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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 CONTINGENCY PLANNING PROCESS AND EMERGENCY RESPONSE FOR BIOLOGICAL INVASIONS IN 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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JUNE 2017

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ACRONYMS AND ABBREVIATIONS

Abbreviation	Full Name
ACEO	Assistant Chief Executive Officer
APHIS	Animal and Plant Health Inspection Service
APPPC	Asia and Pacific Plant Protection Commission
ASF	African Swine Fever
CABI	Centre for Agriculture and Biosciences International
CARBAP	African Research Centre on Bananas and Plantains
CBD	Convention on Biological Diversity
CEO	Chief Executive Officer
CII	Cooperative Initiative on Invasive Species on Island
CITES	Convention on International Trade in Endangered Species
CBPP	Contagious Bovine Pleuropneumonia
CP	Contingency Plan
CPB	Cartagena Protocol on Biosafety
DRCQ	Department of Regulation and Quality Control of Inputs and Agricultural products
DVS	Director of Veterinary Services
EMPRES	Global Animal Disease Information System
EPPO	European and Mediterranean Plant Protection Organization
ER	Emergency Response
ERMC	Emergency Response Management Committee
FAO	Food and Agriculture Organization
FMD	Foot and Mouth Disease
FMDV	Foot and Mouth Disease Virus
GEF	Global Environment Facility
GISD	Global Invasive Species Database
GMO	Genetically Modified Organism
GREP	Global Rinderpest Eradication Programme
HPI	Heifer Project International
IAS	Invasive Alien Species
IBD	Infectious Bursal Disease
IITA	International Institute of Tropical Agriculture
IMO	International Maritime Organisation
INNS	Invasive Non-Native Species
IPPC	International Plant Protection Convention
ISPM	International Standards for Phytosanitary Measures
ISSG	Invasive Species Specialist Group
IPM	Integrated Pest Management
IRAD	Institute of Agricultural Research for Development
IUCN	International Union for Conservation of Nature
LANAVET	National Veterinary Laboratory
LMO	Living Modified Organism
MINADER	Ministry of Agriculture and Rural Development
MINATD	Ministry of Territorial Administration and Decentralization
MINEPDED (MINEP)	Ministry of Environment, Protection of Nature and Sustainable Development
MINEPIA	Ministry of Livestock, Fisheries and Animal Industries

MINFOF	Ministry of Forestry and Wildlife
MINRESI	Ministry of the Scientific Research and Innovation
MINSANTE	Ministry of Public Health
NAPPO	North American Plant Protection Organization
NCA	National Competent Authority
NDMC	National Disaster Management Committee
NGOs	Non-Governmental Organizations
OCC	Operational Control Centre
OIE	International Office of Epizootics
PARC	Pan-African Rinderpest Campaign
PCP	Progressive Control Pathway
PCU	Project Coordination Unit
PPR	Peste des Petits Ruminants
PRA	Pest Risk Analysis
PTA	Project Technical Adviser
PVM	Post Vaccination Monitoring
PVS	Post-Viral Syndromer
RPPO	Regional Plant Protection Organisations
SARS	Severe Acute Respiratory Syndrome
SODEPA	Société de Développement et d'Exploitation des Productions Animales
SPREP	Secretariat of the Pacific Regional Environment Programme
TCP	Technical Cooperation Programme
UNEP	United Nations Environment Programme
UNVDA	Upper Nun Valley Development Authority
WTO	World Trade Organisation

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EXECUTIVE SUMMARY

0.1 Context and Justification

It was made clear in the Biosecurity Project document that a major weakness in the management of invasive alien species (IAS) and living modified organisms (LMOs) in Cameroon is capacity in all aspects of risk-based management of invasion pathways and invasion species, from prevention to early detection and rapid response, eradication, control and mitigation. The management of biological invasions is underpinned by some fundamental skill sets. First and foremost, you need to be able to detect the target taxon directly or via evidence of its presence such as feeding damage or disease symptoms. This can be relatively straightforward for large and easily recognised entities but in many cases may require specialised diagnostic procedures. The latter is notably the case for LMOs which can almost never be identified authoritatively by visual inspection alone. Identification is necessary but not sufficient for the management of biological invasions which need to be monitored to understand their dynamics over time.

The Project Objective of the UNEP/GEF funded Cameroon Biosecurity Project (*Development and Institution of a National Monitoring and Control System (Framework) for Living Modified Organisms (LMOs) and Invasive Alien Species (IAS)*) being executed by MINEPDED in collaboration with other key institutions is to increase capacity to prevent and control the introduction, establishment and spread of Invasive Alien Species (IAS) and management of LMOs in Cameroon through the implementation of a risk-based decision making process.

This project intends to bridge the gap existing in the area of invasive alien species management (which has been documented as one of the major causes of accelerated biodiversity loss including nefarious impact on human and animal health as well as diminishing returns in ecosystems services provision). Since living modified organisms present several benefits to science, agriculture, health and economic growth but carry along with them a potential to become invasive, the need for detecting, diagnostics and monitoring these novel species has also been underscored in the framework of this Project.

Preventing the introduction of invasive species is the first line of defence as part of a risk-based management system for biological invasions as a whole. However, even the best prevention efforts will not stop all invasive species introductions. Early detection and rapid response (ED&RR) efforts increase the likelihood that invasions will be addressed successfully while populations are still localized and population levels are not beyond those which can be contained and eradicated. Contingency planning is essential to ensure a timely, efficient and effective response to new introduced species incursions and it is essential to formulate emergency response exercises that will help ensure that responsible organisations have the capacity to respond to new introduced species incursions unpredictable in space and time.

Despite general low levels of awareness and capacity in Cameroon, some emergency responses have been formulated in the country. For instance with the cases of African swine fever, bird flu and cholera some strategies have been put in place to curb their effects.

Based on global good practice and existing national initiatives, a technical manual on contingency planning with emergency response exercises for biological invasions in Cameroon (MINEPDED 2015) has been produced under the Cameroon Biosecurity Project (CBP). This manual will be essential input into this training process, which will help build awareness and capacity levels among key agencies in Cameroon.

0.2 Objective of the activity

The objective of activity C12 is to produce and deliver a training course in the contingency planning process and the formulation of emergency response exercises for biological invasions (including potential LMO invasions) in Cameroon. The materials will be based on a training course of 6 modules produced by the trainers and modified to include, where possible, content directly relevant to Cameroon. Furthermore, this activity will produce a course manual on Training of Trainers in contingency planning process and the formulation of emergency response exercises for biological invasions (including potential LMO invasions) in Cameroon.

Learning Outcomes

By the end of the course the trainees (potential national trainers and project personnel) will be expected to:

1. Understand the role of contingency planning and emergency response as part of an integrated, risk-based approach to the management of biological invasions.
2. Know the components of a contingency plan required for the management of an incipient biological invasion.
3. Understand the specificity of different processes as required for different species and taxa (including LMOs).
4. Understand how to formulate generic emergency response exercises for biological invasions.

0.3 Methodology

The Consultants examined multiple sources of information both from within Cameroon notably technical reports produced within the CBP as well as pertinent national legislation, information from concerned international Organizations, Research and Scientific Institutions including other governmental Institutions. The initial step after presenting a work plan which was validated by the Component's Task Team was the gathering of information from previous activities of the Cameroon Biosecurity Project (reports, previous training manuals, interviews with national experts, exploitation of literature from organizations involved in IAS/LMOs related issues, Invasive species list for Cameroon, focusing on biological invasions and taking into account case studies which can be applicable to Cameroonian context which outlined best practice

approaches). Using these information sources and the international literature, the consultants drafted the manual which was used as a basis for the training of Trainers in a National Workshop which brought together over thirty-five experts. The experts whose capacity had to be enhanced during the training course were selected from target biosecurity related institutions and some non-governmental Organisations in Cameroon. They were those in institutions (Customs, Environmental Inspection, Agricultural /Livestock Inspection, Researchers, Curators at the National Herbarium, Lecturers in Universities notable those where biotechnology Centres exist, and representatives of NGO dealing with environmental public awareness) occupying various positions that required them to have a general overview of the importance and understanding of the components of Contingency plan and Emergency Response exercises for biological invasions. The training approach was inter-active, presentations in plenary, sub group discussions on case studies followed by sub-group results presentations, questions and answer sessions.

Valuable input provided by the experts during the two-day Training (10 and 11 of November 2016) enabled the repositioning of views and examples used in the document to be in coherence with the Cameroonian context. Some of the experts also provided further information which was used to redraft the manual.

0.4 Project Deliverables

The project output is presented in this document, as a Training of Trainers manual organized in 6 sections.

The following outputs are also produced:

1. Delivery of a two-day training course for 30 participants (from key disciplines and sectors) including a course evaluation of relative capacity before and after the course.
2. Accompanying course notes for the PowerPoint modules.
3. Course Word and PowerPoint modules for the training of trainers and project personnel in the formulation of IAS and LMO contingency plans and emergency response exercises.

The following course modules have been produced:

- **MODULE 1:** Introduction and Course evaluation: pre-course knowledge assessment relative to course objectives.

- **MODULE 2:** An overview of biological invasions globally and in Cameroon - root causes, impacts, management responses and the part played by contingency planning and emergency response in an integrated, risk-based approach to the management of biological invasions.

- **MODULE 3:** Components of an IAS/LMO contingency plan: Pre-event: Prevention (e.g. quarantine, monitoring and surveillance, quality management) and preparedness (e.g. incursion planning, determination of responsibilities, funding, compensation and legislation, training and awareness, research and development). Trigger: Preliminary assessment and diagnosis and containment of the problem. Scope of the problem: e.g. Disease characterisation, epidemiological assessment, impact assessment.

- Operational response: Implementation of the predetermined response strategies. Stand down: Continued surveillance to ensure freedom from the pest or disease.

- **MODULE 4:** Formulation of generic emergency response exercises for the initial and emergency response using the contingency plan components as a guide.

- **MODULE 5:** International institutions, organisations and networks that can assist Cameroon in contingency planning and emergency response.

- **MODULE 6:** Course evaluation: post-course knowledge assessment relative to course objectives.

Course manual

This manual has been produced to accompany the course and to serve as a resource for the subsequent national training courses in contingency planning and emergency response. The manual (in modules) comprises PowerPoint presentations used in the course and accompanying course notes.

0.5 Next Steps in conformity with the CBP log frame

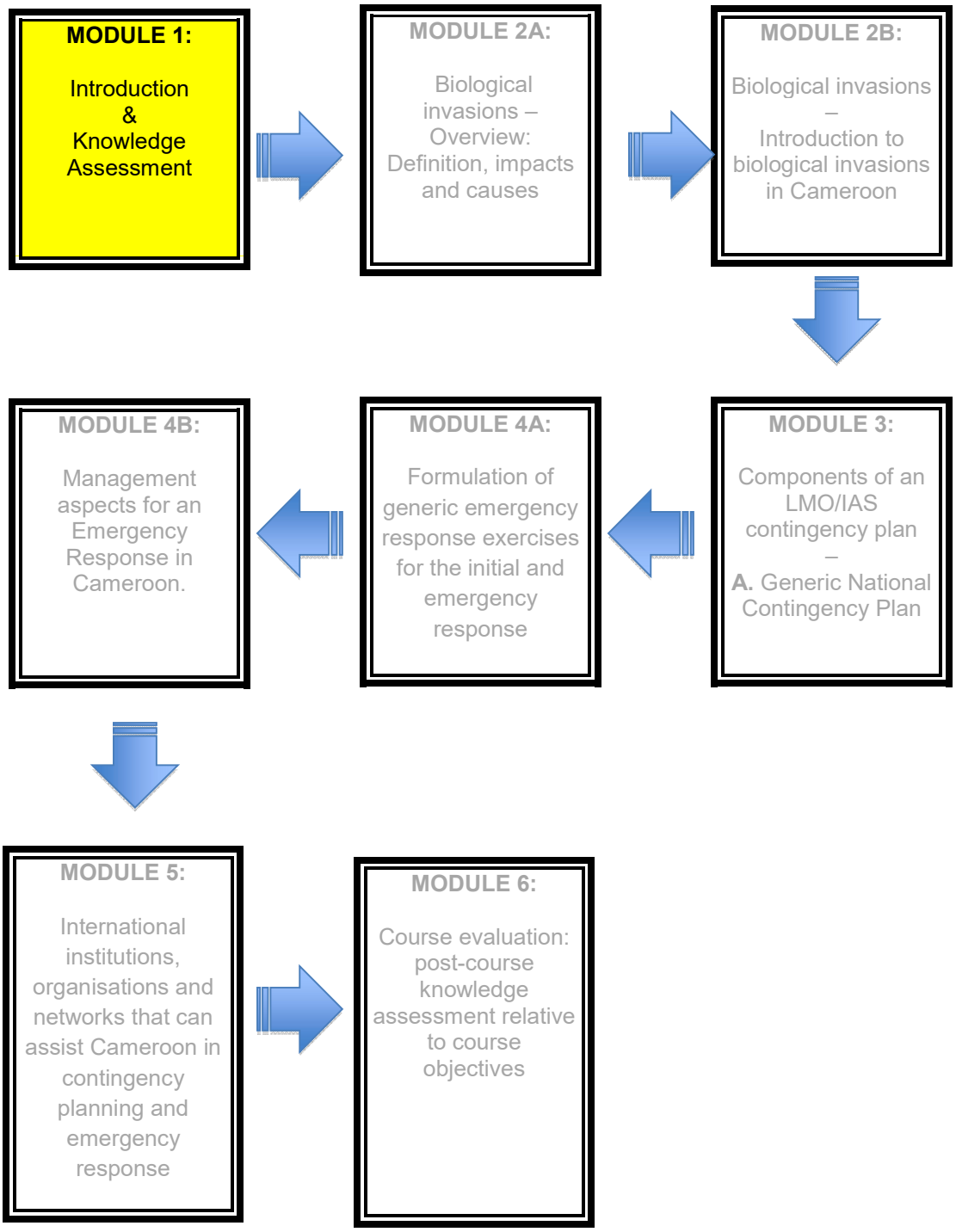
Despite the existence of several key actors in the field of LMO/IAS diagnostics, detection and monitoring, biosecurity measures still encounter a set of draw backs – lack of proper coordination in actions and strategies; weak law enforcement; inadequacy of biosecurity legislation; poor infrastructure, insufficient technical capacity building through training of trainers; insufficient public awareness creation and insufficient government funding for functional biosecurity institutions and personnel to carry out biosecurity duties. In the area of cooperation or partnership development, much effort has to be made in order to tap the diverse opportunities offered by bilateral/multilateral cooperation existing in the area of management of LMO/IAS and

LMOs in general and enhancing national capacity for diagnostics, detection and monitoring in particular especially from countries with tremendous experience like Australia and New Zealand that are quite ready to provide needed support to developing countries like Cameroon. Some available expertise is sometimes poorly utilised creating frustrations and consequent brain drain.

