who are the potential stakeholders in this issue?
- Besides stakeholders, who else should be consulted?
- What are their potential concerns?
- How might these concerns be addressed?
- What communications strategies could be employed in this instance?

6.2. RECOMMENDED READING

i. MINEPDED (2015). National Biological Invasions Communications and Awareness-raising Plan for Cameroon. Report prepared by John Mauremootoo (John@InspiralPathways.com) and Dora Shey (sheyilla@yahoo.fr) under the supervision of The Project Component 4 Interministerial Task Team (Task team institutions: MINADER, MINEPDED, MINEPIA, MINRESI), as part of the Cameroon Biosecurity Project. MINEPDED, P.O. Box 320, Yaoundé, Cameroon to MINEPDED under the UNEP/GEF Cameroon Biosecurity Project: Development and Institution of a National Monitoring and Control System (Framework) for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS). Yaoundé, Cameroon.

ANNEXES

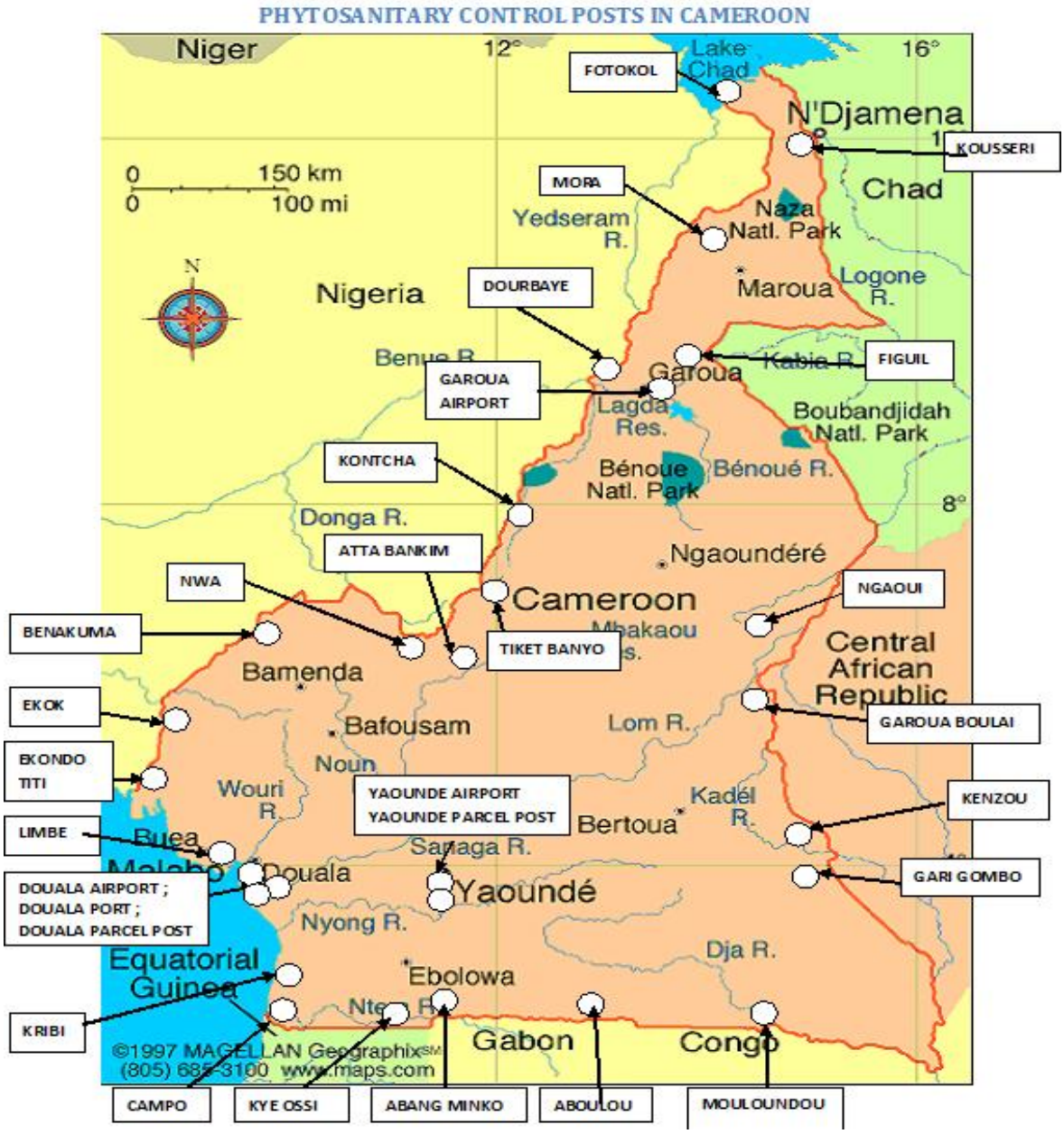
Annex 1: Phytosanitary Control Posts in Cameroon by Region