MODULE 1

INTRODUCTION AND KNOWLEDGE ASSESSMENT

Trainer's Edition


MODULE 1:
Introduction & Knowledge Assessment
MODULE 2A:
Biological invasions – Overview: Definition, impacts and causes
MODULE 2B:
Biological invasions – Introduction to biological invasions in Cameroon
MODULE 3:
Components of an LMO/IAS contingency plan – A. Generic National Contingency Plan
MODULE 4A:
Formulation of generic emergency response exercises for the initial and emergency response
MODULE 4B:
Management aspects for an Emergency Response in Cameroon.
MODULE 5:
International institutions, organisations and networks that can assist Cameroon in contingency planning and emergency response
MODULE 6:
Course evaluation: post-course knowledge assessment relative to course objectives

MODULE 1 - INTRODUCTION AND KNOWLEDGE ASSESSMENT

By the end of this module participants should:

- *Have completed a survey on their baseline knowledge of* contingency planning process and emergency response exercises for biological invasions in Cameroon;
- *Understand the objectives and the structure of the course; and*
- *Understand the course facilitation approach.*

1.1 Course Overall Objective

The overall course objective is to teach stakeholders about contingency planning process and emergency response exercises for biological invasions: definitions, exercises and management approaches for Cameroon.

What this training will do and not do

This training will equip trainees with a strategic overview of contingency planning process and emergency response exercises for biological invasions and an ability to ask the right questions when planning biological invasion management efforts.

This training will not develop “hands-on” skills such as how to undertake a risk assessment, how to control a plant invasion or how to inspect and treat commodities.

1.2 Development of the course

This course has been developed within the Cameroon Biosecurity Project funded by the Global Environment Facility (GEF) through the United Nations Environment Programme (UNEP) and the Government of Cameroon. The project’s lead executing agency is the Ministry of Environment, Nature Protection and Sustainable Development (MINEPDED). The project is divided into the following four main components: 1.Policy, regulatory and institutional framework for biosecurity; 2. Implement sustainable biosecurity strategies; 3. Capacity Building; and 4. Information and awareness.

The manual prepared by the Consultants was tested during the Course and reviewed by the participants in the course and their further suggestions incorporated to obtain this final document. The manual is designed to be a living document and will be updated over time.

1.3 Course Structure

The written training modules and the accompanying PowerPoint presentations provide a foundation for course facilitators. They are designed to be customised according to the knowledge and aptitudes of the facilitators/trainers and the nature of the participants. A possible course programme is provided in Annex 1. This may be changed as appropriate. For example, it may be possible to integrate a field visit into the course e.g. to a quarantine facility, a site which

is impacted by a biological invasion or a project location in which a biological invasion is being managed. Some of the course participants may have valuable expertise which they can share with the group in the form of a presentation or informal exercise. The course training last two days.

1.4 Training Manual Structure

The Training Manual consists of 6 written chapters ("Trainer's Notes") and 6 accompanying PowerPoint presentations. These correspond to the following course modules.

- **MODULE 1**: Introduction and Knowledge Assessment.
- **MODULE 2**: Biological invasions
  - **2A**. Overview: Definitions, impacts and causes
  - **2B.** Introduction to Biological Invasions in Cameroon
- **MODULE 3**: Components of an LMO/IAS contingency plan.
  - **3A**. Generic National Contingency Plan.
  - **3B**. Specific disease Contingency plan.
- **MODULE 4**: Formulation of generic emergency response exercises Management aspects for an Emergency Response in Cameroon.
  - **4A**. The Initial Response & the Emergency Response.
  - **4B**. Management aspects for an Emergency Response in Cameroon.
- **MODULE 5:** International institutions, organisations and networks that can assist Cameroon in contingency planning and emergency response.
- **MODULE 6**: Course evaluation: post-course knowledge assessment relative to course objectives.

Each module contains boxes – "Trainer notes", "Key Points", "Activities" and "Examples". The trainer notes contain instructions to trainers, e.g. facilitation tips and information to support the concepts outlined in the main text. The information given in the trainer's notes is much more detailed than that given in the Power Points. It is essential that trainers familiarise themselves with the trainer's notes and some of the key references cited in order for them to have a thorough knowledge of the subject matter before leading a training workshop. Key points reinforce essential learning messages. Activities are suggestions only. It will not be possible to undertake all the suggested activities. Neither do these activities constitute an exhaustive list. The facilitators are encouraged to be creative and innovative in devising activities of their own. Examples are used to illustrate the points made in the text. They are sometimes but not always summarised in the PowerPoint. Facilitators are encouraged to use examples about which they have particular knowledge in addition to the examples used here.

1.5 Facilitation approach

The exact facilitation approach adopted will depend upon the facilitator's own background and the nature of the participants (level of expertise, experience with different facilitation approaches, etc.). The following points regarding the facilitation approach were outlined at the TOT workshop.

- Knowledge sharing: *Nobody knows nothing and everybody knows something*

- Apply Cameroon examples as far as possible: through the contribution of the participants
- This is a training course not a decision-making workshop
- We are flexible with time but we have a lot to address so we cannot be infinitely flexible.

Topics that we do not have time to discuss at that moment will be put in the parking lot for later discussion.

Trainer notes:
Contingency planning and Emergency Response exercises are very extensive subject area and it is easy to get into very long and detailed discussions about related issues. It is, therefore, imperative to keep on track as far as possible while at the same time honouring participant's knowledge, background and perspectives. In order to keep to time and topic without losing important perspectives it is useful to devise a "parking lot" – an area of the wall on which flipchart paper is stuck on which participants can record issues that can be discussed at a designated time.

1.6 Resources needed

In addition to facilitators (a minimum of one but preferably two) and a meeting room the minimum requirements for the course are:

- A laptop computer and PowerPoint Projector;
- A pointer (a physical pointer or a laser pointer);
- A projector screen or light coloured wall that can serve as a screen;
- One or more flip charts;
- One or more sets of flip chart pens;
- One or more packs of flip chart paper;
- Access to a printer; and
- Access to a photocopier for hand-outs.

1.7 Knowledge Survey

Activity 1.1
Administer the questionnaire to the workshop participants (Annex 5). Allow at least one hour for this activity. Help participant where they do not understand the nature or wording of the questions but do not give them substantive information which may bias the survey if not given. Then proceed to look at some basic terms and definitions associated with biological invasions.

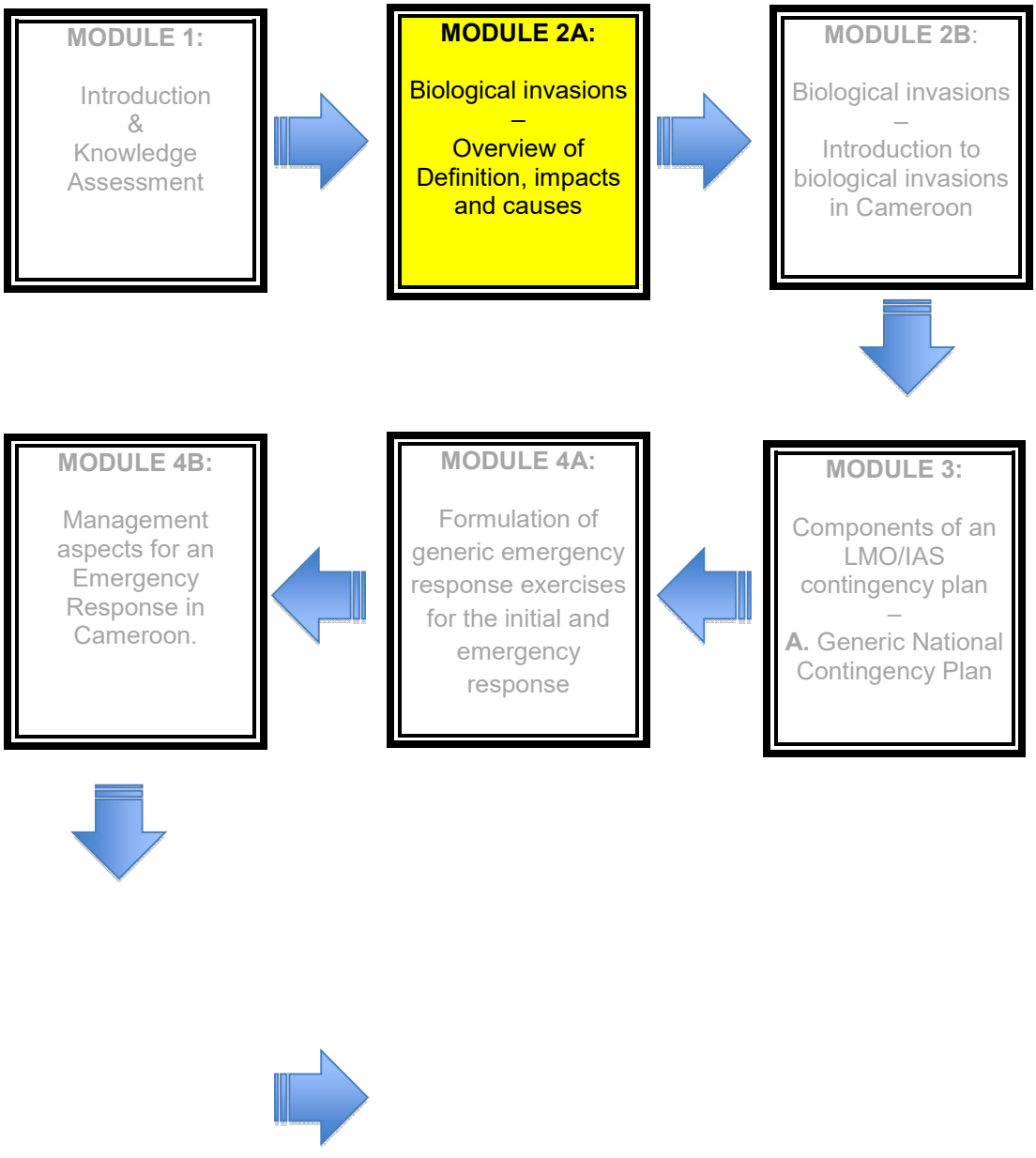
Trainer notes:
Do not give a detailed introduction to the workshop until the survey is completed.
In meetings of this nature it is customary to have some kind of introductory activity to allow the participants to get to know each other. This may take the form of a simple "structured go-around" in which each participant gives their name, institution, interest in the subject matter and aspirations for the meeting (e.g. "what I would like to learn at the workshop" or "what I would like to achieve from this meeting"). A participant introduction is essential. However, it should be kept

to a minimum – name and institution only. It may be necessary for the facilitator(s) to explain why the introductory activity is so brief in order to minimise the risk of some participants imparting their biological invasions knowledge and attitudes at this stage.

MODULE 2

2A: BIOLOGICAL INVASIONS: OVERVIEW OF DEFINITIONS, IMPACTS AND CAUSES.

Trainer's Edition



MODULE 5:

International institutions, organisations and networks that can assist Cameroon in contingency planning and emergency response

MODULE 6:

Course evaluation: post-course knowledge assessment relative to course Objectives

MODULE 2A - BIOLOGICAL INVASIONS: OVERVIEW OF DEFINITIONS, IMPACTS AND CAUSES.

By the end of this module participants should be able to:

- *Understand some key terms;*
- *Understand different types of impacts & the costs associated with biological invasions;*
- *Give examples of problematic species – internationally and in Cameroon;*
- *Understand the process of biological invasions;*
- *Understand the root causes of biological invasions; and*
- *Understand factors contributing to increased risk of biological invasion.*

2.1 Definitions

Trainer notes – Disputes over definitions
Definitions can be problematic as it is unlikely that all definitions given will be agreed upon by all participants. To avoid long and often circular discussions it is useful to point out that in the definitions given have been derived from an extensive process of international stakeholder consultation.

Invasive Alien Species (IAS)/Invasive non-native species (INNS). The term alien species is used in preference to the term introduced species since introduced is associated with deliberate actions, whereas alien is considered to be more neutral[1].
The most problematical alien species are often termed as either invasive or invading species. A synonym term to alien species is non-native species. Species are considered to be alien if they have been assisted in reaching the country, actively or passively, as the result of human activities.
The definition alien species itself is in accordance with the definition of the International Union for Conservation of Nature (IUCN): “Alien species” (non-native, non-indigenous, foreign, exotic) means a species, subspecies, or lower taxon occurring outside of its natural range (past or present) and dispersal potential (i.e. outside the range it occupies naturally or could not occupy without direct or indirect introduction or care by humans) and includes any part, gametes or propagule of such species that might survive and subsequently reproduce (http://data.iucn.org/dbtwwpd/edocs/Rep-2000-052.pdf)[2]

Species of Biological Concern. Species of biological concern is narrowly understood as alien species which have not yet arrived Cameroon, but are expected to arrive the country and establish reproductive populations in the near future[3]. This might be an alien species which is already established in one of the neighbouring countries, and which unaided may cross national boundaries into Cameroon. Also defined as ‘Doorknockers’ they are:

1) biological invaders in neighbouring countries that are considered to be able to establish themselves in Cameroon through secondary introductions (species which can spread by self-dispersal from wild populations in countries bordering Cameroon, but which are considered as alien species in the country);

2) species with a likelihood of being spread to Cameroon via man-made vectors and which have species characteristics allowing them to establish themselves and reproduce in Cameroon; and

3) species which conform with the definition of alien species, but which (at present) only survive and reproduce in artificial structures and habitat types, and which are considered likely to be able to become established in Cameroon during the next 50 years[4].

A Biological Invasion is the process by which a population of a taxon (species, sub-species or lower taxonomic level) increases in density and/or spreads to threaten ecosystems, habitats or species with economic or environmental harm[4]. This phenomenon is a threat to biodiversity, food security, health and economic development[5]. The problem of biological invasions is particularly severe in the developing world where the magnitude of the threat appears to be in inverse proportion to prevailing awareness levels and the capacity for all forms of management including prevention[6].

Trainer notes – "Invasive species" & "biological invasions" – what happened to the word non-native or "alien".
Most but not all invasive species are also introduced or alien species. However, from the perspective of communities (farmers, fisherfolk, foresters, etc.) what is important is not the place where the species originated but its impacts. We are therefore using the term invasive species in this course to denote a species whose establishment and spread threaten ecosystems, habitats or species with economic or environmental harm regardless of its origin and biological invasion as a general term for the invasion of one or more species. Where we are specifically referring to an introduced species that has become invasive we use the term invasive non-native species (INNS) rather than invasive alien species (IAS) as the term non-native is more understood than alien with its "extraterrestrial" connotations. However, the term IAS is widely used (e.g. in CBD texts) and will be encountered in relevant literature so it is important that trainees are aware of the term.

Genetically Modified Organism (GMO): "Any organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology."[7].

LMOs: Living modified organisms (LMOs), any living [emphasis added] organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology (Article 3 of the CPB) are a subset of genetically modified organisms - any organisms [living or dead] - that possess a novel combination of genetic material obtained through the use of modern biotechnology.

Pathways: Pathways are the routes along which potentially invasive species can be transported such as shipping routes and roads.

Vectors: Vectors are the “vehicles” which can transport potentially invasive species such as shipping containers and trucks.

Biosecurity: …“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 Or: The protection of biodiversity from all biological threats from all pathways into and within Cameroon.

Contingency Plan (CP): a Contingency Plan is a tool prepared to assist personnel to deal with an unpredictable event and to promote a trained and practiced response when personnel are faced with emergency situation. A CP needs to be considered and agreed upon in advance by all major stakeholders, including the political arm of government and the private sector, the CP should be routinely reviewed and updated in order to preserve accuracy of the data and the information that it contains and refined through simulation exercises and personnel should be trained in their individual roles and responsibilities to implement the CP.

Emergency Response (ER): This is an effort to mitigate or eliminate the health, social, economic and environmental impact from the incursion of a biological invader.

Emergency Response Exercise: This is a simulation which helps to identify the key component of a response to a suspected biological incursion plus the management structure that would best support the successful implementation of a response mechanism.

Trainer notes – LMOs as invasive species – evidence to date
Commonly mentioned risks associated with LMO release include the possibility of LMOs becoming invasive[9]. This needs to be tackled by some form of risk analysis.
As LMOs are by definition novel organisms one of the best predictors of invasiveness (invasiveness elsewhere) cannot be applied. Questions to be asked in a risk assessment for a proposed LMO release include:
· What is the molecular characterisation of each new gene and protein produced?
· What is likelihood this new gene or trait will increase the potential of the organism to pose an invasion risk?
· What are the characteristics of the whole organism that could make this organism more of an invasion risk than the non-engineered organism?

These analyses are not trivial undertakings as evidenced, for example, by the extensive studies on herbicide-tolerant oilseed rapes to compare modified and unmodified plants[9].

All LMOs subject to risk assessment by the US Animal and Plant Health Inspection Service up to 2005 (APHIS) have either been determined not to pose a pest risk or the product has been withdrawn from review[10].
However, LMOs have been released into the environment only since the mid-1990s so it is impossible to give a definitive assessment of the potential of LMOs to become invasive species.
It is therefore, imperative to subject any proposed LMO introduction to a systematic and transparent risk analysis process. In addition to assessing the risk of the proposed introduction becoming invasive, an LMO risk analysis must consider the potential impact of the proposed introduction on human health and other environmental effects such as the potential for gene transfer to wild species.

Activity 2.1
List five species that are present in Cameroon that you consider to be invasive and five that you do not. Identify those that are native to the ecosystem under consideration and those that are not.

Trainer notes
Record the answers on a board or flip chart. These examples can be used later to illustrate some other parts of the course.

2.2. Which taxa can invade?

ALL TAXA THAT ARE LIVING CAN INVADE

Crawley (1986)[11], defined the “condition for potential invasiveness” as:

$$dN/dt > 0$$

Where d = change, N = population and t = time.

Effectively he was saying that if a species can increase in population over time (dN/dt > 0) it is at least potentially capable of invading a landscape. All species meet this condition so at least *potentially* all species have the potential to invade. It is a precondition of species existence.

Note that this definition says nothing of the potential for the potential for adverse impacts on the environment, the economy or human health which is part of our definition of invasiveness.

Invasive species are found in all taxonomic groups including, mammals, aquatic and terrestrial plants, fish, birds, insects, amphibians, molluscs, reptiles, fungi and viruses. Below are some examples (Figures 2.1 to 2.5)

The house sparrow is of Asian origin. It was introduced to Eastern Africa from trading ships on which it hitchhiked from about 150 years ago. They have been gradually spreading from port areas in Eastern and Southern Africa ever since. In the East they are now found from Cairo to Port Elizabeth and west to Cape Town and most urban areas and many rural areas in between. The house sparrow has spread westwards across the continent and is an invader of most cities across Africa. In East Africa it has slowly moved inland from the coast and is still spreading westwards. For example it reached Nairobi business district in the late 1980s/1990s and took another ten years to appear in the western suburbs of that city then moving slowly west, north and south from a suburban centre to the outlying peri-urban and farming areas of Kiambu and Ngong. As their name implies house sparrows are closely associated with humans. They feed on grains and insects and can also feed on domestic refuse. They can cause extensive damage to crops and fruit trees and damage the eaves and roofs of houses with their nesting activities. They can also take over the nesting sites of native cavity-nesting birds. In Africa it appears that the sparrow is displacing several similar granivorous and house-nesting birds – especially the local species of sparrows such as the rufous sparrow (*P. rufocinctus*), Somali sparrow (*P. castanopterus*) and the grey-headed sparrow (*P. griseus*). The presence of the domestic sparrow can easily be determined by its distinctive calls (the "*chirp, chirp*" and "*trit treet trit tret tret* ..."). If one listens to the background noise during daylight interviews (e.g. on television and radio news) it is often possible to hear the house sparrow. This is a way of plotting its distribution across Africa – and indeed its gradual spread across the world – (where there are other subspecies). This is a truly invasive species which has become so commonplace that most people do not even see or hear it as it spreads and replaces other birds.

Figure 2.1: The House Sparrow (*Passer domesticus indicus)* – Bird (http://www.fnal.gov/ecology/wildlife/pics/House_Sparrow2.jpg)

The Indian house crow was introduced to the east coast of Africa over a century ago, has spread to coastal towns on the Red Sea and Indian Ocean and is spreading inland. They form large flocks around human habitation where they negatively impact on human health, public amenity, poultry and native bird populations.

Figure 2.2: The Indian house crow (*Corvus splendens*) – Bird (http://www.kolkatabirds.com/housecrow8.jpg)

The Argentine ant is blamed for reducing species diversity in South Africa. They can also bite humans and they are a pest in gardens where they protect scale insects and aphids. In orchards swarms of these ants will invade, taking over trees and destroying fruit crops. The Argentine ant is a worldwide economic and environmental threat.

Figure 2.3: The Argentine ant (*Linepithema humile*) – Land invertebrate (Photo from Hölldobler and Wilson 1990[12].

Figure 2.4: Black rat (*Rattus rattus*) – Mammal

The black or ship rat, of Eurasian origin is the most significant invasive mammal species in Africa. It is an indiscriminate feeder, causing massive economic losses throughout Africa and worldwide by consuming and contaminating foodstuffs (e.g. crops, seeds and seedlings, fruits, etc.) and animal feed. The black rat can also cause structural damage to buildings by burrowing and chewing.

By preying on other species or competing with them for food, black rats have directly caused or contributed to the extinction of many species of wildlife including birds, small mammals, reptiles, invertebrates and plants, especially on islands. Among the diseases that the black rat may transmit to humans or livestock are murine typhus, leptospirosis, trichinosis, salmonellosis (i.e. food poisoning), rat-bite fever and bubonic plague. The latter disease is known to have been spread by black rats in Zimbabwe and where it is still a significant vector.

Figure 2.5: Water hyacinth or Jacinthe d'eau (*Eichhornia crassipes*) – Aquatic plant (Photo and information contributed by J.P. Ghogue, Cameroon National Herbarium).

Water hyacinth is a serious aquatic weed in many countries and is widely considered to be the world's worst water weed. It is found in slowly flowing rivers, lakes and small ponds; 0-1700 m alt. in the tropics and sub-tropics. In Cameroon it is mostly found in the littoral region where it has recently expanded its extent spectacularly. Water hyacinth forms thick mats that choke waterways, impeding water flow, obstructing boat traffic and fishing activity and disrupting hydro power generating activities. Infestations provide an ideal breeding environment for disease-carrying mosquitoes. It also has beneficial effects such as water purification and as a raw material for handicrafts but these are outweighed by the negative impacts. So far water hyacinth has only been managed by hand removal although effective biological control agents have been introduced to neighbouring countries.

2.3. Impacts of biological invasions

Biological invasions have been implicated in the extinction of many species (Figure 2.6). The impacts of invasive non-native species (INNS) have been particularly dramatic on oceanic islands and other isolated ecosystems. For example, the island of Guam in the Pacific Ocean has lost almost its entire native forest bird species to one INNS, the brown tree snake (*Boiga irregularis*).

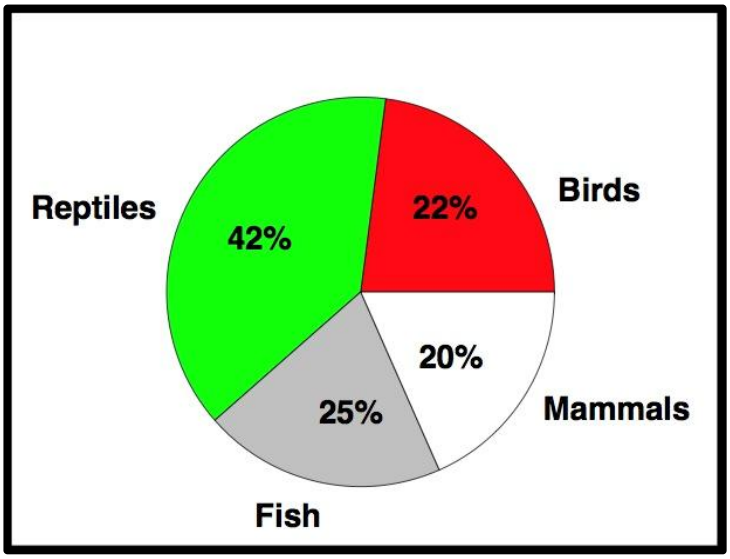


Figure 2.6: Percentage of extinctions caused by INNS[13]

Biological invasions impose a heavy financial toll on the world's economies through direct losses to agriculture, forestry, fisheries and other industries (Table 2.1). For example, it has been estimated that a single INNS the water hyacinth (*Eichhornia crassipes*) cost Uganda US$112 million in 1999[14].