N°	REGION	LOCATION	REFERENCE (Date of creation)
1	Adamaoua	Tiket-Banyo	Order n°028/92/MINAGRI of 13 November 1992
2		Kontcha	
3		Atta-Bankim	Order n°028/92/MINAGRI of 13 Novemberr 1992
4		Ngaoui	
5	Centre	Yaoude–Nsimalen Airoport	Order n°97/0045/A/MINAGRI/DOA/SDPV/SQV of 1997
6		Parcel Post Office, Yaounde	Order n°97/0045/A/MINAGRI/DOA/SDPV/SQV of 1997
7	East	Garoua boulaï.	
8		Gari-gombo	Order n°97/0045/A/MINAGRI/DOA/SDPV/SQV of 1997
9		Kenzou	Order n°97/0045/A/MINAGRI/DOA/SDPV/SQV of 1997
10		Mouloundu	Order n°97/0045/A/MINAGRI/DOA/SDPV/SQV of 1997
11	Far North	Kousseri	
12		Mora	Decree n°83/084/MINAGRI of 14 February 1983

14		Fotokol	
14	Littoral	Douala port	
15		Douala Aéroport	Decree n°031/MINAGRI of 5 September 1983
16		Parcel Post Office Douala	
17	North	Garuoa Aéroport	Decree n°83/084/MINAGRI of 14 February 1983
18		Figuil	
19		Dourbaye	
20	North West	Nwa,	Order n°028/92/MINAGRI of 13 November 1992
21		Benakouma	Order n°97/0045/A/MINAGRI/DOA/SDPV/SQV of 1997
22	South	Kribi	
23		Campo	
24		Abang Minko'o	
25		Kye Ossi.	
26		Aboulou	
27	South West	Limbé.	
28		Ekondo titi.	

29		Ekok	
	West		

Positions of Phytosanitary posts on the map



Map 0-1 Positions of Phytosanitary Posts on the map of Cameroon

Annex 2: Pre-Training Evaluation (a template)

Name: …….

Profession/ Expertise: ……...

Institution: ……

1. What do you understand of the concept Pest Risk Assessment?

……
……
……
……

2. Have you participated in/ observed/ read about Pest Risk Assessments?

a) Yes b) No

If you answered yes, can you elaborate?

……
……
……
……

3. To what extent do you expect this training will make a difference and or add responsibilities to your current job?

No Tremendous Difference Difference

Comments:

……

4. What are the three important things [or topics] that you expect to learn during this training?

a)

……

……

b)

……

……

c)

……

……

5. What kind of material and or exercises do you anticipate as being necessary to ensure learning is effective for the course?

……

……

……

……

6. Are you aware of the International Plant Protection Convention?

……

……

……

Annex 3: Draft Programme for Training of Trainers Workshop

TIME	Activity	RESPONSIBLE
DAY 1:		
08:30-09:00	Registration and Pre-workshop knowledge assessment	
SESSION 1: OPENING		
09:00-09:10	Welcome Remarks	
09:10-09:30	Official opening	
09:30-09:45	Introductions	**All**
09:45-09:50	Workshop purpose, objectives and learning approach	
09:50-10:00	Reflection on participant's expectation and fears	
10:00-10:30	Group Activity: Developing a shared understanding of key terms	**All**
10:30-10:45	**HEALTH BREAK**	
***MODULE 1:* INTRODUCTION TO PRA, STATUS OF LMO and IAS, and NATIONAL AND INTERNATIONAL REQUIREMENTS**		
10:45 - 11:45	Introduction to PRA	
11:45 – 12:45	Status of PRA and National Legislation	
12:45 – 13:00	Plenary discussion	
13:00-14:00	***LUNCH***	
14:00-14:45	International Obligations/ Agreements for PRA	

	of LMOs and IAS (IPPC, FAO, WHO, CPB, CABI etc.)	
14:45 – 15:20	Status of LMOs, IAS, and pests in Cameroon	
15:20 – 15:30	Plenary discussion	
15:30-15:45	**HEALTH BREAK**	
15:45-16:45	Group Activity – World Café (Raising issues)	**All**
16:45-17:00	Reflection on the day's proceedings	**All**