Table 2.1: Examples of annual national economic losses due to INNS (billions of dollars)[16].

Country	Cost ($US billions)
Brazil	$50
India	$117
South Africa	$12
United Kingdom	$12
United States	$137

The costs to non-economic sectors (for instance, the natural environment and societal or cultural values) of biological invasions, while not directly measurable in monetary terms are also significant. For example, invasive species may have negative impacts on ecosystem services upon which humans depend. These include controlling flooding, erosion and silt accumulation, purifying our water supply and providing clean air.

Invasive species can also have severe impacts on human health. Infectious disease agents may themselves be INNS or may be introduced by INNS vectors (e.g. mosquitoes)[5]. West Nile

Virus first found in Uganda in 1937, was introduced to the United States in 1999. The virus causes encephalitis (inflammation of the brain) in humans and horses, as well as mortality in certain domestic and wild birds. According to the US Centers for Disease Control and Prevention, 9,862 people in the US tested positive for the West Nile Virus in 2003, and 264 people died of the virus (http://www.cdc.gov). Some invasive species can harm people by biting or stinging them. For example, in the US, the red imported fire ant (RIFA) (*Solenopsis invicta*), a notoriously aggressive stinging ant, has been implicated in the death of over 80 people. When disturbed, these ants deliver multiple stings, releasing venom that can be fatal to some people.

While most of what we know about biological invasions originates from developed countries, this does not mean developing countries are immune from their impacts. There is strong evidence that invasive species are threatening people's livelihoods in the developing world[17].

2.3.1. Economic Impacts

The economic costs of biological invasions are immense. In the United States the economic costs of damage caused by invasive plants and animals has been estimated at US$137 billion per year[17]. Impacts of biological invasions will be discussed by sector**.** They are often cross-sectoral and may be economic, social and environmental. The division adopted here is for convenience.

Primary Production

Biological invasions can significantly reduce the yield and hence economic worth of many primary industries. Detailed discussions of the processes by which these impacts occur are covered in Section 2.3.3.

Agriculture

Activity 2.2
List five species that are present in Cameroon that you consider to be invasive and five that you do not. Identify those that are native to the ecosystem under consideration and those that are not**.**

The economic losses due to biological invasions in agriculture are huge. Pests are thought to take 35-40% of global agricultural production – this is up to 49% in Africa[18]. A quarter of the United States agricultural Gross National Product is lost each year to invasive pests and the costs in controlling them[17]. These losses are so large because of the diversity of species (plants, mammals, insects, birds and pathogens) that can affect crop and livestock production. Farmers have always waged a war on invasive plants because of their impact on crop yields and harvest operations.

Parthenium weed (*Parthenium hysterophorus*) is an annual herb that aggressively colonises disturbed sites. It has been accidentally introduced to many countries in Africa, Asia and the Pacific where it has become a serious weed of medium rainfall, semi-arid rangelands and seasonal cropping areas.

Negative impacts of Parthenium weed include livestock poisoning; increased effort and management costs both in crop and rangeland systems; exclusion of useful plants; pasture seed, grain and hay contamination and an impact on human health- frequent contact with the plant or pollen can produce serious allergic reactions[19].

Figure 2.7: Parthenium weed in flower (Rüdiger Wittenberg)

The vast majority of plant invaders have been introduced unintentionally, arriving via commerce in association with produce and grain shipments, living plants and soil, cut flowers, wood products and dry ballast[19]. However, invasions are not confined to commercial pathways. For example, gardeners in the Pacific Islands have been known to smuggle in garden plants, seeds and produce for their own use. Unfortunately, on occasion such materials has been contaminated with plant pests and diseases and have resulted in the introduction of invasive species that go on to have wide economic consequences[16].

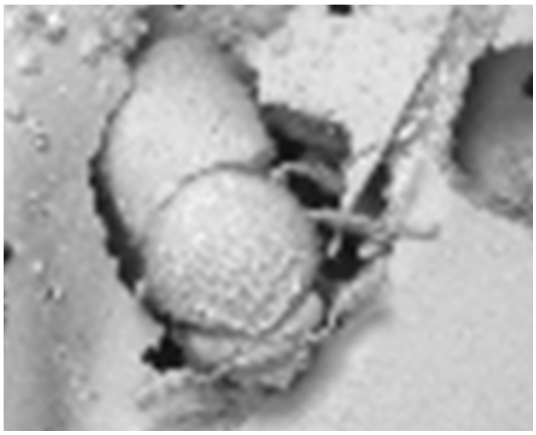
Introduced mammals can have a huge impact on agriculture. Their main impacts are killing livestock for food (e.g. cats and dogs), feeding on crops (e.g. rats and mice) or impacting on the land itself (e.g. rabbits).

The European rabbit feeds on many crops including wheat and livestock forage. Approximately 15 rabbits consume the equivalent pasture forage needed by one sheep.

The annual loss to Australia's agriculture production due to rabbit feeding is US$373 million[20]

Invasive insects and mites cause about US$15.9 billion in crop losses each year (mainly by eating crops). The annual losses attributed to introduced insects are also significant: US$960 million in the UK, US$1 billion in South Africa, US$16.8 billion in India, and US$ 8.5 billion in Brazil[21].

Figure 2.8: European rabbit (*Oryctolagus cuniculus*) (Auckland Regional Council, NZ)



The larger grain borer (*Prostephanus truncatus*), a native of South and Central America, was first detected in Tanzania in the late 1970s. The pest was first detected in Kenya in 1983, Rwanda in 1984, Malawi in 1992 and Zambia in 1993. It has also spread in West Africa being detected in Togo and Benin in 1984, Guinea- Conakry in 1987 and Burkina Faso in 1991.

The larger grain borer can affect a wide variety of stored products. It is very damaging to maize, both in the field and in storage, reducing yield by up to 30% within six months of storage. It is also particularly damaging to dried cassava causing losses of up to 70% within four months of storage[22].

Figure 2.9: Larger grain borer (*Prostephanus truncatus*)

Countries that depend on a small number of crops are particularly vulnerable to the impacts of invasive species. In Samoa an outbreak of taro leaf blight, a fungal disease, decimated taro production, which formed a key part of the Samoan economy. It is estimated to have cost Samoa more than the impact of three cyclones, ($US40 million) to replace domestic consumption, lost exports and the cost of measures to control the disease.

Forestry

Insects and pathogens are considered as two of the most important damaging agents with respect to forests. Non-native plants and plant pests cost more than $US100 billion per year in timber losses plus the expense of herbicides and pesticides. This figure does not include the costs of invasions in less intensively managed ecosystems, such as wetlands. In the 19th century, the chestnut (*Castanea dentata*) was also among the most economically important trees in the eastern United States; in some areas accounting for as much as 25 percent of all trees. Its wood was highly valued for furniture and construction, and the tree's nuts were both a cash crop and a staple for wildlife22. However, in less than fifty years after arriving in New York City the introduction of the chestnut blight fungus (*Cryphonectria parasitica)* had destroyed virtually every chestnut tree within an area the size of 91 million hectares (about one billion trees).

Activity 2.3
Ask the participants how they think insects and pathogens damage trees?

Figure 2.10: A cypress aphid *(Cinara cupressivora)* colony (W.M. Ciesla and D. Ward)

The cypress aphid (*Cinara cupressivora*) of Eurasian origin was reported in Malawi in 1986 and was soon widely distributed throughout Eastern, Central and Southern Africa.

It sucks the sap of introduced plantation and ornamental cypresses as well as indigenous trees including the Mulanje cedar (*Widdringtonia cupressoides*) - the national tree of Malawi and *Juniperus procera* an important tree of many water catchment areas in Kenya.

The aphid forms dense colonies attacking a wide range of feeding sites. Damage is characterised by dieback with severe infestations causing the death of mature trees. By 1991 it was estimated that the aphid had killed US$41 million worth of trees in Africa and was causing US$13.5 million in lost annual tree growth. Cypress aphids are now largely under control following the release of biocontrol agents[23].

The Eucalyptus longhorned borer beetle (*Phoracantha semipuncata*) is native to Australia and has become established in most of the regions of the world where its *Eucalyptus* spp. host trees have been introduced (for forestry, fuel wood and shade trees). In Africa it is believed to have first established in South Africa and then moved northwards amongst and between the numerous plantations of the many species of eucalypts in urban and rural Africa (the trees themselves beginning in some cases to be invasive).

Figure 2.11: Eucalyptus longhorned borer (http://www.pbase.com/image/53170060). This longicorn beetle can kill large numbers of trees, particularly in those areas with Mediterranean climates. Both sexes are attracted to stressed, dying, recently killed, or damaged eucalyptus trees by volatile host chemicals. Mated females lay batches of 10 to 40 eggs in cracks and crevices on or under the bark. The larvae bore through the outer bark of the tree into its tissues. This can severely debilitate or kill the tree and certainly reduce the timbers' value considerably. These beetles became especially damaging in South Africa in the 1990s following a period of drought, which stressed eucalyptus populations. Biological control agents have recently been released in South Africa from their origin in Australia.

Fisheries

Several fisheries (both marine and freshwater) have been ruined by biological invasions. They impact fisheries by disrupting the ecosystem by predating on or out competing native species.

Activity 2.4
Ask the participants how they think marine species get transferred between different areas of water?

Biological invasions can also negatively impact aquaculture production. For example, by 1993 China was the world's biggest shrimp producer. However, virtually all production was lost over the course of a few days due to an epidemic of viruses, bacteria and protozoa. At the same time an epidemic cost Ecuador's shrimp industry $200 million dollars[24].

In the 1940's and 1950's, sea lamprey populations in the Great Lakes, Canada, exploded (from 1,000 to 70,000) as there were no effective control methods. This contributed significantly to the collapse of fish species that were the basis of an important part of the Great Lakes fishery. For example, lake trout numbers in two of the lakes, before sea lampreys, were 6.8 million kilograms per year. Thirty years later the catch was only about 136,077 kilograms. As well as

the economic impact due to yield losses there is a management cost (see Section 2.5) of approximately US$20 million per year on the control of sea lamprey numbers and restocking affected fish populations[25].

The sea lamprey (*Petromyzon marinus*) is shaped like an eel and feeds by attaching to other fish and extracting blood and other body fluids (like a 'fish vampire')[15]. This species entered the Great Lakes about 1921 and has had an enormous negative impact on the Great Lakes fishery. Because sea lampreys did not evolve with naturally occurring Great Lakes fish species, their aggressive, predaceous behaviour gives them a strong advantage over their native fish prey.

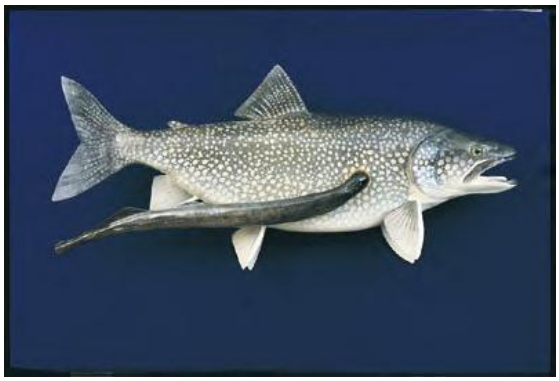


Figure 2.12: Sea lamprey (*Petromyzon marinus*) attached to a trout.

(Great Lakes Fishery Commission) (https://www.google.it/search?q=Petromyzon+marinus&espv=2&biw=1783&bih=822&source=lnms&tbm=isch&sa=X&ved=0ahUKEwix0OC56enPAhVQrRQKHSdBAkoQ_AUIBigB#imgrc=dCNJ7pD2PNCQ6M%3°)

Trade

Activity 2.5
Ask the participants why is it important to keep INNS out from Cameroon?

Section 2.1 discussed the economic impact of invasive species-induced crop losses, a further

impact is the closing of markets, particular export markets and/or loss of demand for produce of industries or countries affected by INNS.

Many products are often only accepted on the international market if they come from a pest-free area. If a damaging invasive species is found in a country, this can mean overseas export markets are closed. For example, Hawaii lost millions of dollars in trade of fruit when fruit flies were found. Therefore, being free of invasive species is an asset for trading with other countries[23].

Also significant is the damage to public perception and associated decrease in demand for the product when INNS introductions are discovered. Countries or industries that use a clean-green image as a competitive advantage and/or a positioning to charge premium prices are particularly exposed to such impacts.

Resources

There are several international regulations focusing on invasive organisms and global trade, including the World Trade Organization Sanitary and Phytosanitary Agreement (WTO SPS Agreement), the International Plant Protection Convention (IPPC), and the World Organization for Animal Health (OIE).

The WTO SPS Agreement defines the basic rights and obligations of WTO member countries with regard to the use of sanitary and phytosanitary measures, which are necessary to protect human, animal or plant life or health, including procedures to test, diagnose, isolate, control or eradicate diseases and pests[26].

The IPPC develops international standards for phytosanitary measures, e.g. "Code of Conduct for the Import and Release of Exotic Biological Control Agents"; while the OIE is establishing animal health standards and guidelines for international trade in animals and animal products[26].

Other Sectors

Many other industries are indirectly affected by the environmental changes due to biological invasions. Possibly the most affected industry is tourism. For many countries, often particularly for developing countries, tourism is a major industry and export earner. Tourist industries that are dependent on the natural environment can be very sensitive to invasive species impacts. Decreases in the attraction of a tourist destination can be driven by a decrease in the appeal or quality of experience on which the tourist industry is built (see Case Study) and perceived or actual health risks to visitors of visiting the location.

In South Africa, the triffid weed (*Chromolaena odorata*) is considered a threat to conservation and ecotourism, as it has primarily invaded natural areas. It reduces the biodiversity of grassland, savannah and forest, and compromises game-viewing in nature reserves and national parks[20].

Figure 2.13: Leaves of *Chromolaena odorata* (Jim Space)

Diseases can affect the movement of people and limit tourists to an area. This was demonstrated by the Severe Acute Respiratory Syndrome (SARS) outbreak in 2003 where there was a worldwide downturn in tourism. For example, the SARS outbreak cost China $17 billion to the tourism industry in 2003[27]. There was also a cost in lost exports and foreign investment.

Animal diseases can also have an effect. Rinderpest (cattle plague), a virus disease of ruminants, first reached Africa in the 1890s in cattle imported from Italy or India. Within five years, more than 80 percent of all domestic ruminants had died over the entire continent. Africa suffered famine, and the disease continued to inflict widespread misery until the 1960s, when it was largely brought under control through cattle vaccination programs. Following the success of the Global Rinderpest Eradication Programme (GREP), launched in 1994, the disease was officially declared eradicated from the planet on 25 May 2011[28].

The green seaweed (*Caulerpa taxifolia*) is a good example of an invasive species with multiple types of impacts. It has rapidly spread through the Mediterranean Sea including the North African coast, causing ecological and economic devastation. It is reported to have harmed tourism and pleasure boating, devastated recreational diving, and had a costly impact on commercial fishing, both by altering the distribution of fish as well as creating a considerable obstacle to net fisheries. The dense carpet that this species can form on the bottom could also stop the establishment of juveniles of many reef species.

Figure 2.14: Dense carpet of *Caulerpa taxifolia* on the Mediterranean seafloor (Alexandre Meinesz)

Damage to Infrastructure

Invasive species can damage and cause disruptions to industrial and social infrastructure. The cost of repairs and lost production can amount to many millions of dollars. Other examples include molluscs that block water pipes, termites that can damage buildings and weeds that can block irrigation and interfere with public water supplies. industries such as industrial water users, municipal water supplies, irrigation water sources and nuclear power plants can be negatively affected by fouling.

The zebra mussel (*Dreissena polymorpha*) is a thumbnail-sized mollusc that forms dense mats that clog industrial water intakes and discharge pipes. They cause industries reliant on water to shut down by clogging water intake pipes. They do this by cementing themselves to any and all submerged hard surfaces. They also adhere to the shells of our freshwater mussels interfering with the natives' feeding, growth, movement, respiration and reproduction[29]. It is estimated that it will cost US$10 billion to manage it over 10 years.

Activity 2.6
Ask the participants why water is important for power generating plants and what could happen if mussels or other animals block the water supply?

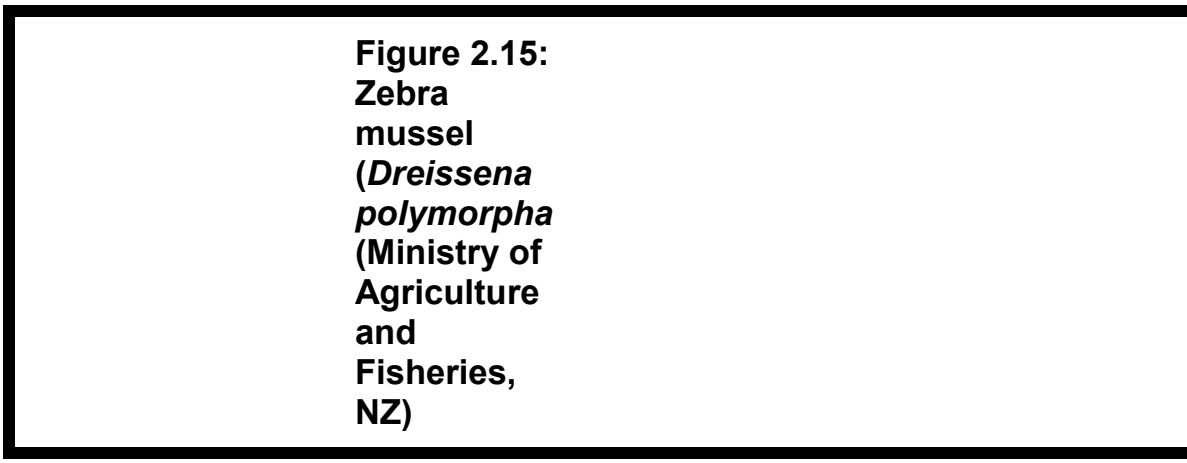


Figure 2.15: Zebra mussel (*Dreissena polymorpha* (Ministry of Agriculture and Fisheries, NZ)

Figure 2.16: Formosan subterranean termite (*Coptotermes formosanus*)

(Scott Bauer, U.S. Department of Agriculture)http://cdn.beritaunik.net/wpcontent/uploads/2012/08/CoptotermesFormosanusShiraki1.jpg

The Formosan subterranean termite (*Coptotermes formosanus*) is estimated to cause $US1 billion/year of damage in the United States. It is considered the single most economically important insect pest in the state of Hawaii. The termite causes severe economic losses to property as houses are demolished because of structural damage or thousands of dollars are spent to repair and treat homes Furthermore, people are defaulting on loans because they do not have the money and cannot get loans to repair their homes after damage done by the termite.

Moreover, if a structure is weakened by termite attack, the structure is at a greater risk of collapsing, resulting in increased safety risk and economic loss. Trees weakened by termite infestation are also susceptible to being blown over in high winds and possibly falling on homes, structures, cars, other property, roads or people. (http://www.louisianahouse.org/termites/economicimpact.asp).

In addition causing agricultural losses (Section 2.3.1) and affecting human health (Section 2.3.2) rats also cause significant widespread infrastructural damage, including direct damage

and causing fires. The total cost of destruction by introduced rats in the United States is estimated at more than $19 billion per year. Finally, water plants can block irrigation and drainage canals, interfere with public water supplies, clog dams and restrict public water uses[30].

Management

Globally, billions of dollars are spent each year to prevent, eradicate, and control the impacts of invasive species as well as on restoration and mitigation. Some of these costs include:

Prevention and border control

Some of the costs of preventing invasive species introductions include:

- Establishment and maintenance of border control and quarantine systems;
- Inspections at ports of entry; and
- Treatments of goods to get rid of any harmful hitchhikers.

Although the costs of prevention are often high, they are minor compared to the losses and costs if an invasive species were to enter and establish in an area.

Eradication, control, restoration and mitigation

The costs associated with controlling invasive species are very high. In the United States the Animal and Plant Health Inspection Service (APHIS) budgeted for spending of nearly US$250 million in 2003 on control. US$100 million dollars a year is spent on controlling Dutch elm disease (*Ophiostoma ulmi*) in the United States. Since 1996, the state of Florida has spent in excess of US$300 million dollars trying to eradicate citrus canker (*Xanthomonas axonopodis citri*). The annual government expenditure on eradication and sustained control for exotic mammals in New Zealand is NZ$40 million[31].

The cost of pesticides and fungicides to treat introduced insects and pathogens probably exceeds US$1 billion per year, and farmers and ranchers spend about $8 billion to control invasive exotic weeds in croplands and pastures[17]. In Egypt annual expenditure for manual and mechanical control of water hyacinth costs about US$7 million[28]. Control of *Cymbopogon nardus*, an unpalatable grass that has infested thousands of square kilometres of Ugandan rangelands was estimated to cost 'one cow per acre' (ca. US$100) in 2004[32].

In the United States, pest control for termites and other household pests (e.g. cockroaches, rats, etc.) costs roughly US$6 million (extermination services, retail products and associated items)[17].

Research and Development

A large amount of money is spent to research and develop management programs to lessen the impacts of biological invasions. Money is also spent to develop programs that focus on ecological restoration and breeding programs for endangered species, often affected by

invasive species.

2.3.2. Social Impacts

It would be no exaggeration to say that biological invasions can change the course of history. Probably some of the most profound social changes have been caused by the spread of infectious diseases to societies that were previously unaffected. A well-documented example is the spread of infectious diseases introduced with the Europeans when they colonised the New World. It has been estimated that 95% of the New World's native population were killed by diseases such as smallpox and measles to which they had not built up immunity[33].

Examples of types of social impact caused by biological invasions are given below.

Human Health

Introduced infectious diseases, passed onto humans by other infected humans or animals, can have a devastating impact. Many such diseases are transferred by animals, for example, malaria by mosquitoes. There are many examples of the massive impact of epidemic diseases. For effect of introduced diseases on the indigenous peoples of the New World is mentioned above. The Black Death (bubonic and pneumonic plague), which killed 33 to 40% of the population in some places in Europe in the middle ages, is another well-known example of the historic impact of disease epidemics. The transfer of diseases from one region to another continues to increase because of population growth, high density, and rapid movement of people to new areas.

Perhaps the most notorious of all invasive human diseases is acquired immune deficiency syndrome (AIDS) that originated in central Africa. Since the early 1980s the disease has spread to all inhabited parts of the globe. AIDS has been particularly devastating in sub-Saharan Africa. In Uganda alone AIDS has taken over 1 million lives since it was first diagnosed. The effects of the disease are estimated to cost Uganda over US$700 million per year – this in a country with an annual GDP of only about US$6 billion (http://news.bbc.co.uk/2/hi/africa/2491299.stm).

The cholera bacterium from Asia was introduced through ballast water from ships to Peru in 1991, then spread across South America and infected more than 10 million people by 1994, killing more than 10,000. In addition to human suffering, cholera outbreaks cause panic, disrupt the social and economic structure and can delay development in the affected communities. Reactions by other countries included restricting travel from countries where a cholera outbreak is occurring, or import restrictions on certain foods. For example, the cholera outbreak in Peru in 1991 cost the country US$770 million due to food trade bans and adverse effects on tourism (http://www.who.int/en/).

Rats can carry and spread several diseases, including salmonellosis and leptospirosis, and, to a lesser degree, plague and murine typhus[17]. The Black Death that killed 33 – 40% of the European population was spread via rats.

Livelihoods

Biological invasions can also indirectly impact on unemployment and increase poverty in a region. For example, the presence of water hyacinth in Zimbabwe has overgrown dams, sometimes backing up enough water to burst them. The loss of water that was valuable for irrigation in the region caused crops to fail, leading to a high level of unemployment.

Tens of thousands of fishing families have lost their livelihoods to invasive species. For example, water hyacinth (*Eichhornia crassipes*) in Lake Victoria in the 1990s choked the harbours so fishing boats cannot get through the weed to reach open water, causing many people to lose work[25].

During the 1980s, a severe outbreak of the Kariba weed (*Salvinia molesta*) on the island of New Guinea in Papua New Guinea seriously affected the livelihoods of the island community. The lives of the people of the region were linked very closely with the river, as a main source of food and water, and as a principal means of travel in the more remote parts. By completely dominating the river system, the Kariba weed invasion caused some villages to be abandoned when access became impossible, leaving communities without critically needed medical care and food aid assistance[20].

Invasive species can negatively affect local forest resources due to parasitism, pathogens, competition, etc. The loss of forest products can lead to a change in the local people's use of resources Invasive species can also impact on the cultural values and activities of an area. Some examples of cultural impacts might be the loss of native grasses used in basket making, the loss of species harvested for ritual, and the loss of land for subsistence such as the invasion of pasture by *Prosopis* species in many countries is threatening nomadic cultures that have been maintained for centuries.

In areas of Ethiopia where *Prosopis* (*Prosopis juliflora*) has invaded local people have to spend considerably more time in land preparation than before; reducing the amount of time they have available for other activities[34].

Figure 2.17: Removal of *Prosopis* prior to

cultivation (Sarah Simons, CABI).