TIME	**Activity**	**RESPONSIBLE**
DAY 2:		
MODULE 3 and MODULE 4: PEST RISK ASSESSMENT AND MANAGEMENT		
09:00 - 09:45	PRA – principles and practise	
09:45 – 10:30	RA – principles and practise	
10:30-10:45	**HEALTH BREAK**	
10:45-12:00	Group Activity – Risk Assessment (contributing to decisions)	
12:00-13:00	Plenary discussion	
13:00-14:00	**LUNCH**	
14:00-15:15	Group Activity – Risk Management (limiting spread)	
15:15-15:30	Plenary discussion	
15:30-15:45	**HEALTH BREAK**	
15:45-16:45	Group Activity – Refocusing on issues	

16:45-17:00	Reflection on the day's proceedings	

TIME	**Activity**	**RESPONSIBLE**
DAY 3:		
MODULE 5: PEST RISK COMMUNICATION		
09:00-10:00	Risk Communication	
10:00-10:30	Stakeholder mapping	
10:30-10:45	**HEALTH BREAK**	
10:45-11:15	Group Activity – Role play	
11:15-12:00	Plenary discussion	
12:00-13:00	Post-course evaluation, reflection and closure	**All**
13:00-14:00	**LUNCH**	

Annex 4: Post Training Assessment

Name: ……..

Instructions: Please attempt all the questions.

Indicate whether the following statements are True or False

1. The following is a risk
   a) Reduction in monarch butterfly population size ……F……..
   b) Evolution of resistance in maize borers to Bt maize ……F…….
   c) There is a 0.001 probability that monarch butterfly populations will be reduced by 0.02% by the widespread use of Bt maize in the US ……T…….
   d) Indicate whether the following statements are True or False
2. The following is an adverse effect
   a) A reduction in monarch butterfly population size ……T……..
   b) A Nature Biotechnology paper said that one environmental risk of a transgenic potato was the reduction in an insect pest population ……T…….
   c) A reduction in native Trichogramma wasp populations …T……..
3. Mention any two aims of the International Protection of Plants Convention
   - *Prevent introduction & spread of pests*
   - *Promote fair & safe trade*
   - *Protect plant life*
4. Risk is defined by Likelihood X Impact
5. List the four components of Pest Risk Analysis
   - *1 initiation*
   - *2. Risk Assessment*
   - *3. Risk Management*
   - *4. Risk Communication*
6. Mention any three stakeholders of a pest risk analysis (interested and or affected parties)
   - *Nations Plant Protection Organisations (NPPOs)*
   - *Regional Plant Protection Organisations (RPPOs)*
   - *Trading Blocs (EU, ECCAS,SAARC, EAC, ECOWAS…)*
7. What is a pest?
   - *Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products*

8. What kind of information is needed to indicate if an organism is a pest or not? Name at least two.
    - *Known to be a pest elsewhere*
    - *Shares characteristics with known pests*
    - *has similar biology & effects on plants*
    - *Found in connection with signs of injury to plants or beneficial organisms*
    - *Related to known pests*
    - *Known as a vector for known pests*
    - *Known to cause adverse effects on non-target organisms beneficial to plants*
9. What are the social consequences of pest risk analysis? Name at least two.
    - *Loss of employment*
    - *Migration*
    - *Reduction in property values*
    - *Loss of tourism*
    - *Reduction or loss of availability of traditional plants for cultural purposes*
    - *Human health risks*
10. a) When is Risk acceptable?
    - *Level of risk is so low that specific treatment is not cost effective*
    - *Level of risk is no greater than that already experienced*
    - *Cost of mitigation is excessive compared to the benefit*

    b) When is Risk not acceptable?

    - *Pest incursion would result in economic, environmental or social consequences*