An example of a biological invasion resulting in a range of cultural changes is the introduction of the Nile perch (*Lates niloticus*) to Lake Victoria in the 1950s and 1960s, which has changed the cultural landscape of the lakeside communities in Uganda, Tanzania and Kenya. The Nile perch, which can weigh over 200 kg, has gone on to become the dominant fish species in the lake, causing the extinction of smaller indigenous fish upon which local communities traditionally relied. The small boats and nets used by the local community are unsuited catching Nile perch. The result has been the loss of traditional livelihoods, reduced protein intake and poverty for large numbers. In sharp contrast, the Nile perch has provided the basis for a multi-million dollar industrial fishing industry with large commercial fishing vessels and foreign-owned factories to process the fish for export. The industry has attracted large numbers of single men from outside the area resulting in an increase in prostitution and a rise in Aids[35].

Recreation

An example is invasive plants that interfere with recreational activities. There are a number of impacts invasive plants can have on water bodies when they overrun an area. The presence of alien aquatic plants, such as hydrilla (*Hydrilla verticillata*), water hyacinth (*Eichhornia crassipes*), and water lettuce (*Pistia stratiotes*), alter the habitats of fish and other aquatic species, choke waterways, alter nutrient cycles, and reduce recreational use (e.g. fishing, boating, swimming) of rivers and lakes. Despite the large cost to control Hydrilla (Florida spends about US$14.5 million each year), infestations in two Florida lakes have prevented their recreational use, causing an annual loss of S$10 million[36]. In addition, these invasive aquatic plants can also affect the aesthetic appeal of an area by reducing biological diversity in aquatic ecosystems by crowding native aquatic plants, degrading water quality and accelerating the filling of lakes and reservoirs.

Activity 2.7
Ask the participants to list impacts that invasive water plants can have?

Figure 2.18: Algal bloom showing dead fish (http://glisa.umich.edu/climate/

al ga l- bl oo m s)

There is also a cost (both recreational and financial) in the control of invasive plant in gardens, lawns, golf courses, highway rights-of-way and industrial sites. In the United States approximately $36 billion is spent on the management of these areas annually[17]. Recreational fishing is also impacted because competition or predation by invasive species that can cause fish stocks to crash. Algal blooms or red tides, usually introduced by ballast water, can produce toxins that can cause paralysis and sometimes death in people who eat affected shellfish. Probably the most notable symptom and sign is abdominal pain with nausea, vomiting and diarrhoea. Skin problems (e.g. rashes) and eye irritations can also occur. Because of these adverse effects, shellfish harvesting has been closed down several times in areas worldwide. Algal blooms can cause the closure of a body of water or beach due to fish kills and toxic aerosols. These can have substantial effects on tourism and fishing.

2.3.3. Environmental Impacts

Ecosystem level impacts

Within an ecosystem all species are connected. A disruption to one species can affect a whole range of other species.

Ecosystem transformation

A situation in which a biological invasion completely transforms the state of an ecosystem is known as “invasional meltdown”. There are not many thoroughly-researched case studies of invasional meltdown but this should not be taken to mean that it is a rare phenomenon.

A complete change in ecosystem commonly occurs in Africa when water bodies are invaded by water weeds e.g. water hyacinth (*Eichhornia crassipes*) and water lettuce (*Pistia stratiotes*), Kariba weed (*Salvinia molesta*), water fern (*Azolla* species) as well as some native species such as *Typha* species. Invasions of these species, if unmanaged can result in reduced fish catches and biodiversity, interfered with water transport, block hydroelectric power turbines. Human health can also be threatened because the large weed mats created breeding habitat for the vectors of malaria and schistosomiasis. Rotting vegetation can contaminate drinking water, increasing cases of gastrointestinal diseases.

Species level impacts

Invasive species can affect native species by:

- Changing their abundance;
- Changing their geographical range; and
- Causing local or global extinction.

Biological invasions are widely thought to be the second greatest cause of species extinction after habitat loss[37].

Biological processes

Invasive species affect species and ecosystems via a variety of biological processes as outlined below.

Competition

Some species are able to compete better than others for resources such as food, water, shelter, light and nesting sites. In ecosystems where resources are limited those species that can out compete will prosper at the expense of the other species and become invasive.

Predation

Predation is when one animal eats another. Predation will not always cause extinction, but may cause a change in the population of species on which it predates. The Nile perch (*Lates niloticus*) has caused the extinction of 200 native cichlid fish species since it was intentionally released for fishing and food in the 1960's in Lake Victoria. The perch is a more voracious feeder than the native fish species. This was perhaps one of the largest ever mass extinctions due to one species[38].

The natural enemy release hypothesis states that the abundance or impact of some INNS is related to the scarcity of natural enemies (predators, parasites, diseases and disease vectors) in the introduced range compared with the native range.

The lack of predators and other natural enemies of INNS is a key reason why many introduced species become invasive in their introduced range

Herbivores are animals that eat plants. Like predation, herbivory will not always cause extinction but can reduce the populations of species. A notorious invasive herbivore is the desert locust (*Schistocerca gregaria*). Desert locust plagues can affect 20% of the earth's surface across Africa, the Middle East and Southwest Asia. Over 65 countries can be at risk[39].

Infection by disease (pathogens) and disease and parasite vectors

Disease infection can have a general impact on the health of a species as well as causing death and abundance decreases. Introduced diseases have had major impacts on many different animal and plant groups, bringing devastation to agricultural sectors in addition to the widespread environmental damage. Humans have also been affected by invasive non- native pathogens (see social impacts – Section 2.3.2.).

In Mauritius, introduced birds are host to avian pox and other bird diseases. Feral pigs spread brucellosis, pseudorabies, and trichinosis and the mongoose is a vector for rabies and leptospirosis in Puerto Rico and other islands[17]. The introduction of aquaculture species to a new area can lead to the introduction of diseases to native animals (e.g. bonamia in oysters and gaffkemia in lobster[40]).

Parasitism

Some parasites can cause harm or transmit diseases to humans, but most only harm the host organism. Parasites are often transferred with their hosts to new regions. Sometimes the parasites can infect new hosts in the introduced area, sometimes the transferred hosts escape to the wild, bringing their parasites with them. Livestock losses to parasites have been estimated to be approximately $9 billion/year[17].

A recent dramatic decline in populations of the burrowing mud shrimp (*Upogebia pugettensis*) in bays and estuaries from Alaska to Baja California has followed the invasion by the isopod parasite *Orthione griffenis*[41], which was probably introduced through ship's ballast water. The mud shrimp is used as fishing bait and is valuable prey for birds, fish, and other animals in estuaries. They are the dominant species in many estuaries where their filter feeding plays a role in water purification. Mud shrimp feeding may filter as much as 80 percent of the water per day in some estuaries.

Unlike a large number of parasites *Orthione griffenis* is large and its effects are easy to detect. In addition the identity of native parasites is often poorly known which makes it problematic to identify what is native and what has been introduced. It is therefore likely that the impact of introduced parasites has been greatly underestimated.

Hybridisation

Mating between closely related introduced and native species can lead to an extinction of the native species[17]. For example, mallard ducks (*Anas platyrhynchos*) that have been introduced into various regions of the world have had large genetic effects. They have hybridised and reduced populations of the New Zealand grey duck (*Anas superciliosa superciliosa*), the Hawaiian duck (*Anas wyvilliana*), and the Florida mottled duck (*Anas fulvigula fulvigula*). In addition, farmed Atlantic salmon (*Salmo salar*) escaped and mated with wild salmon. This has reduced the genetic diversity of native populations[17].

Figure 2.19: Mallard duck (*Anas platyrhynchos*) (P & H Harris)

Physical processes

Biological invasions can change physical processes through their abundance and different physical and chemical properties from the species that have been replaced (e.g. fire regimes and nitrogen cycles).

Introduced species may alter fire regimes. They do this by promoting the spread of fire where it was historically infrequent by either decreasing the amount of grass fuel or by increasing the potential for high intensity fires. Some invasive alien grasses especially benefit from fire, and promote recurrent fire, in many cases to the point where native species cannot persist and native plant assemblages are changed to invaded annual grasslands.

Through their effects on vegetation and the physical environment, invasive species can also change the fundamental characteristics of the water cycle of an ecosystem. A variety of invasive woody species have colonised South African watershed areas that were previously dominated by less water-demanding plants. This has resulted in substantial reductions in ground water and stream water, which in turn has decreased water availability for human activities[19]. Through their devastating effects on soils and hydrology, these INNS may alter or eliminate the habitat of rare species.

2.4. The invasion process

Trainer notes: It may be worth spending a bit of time on this section. It is important that the participants understand the concept of the lag phase i.e. often by the time the signs of invasion start showing; it is difficult to do anything about it.

2.4.1 Phases of the Invasion Process

The main phases in the invasion process are:

Introduction

This can be intentional or unintentional. Species must survive during and after the journey to a new location. Many species fail to survive because of unsuitable environmental conditions such as light, temperature, salinity, moisture, soil nutrient levels, etc.

Establishment

The survivors must persist and reproduce successfully until they naturalise i.e. establish a self-sustaining population.

Spread

Often after a time lag (or lag phase) of a few years, decades, or even centuries, some of the naturalised species will multiply and spread across the landscape. This is the explosion phase. The explosive or spread phase may be divided into two: naturalisation, where a species becomes part of the flora or fauna of a new habitat; and invasion, where the species population further expands to cause adverse impacts on the environment, the economy or human health.

The Lag Phase

Biological invasions usually have a lag phase during which they are low in abundance and their impacts are not noticeable. However, over time the population increases rapidly (explosion phase) and the impacts become apparent. The lag phase can be short or last over a century. Following the explosion phase, the population levels out as the population reaches the carrying capacity of the environment (Figure 2.20).

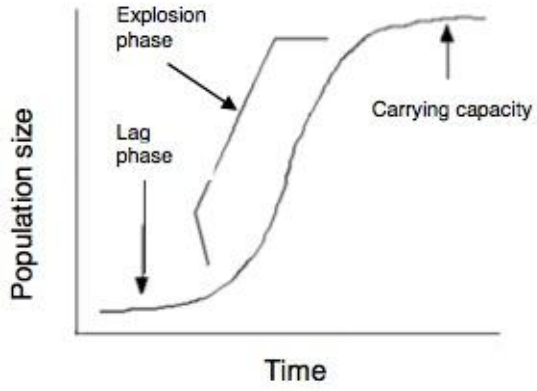


Figure 2.20: The invasion process phases.

Although a time lag is a general feature of the invasion process of many invasive species, there are some organisms, which have virtually no time lag at all and the effects of their invasiveness can be seen almost immediately (e.g. some human, plant and animal diseases). Recent examples of these include the Severe Acute Respiratory Syndrome (SARS) and bird flu. The invasion process (negligible impact initially building up as time goes on) might help to explain why biological invasions are often not viewed as a serious threat in comparison to other environmental perturbations such as dramatic pollution incidents such as oil spills – dramatic initial impacts which diminish over time (Figure 2.20).

Trainer notes: Biological invasions as a slowly boiling frog The parable of the boiled frog is often used to warn us that we must pay attention to slowly changing trends such as biological invasions as well as the more obvious threats. For those who are unaware of the parable, it is said that if you put a frog into a pot of boiling water, it will leap out right away to escape the

danger. But, if you put a frog in a kettle that is filled with water that is cool and pleasant, and then you gradually heat the kettle until it starts boiling, the frog will not become aware of the threat until it is too late. The frog's survival instincts are geared towards detecting sudden changes. It appears that we share certain traits with the aforementioned frog!!

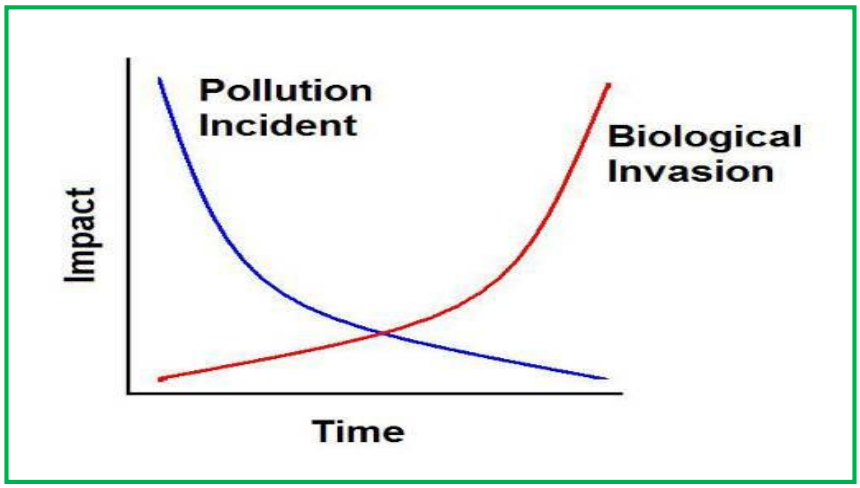


Figure 2.21: Contrast between the impacts of a typical pollution incident and biological invasion over time.

2.4.2. Root Causes of Biological Invasions

Globalisation

Trade liberalisation is a relatively recent phenomenon that has transformed the way in which the world economy operates. Exports from distant countries are now quickly and efficiently transported to almost anywhere in the world in quantities unheard of a century ago. For example, the value of worldwide exports grew from US$192 billion in 1965 to $6.2 trillion in 2000[15] and this upward trend has continued.

Similarly, people are moving at ever- increasing numbers and more remote places are coming under increasing human pressure. The rapid growth in the movement of people and their goods are facilitating the transportation of thousands of organisms (i.e. plants, animals and diseases) around the world. A number of these organisms have become invasive in their introduced ranges and are having severe impacts on societies, economies, human health and the planet's natural heritage.

The distribution of invasive species around the globe through transportation by humans has

occurred both intentionally and unintentionally ever since man began to explore and discover new lands. The tendency of early settlers to introduce familiar species as a reminder of their homelands is a prime example of the way in which many species were introduced outside of their natural ranges.

The problem of invasive species introductions has become much worse, not better. New invasion pathways have arisen, such as the ability to order invasive ornamental plants through the Internet. This has proven to be a major problem, with many people ordering seeds that are sent by mail and may bypass normal border control procedures.

"The Four T's": Trade, travel, tourism and transport are rapidly growing, so too, are the number of invasive species introductions.

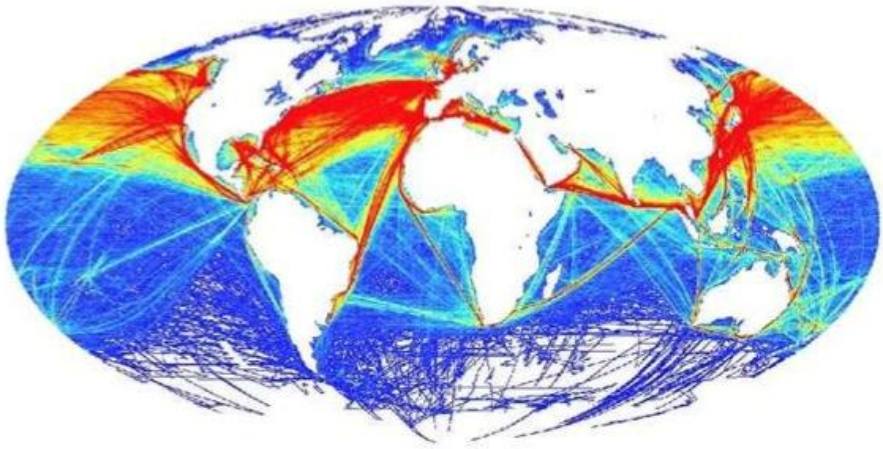
Figure 2.22: How potential biological invaders species move to new locations.

Unintentional introductions of species are also on the rise, with stowaways in the ballast water of container ships or in the cargo of airplanes being transported from place to place with ease. It is estimated that on any given day, some 3000 to 10000 aquatic species are moving around the world with ships' ballast water (Globallast Programme). Examples of species introduced via ballast water include the zebra mussel (*Dreissena polymorpha*), which was introduced to North America's Great Lakes in the mid-1980s. Zebra mussels have since spread throughout the lakes and other waterways of North America, where they are having severe social, economic and ecological impacts.

Its sheer numbers and ability to stick on underwater structures such as water pipes, cause

disruption of supplies of drinking, cooling, processing and irrigating water make it a serious pest. The costs of mitigating these impacts were estimated at US$750 million to US$1 billion between 1989 and 2000 (Globallast Programme). In addition, zebra mussels compete with zooplankton for food, thus affecting natural food webs.

Ballast water



stowaways include species of micro-algae that cause non-toxic blooms, which impact growth rates and survivability of commercially valuable shellfish. An example of this is *Aureococcus anophagefferens*, a harmful alga which has caused 'brown tides', which was introduced to Saldanha Bay, South Africa from Eastern North America. This species impacts the feeding ability of valuable mariculture species such as oysters and mussels, affecting their growth rates and marketability.

The increasing number of ships and planes, all of which have the potential to introduce damaging species over long distances, require strict border control and quarantine measures to be undertaken to reduce the spread of invasive species.

Figure 2.23: World shipping routes in 2008. Most used routes are shown in red and least used in blue.

Land-use Changes

The alteration of the natural environment by humans is nothing new. It has been happening for millennia, ever since humans were able to master nature in order to improve their quality of life. As time has gone by, the ability of humans to mould the natural environment to serve their needs has increased. This has resulted in large-scale environmental changes, such as urbanisation, deforestation and agriculture across the globe.

In many cases, the effects of these changes have provided ideal conditions for invasive species to successfully out-compete the native species that share their environment.

For example, large–scale deforestation creates areas that are conducive to invasion by weedy, fast-growing plants, as the loss of large trees opens up the forest understorey to increased light levels and higher soil temperatures.

The expansion of large cities can destroy natural plant and animal communities, creating niches for opportunistic organisms, such as weeds or rats to establish and thrive.

An understanding of the effects of changes in land-use on the surrounding environment is vital in being able to reduce the effects of unwanted plants and animals.

Climate Change

Growing concern about the effects of human activities on global climate also relate to the topic of invasive species. Increasing global temperatures caused by the 'greenhouse effect' have the potential to alter the worldwide distribution of invasive species.

Invasive species that are native to the tropics, such as ants or climbing vines, have the potential to increase their range if global temperatures increase. An increase in temperature would have the effect of opening up areas where these species were previously unable to exist, due to their low levels of cold-tolerance.

The use of computers for climate modelling may assist in identifying areas that could be at risk of invasion in the future if global temperatures continue to rise.

2.4.3. Intentional & Unintentional Species Introductions

The introduction of species beyond their natural range is closely linked to the historical and present day movement of humans across the globe. Wherever humans have travelled, they have introduced species to new locations for food, social or economic purposes. This type of introduction is referred to as an **intentional introduction**. Many more species have been accidentally transported around the world as the by-product of human activities such as trade, travel and transport. These are called **unintentional introductions** (figure 2.24).

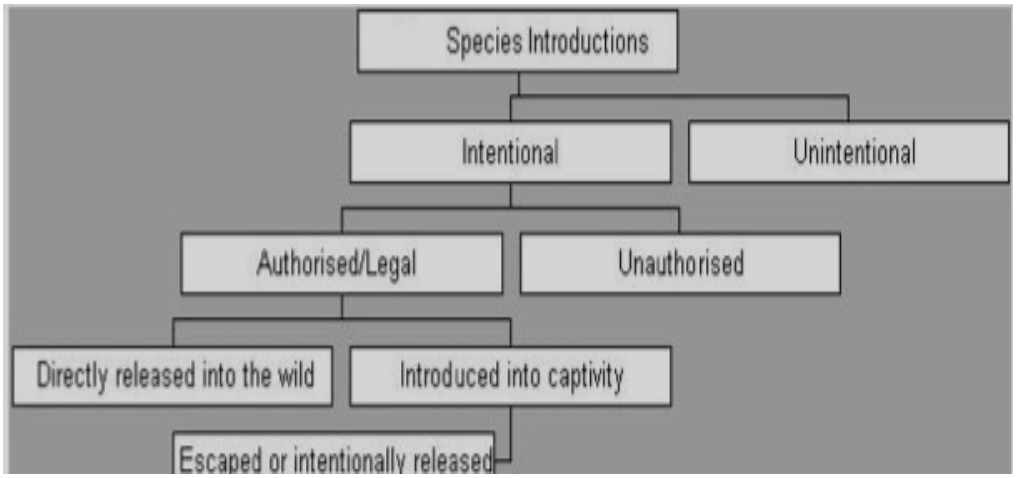


Figure 2.24: Types of species introductions.

Trainer notes: Illustrate the different types of introductions with local examples. Use the examples from Activity 2.1.

Trainer notes: Pathways and Vectors
Pathways are the routes along which potentially invasive species can be transported such as shipping routes and roads. Vectors are the "vehicles" which can transport potentially invasive species such as shipping containers and trucks.

Intentional introductions
Intentional introductions fall into two categories: authorised and unauthorised.

Authorised
Species in this category are usually planned and ideally have been formally approved. Distinction should be made between:

- Species that are directly introduced into the wild often for economic reasons (e.g. crops, domestic animals, game species, biological control agents, or plants intended to improve soil condition or prevent erosion). These species are introduced with the purpose and intention of them establishing in their new ranges. They are usually cared for to ensure a greater chance of establishment.

And

- Species that are introduced into captivity (e.g. zoos, botanical gardens, private gardens, aquaculture, pets, farmed animals (including animals introduced for fur production) and scientific research). These species are not meant to be released into the

wild but be kept in captivity. However, some species have succeeded in escaping or have been released from confinement and have become established in the wild. □

Unauthorised (illegal and legal) □

Smuggling (including the illicit trade in endangered species) of plants, animals, seeds and foodstuffs such as meat and meat products, fruits and vegetables is a serious problem worldwide. The risk of invasive species introductions through this pathway is high and it is necessary to have measures in place to eliminate this pathway. □There may also be instances where there is not an authorisation process in place for regulating non-native species introductions. For example, some countries may regulate the movement of non-native species across their political borders but not within the country itself. It is important to regulate the movement of non-native species across both ecological and political boundaries. □

Unintentional introductions □

Unintentional introductions are those that occur in an unplanned, unpremeditated manner but enter as hitchhikers or stowaways through pathways involving human activities such as trade, travel and transport. Many unintentional introductions occur as by-products of intentional introductions. □The recent rapid growth of world trade, travel and transport has greatly increased the rate of unintentional introductions. The natural protection provided by oceans and mountains that once acted as natural barriers to the movement of species have now been breached, ending millions of years of biological isolation. □Because of their number and unplanned nature, unintentional introductions potentially pose a bigger threat to the environment and society.

Most of the known invasive invertebrates have been introduced unintentionally

Trainer notes: Prevention – it's the "long hops" that matter,
All cross-border movements of commodities and persons pose species invasion risks. It has to be recognised, however, that risks posed by movements over Cameroon's land borders are relatively small. In most cases these national boundaries do not coincide with geographical barriers and the ecosystems on one side of the border are essentially the same as those on the other side. Species are free to move naturally over national boundaries (e.g. animal migrations and bird dispersal of seeds) and have done so for millennia. Even in recent times the allocation of land to various countries has changed. Even if resources permitted the system would not work for all land border crossings as the risk of non compliance is very high. The leakiness of many land border crossings would allow people to cross at unofficial entry points along the border in order to avoid biosecurity procedures (figure 25).

A sensible option for the management of invasive species pathway and vectors, therefore is to focus on international ports and airports. However, a risk
based "prevention is better than cue" approach does not, however, mean that established invasions should be ignored.

PHYTOSANITARY CONTROL POSTS IN CAMEROON

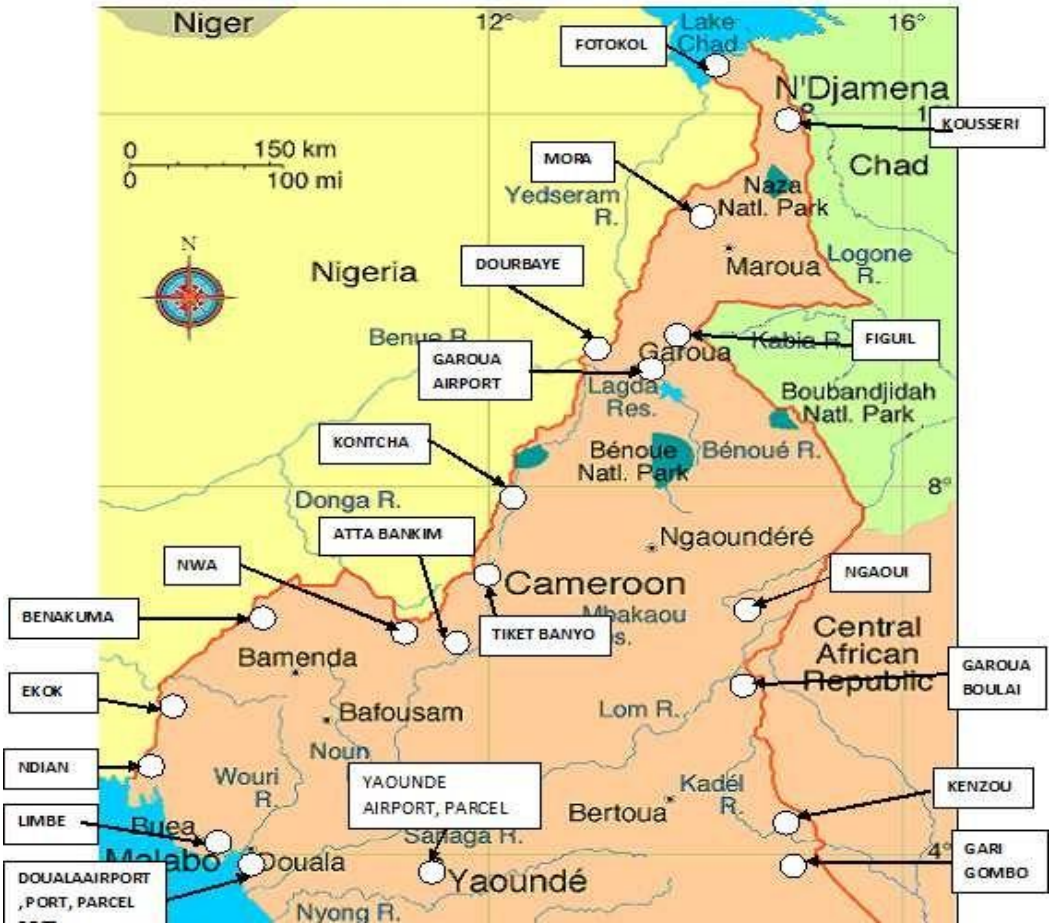


Figure 2.25: Position of official phytosanitary posts in Cameroon (from Ndikontar 2009)[42] .

Activity 2.8
Ask the participants to name the sectors & activities that introduce species in Cameroon *and* discuss the reason for prioritising long distance pathways and vectors for prevention with trainees. If the point is not understood it might be assumed that a comprehensive pathway and vector management approach is being advocated for all national border points. Such an approach would be unworkable

Table 2.2: Types of intentional and unintentional pathways and vectors

Intentional Introductions		Unintentional Introductions
Direct Introductions into the Environment	**Introductions into Captivity/Containment**	
□ Agriculture □ Forestry □ Soil improvements □ Horticulture (*ornamentals, nursery stock, house plants, etc.)* □ Conservation □ Fishery releases □ Hunting and fishing □ Release of mammals on islands as food sources □ Biological control □ Aid trade □ Smuggling □ Aesthetics □ Medicinal □ Religious	□ Botanical and private gardens □ Zoos □ Farmed animals □ Beekeeping □ Aquaculture □ Pet trade □ Aquarium and horticultural pond trade □ Research	□ Vessels/aircrafts/vehicles/trains, etc. □ Ballast water □ Hull fouling □ Sea cargo □ Sea containers □ Personal baggage/equipment □ Agricultural produce □ Seed contaminants □ Soil, gravel, sand, etc. □ Timber □ Packaging material □ Dirty equipment, machinery, vehicles - including military □ Hitchhikers – including parasites and diseases – associated with aquaculture introductions, cut flowers, and introductions for the nursery trade

Activity 2.9
Ask the participants to list the key points of this module.

Trainer notes: You could start the discussion by suggesting the first one, and then encourage them to come up with the rest.

Suggested key points include:
Biological invasions species can:
- Cause the extinction of native plants and animals;
- Interfere with the many benefits humans get from healthy ecosystems;
- Pose a serious threat to the major economic sectors;
- Harm human health;
- Species invasiveness cannot be predicted with certainty;
- Invasive species thrive in disturbed areas and isolated ecosystems;
- The rate of species introduction is rapidly increasing as a result of the rapid growth of □global trade, travel, tourism and transport; and
- The impacts of biological invasions are multi-sectoral.

2.5 Impact assessment approaches for priority invasives

2.5.1 Introduction & methods

The objective of the second part of the consultancy is to develop assessment approaches that can be used to quantify the social, cultural, economic, environmental and biological impact of priority invasive species, with an emphasis on the work to be conducted in pilot sites in the CBP. The focus is on invasive plants since invasive species chosen for pilot site work in the project

are likely to be plants. Although the exact techniques outlined here cannot be used to assess the impact of other groups of invasive species (insects, pathogens, etc.), the principles are applicable to these groups. These tools need to be simple and easy-to-use, so that they can be implemented in situations with resource constraints without difficulties. Another important point is that the tools can be used in all ecosystems with a few adaptations.

Section 2.2. outlines the process of selecting field sites and the different tools to assess the biological impacts of invasive plants in terrestrial and aquatic ecosystems. Appropriate tools are presented, with an assessment of their strengths and weaknesses under different situations. While invasive plant species have impacts on native and other “susceptible”, animals, and abiotic factors, the tools discussed here focus on the assessment of the impacts on the biodiversity of other plant species, because of the importance of plant biodiversity and the relative ease by which quantitative data can be obtained.

2.5.2 Approaches for assessing biological impact

Preparation
Prior to impact assessment some preparatory work must be undertaken. The target invasive plant species (or group of species), for which the assessment of their impacts is to be carried out, must to be chosen and the ecosystem(s) have to be selected for the assessments. The investigation should indicate which ecosystems are at risk from biological invasions and these should be priority areas for assessments. These ecosystems have to be visited to understand the extent of the invasion, the threats posed by it, and the local situation. Based on this knowledge, the best field site for an assessment can be selected while in the field. At the same time the methods or tools best suited to the local situation, can be chosen for the actual assessment.

Selecting representatives of the affected plant community
For the assessment tools either selected species or the entire plant community found in the assessment plots, can be used. The advantage of the former approach is that only a manageable number of species will need to be identified and evaluated. However, the latter approach is more comprehensive in identifying the entire community and the potential impacts of the target species on it. The final decision must be based on the number of species at the field site and the available taxonomic knowledge.

Selecting the study ecosystems
The chosen study ecosystem will be selected by experts of the country, based on criteria such as its importance for local and global biodiversity, the severity of threats by invasive plants, the motivation of the local community to work to manage the target species, and the accessibility of the ecosystem for field work.

a) Terrestrial Ecosystems

Selecting a terrestrial field site within the chosen ecosystem

Any selected ecosystems will be a large area, so a smaller field site must be chosen from within the ecosystem for the actual assessment. It would be advantageous if information on the distributions of affected and target invasive species system is available, as this can be used to pre-select the most appropriate experimental sites. If this information is not available a rapid site survey should be undertaken. Other selection criteria may include accessibility for field work and degree to which local stakeholders are supportive of the assessment work.

Biological impact assessment tools

Four general tools to assess the environmental impacts of invasive plant species(IPS) on plant communities (based on methods successfully used and published in the literature) have been selected (Table 2.3). Three are based on a comparison of the affected plant biodiversity between plots with and without the invader. The fourth tool examines the variance in density of native species in relation to the cover of the invasive species. These four tools can be used to assess the numbers and vigour of the affected plant community.

Table 2.3: Summary of tools for the assessment of biodiversity impacts of invasive plants.

	Assessment of density of affected plants in relation to	
	Presence & absence of IPs	IP Cover
Tool	Comparison Elimination Addition	Cover-related
Parameter measured	Abundance/cover and vigour	

The age of the infestation, if known, is an interesting fact to note, because the time elapsed since the invasion began can be a major determinant of environmental impact. Other parameters (e.g. soil type and microclimate) should be recorded as well, to characterise the situation as much as possible. This information will help us to understand whether the same species at a different site can be expected to show a similar impact on biodiversity.

The comparison tool

For the comparison tool a representative field site in the pilot site area should be chosen as explained above. The field site can be divided into plots by drawing a grid on a map (perhaps 5 by 5 metres depending on the habitat and the size of the species involved). The distribution of the invasive as well as the affected species will be added to this map using GPS readings or measurements in the field. If the invasive species are growing in discreet dense stands, the plots could be divided into plots with weeds and plots free of weeds. Equal numbers of plots with and without the weed can be randomly selected. The number and/or cover of invasive and affected plant species can be counted on these plots and compared. Therefore all species have to be identified (or a selection of target species, as discussed above), and the numbers/cover

and (if the vigour is investigated), the height, spread (and/or other measures of vigour) measured. The number of flowers on flowering plants should also be assessed. The advantage of this tool is that it provides an instant measure of impact. However, the reason why the target species is not growing in some of the plots is not understood. It is possible, that the invasive species cannot grow on the particular plots because of unknown differences between the plots, e.g. so il characteristics, water availability, etc. If the habitat is not identical between the plots with and without the invader, the assessment is at least partly comparing different habitat parameters instead of IP impact. If the plots are being maintained for several assessments, a comparison over time is possible.

The decision whether only the number/cover will be measured or also parameters of the vigour of the plant will be analysed depends largely on the time and effort available for the assessment, since the measurements of plant height and counts of flowers will take considerably longer than the pure counts of the number/cover of plants found in the plot.

The cover-related tool

If no map is available or the terrain is obstructed, the cover-related tool is a better method to use. For this tool, the sample plots can be randomly selected using coordinates, starting at one point of the site without exact knowledge of the distribution of the plants. These plots can be surveyed and all the invasives and affected species counted/measured or even marked and mapped (if the species are large). The plots can be maintained as permanent plots and the abundance of the plants monitored over the duration of the project. A potential problem with this tool is that the results might not be significant if the variation of the cover between the plots is insufficient. In many cases one would need a large number of replicates to obtain significant results.

The elimination tool

The elimination tool can be used if the area is heavily invaded so that no plots without invader can be found or the variation of cover between the plots is very small. A grid of plots can be marked with half the plots to be the treatment plots and the other half the control plots. Assignment of the plots needs to be randomly chosen. On the treatment plot the invader is repeatedly removed. On subsequent visits the affected biodiversity and the target species will be assessed as described for the other tools. This approach gives an indication of what may happen in the ecosystem after successful control of the invader, i.e. how the composition of the community will change due to control efforts. The disadvantage of this tool is the considerable intervention in the treatment plots. This disturbance alone can be a factor, since invasives are often encouraged by disturbance. There are essentially two ways to remove the invader; either by cutting the above-soil part of the plant, leaving the roots in the soil, or by up-rooting the entire plant. Whereas the former approach inflicts less disturbance, the roots can still affect other species in belowground competition. Moreover, several species will show a high sprouting rate, which needs repeated cutting or the application of herbicide to the cut stump/stem.

The addition tool

The addition tool is probably the most sophisticated approach, as it mimics the invasion of an area that has yet to be invaded. Plots are set up outside an infested area and seedlings are planted or seeds of invasives sown onto half of these plots in a random design. The affected species numbers and the spread of the invasive plant on the seeded half will be monitored for several years and compared with the control plots. The parameters measured are the same as described for the other tools. This is a good design to follow an actual invasion into a natural ecosystem. However, it requires that a “pristine” area still exists and that researchers take the responsibility to spread the weed in this assessment.

It should be stressed that the species should only be planted/seeded close to the front of an invasion and not in a new area, thereby introducing the weed to a new site. By restricting this tool to an invasion front, it would only locally enhance the weed, without any real damage.

The requirements, and advantages and disadvantages of each tool are summarised in the table 2.4 below.

Table 2.4: Summary of tools for the assessment of

Tool	Requirements, and advantages and disadvantages
Comparison	Requirements: • Relatively uniform areas with and without invasion present, i.e. an invasion front • Easy topography
	Advantages • Simple • Relatively little work • Most natural • Instant results
	Disadvantages • Risk of measuring habitat difference rather than impact
Cover-related	Requirements • Patchily invaded area • High variance of cover of IP
	Advantages • Shows relationship between density of affected plants and IP cover • Can be used in difficult terrain
	Disadvantages • High number of replicates necessary for significant results • High variance of cover needed
Elimination	Requirements • Dense cover of target species • Affected plants or seed bank still present despite dense IP • Cover
	Advantages • Can be used in heavily infested area • Indicate changes after successful control
	Disadvantages • High rate of disturbance • If not uprooted, below-ground competition is not eliminated • Repeated removal needed in most cases • Suffers drawbacks associated with small plot studies
Add it ion	Requirements • Seeds or seedling of IP available • Invasion front present
	Advantages • No disturbance • Natural way of simulating the invasion process
	Disadvantages • Large number of replicates needed for statistically significant results

Aquatic ecosystem

Selecting an aquatic field site within the chosen ecosystem

Study sites to assess the impact of aquatic invasive plants need to be chosen carefully to obtain useful results, especially as the most prominent invaders are free-floating species. Since rivers are relatively open systems with many natural disturbances, such as high water level fluctuations and flooding events, permanent plots in these areas are difficult to maintain. While species rooted in the soil can be assessed using similar methods to those outlined above for a terrestrial system, free- floating weeds, such as *Eichhornia crassipes*, are not stationary enough to cause a demonstrable impact on the locality chosen under natural conditions. This open system of free-floating vegetation, considerable water level fluctuations, frequent flooding events, and difficult access makes it very complicated to use assessment tools on rivers and lakes. Therefore, the most practical areas to sample are bays of the infested river or lakes/ponds. Those bays can be closed by floating barriers, thereby keeping the weed either inside the bay or preventing its invasion. Another possibility is to look for small ponds in the given area; preferably ponds with and without the target species at the beginning of the experiment. If this is not possible, removal of the target species from some (relatively small) ponds can be carried out. The ponds from which the weed has been removed will serve as a control.

Biological impact assessment tools

The best tool to assess the environmental impact of free-floating weeds is a comparison of plant diversity in ponds with and without weed infestation. In river systems receding water at the end of the dry season often produces isolated lagoons, which could also be used, but their ephemeral status make them less suitable. Ponds, which are isolated more permanently, would be the superior choice for the assessment. However, bays, which are deep enough to keep the water year round, can also be used in conjunction with floating barriers that cut the water surface of the bays from the main water body. These barriers can be narrow nets floating at the water surface. In one bay the weed would be removed mechanically and kept free of the plant, while in another the weed would be caged in by the barrier. If weed cover is too low in the designated ‘infested’ bay, it could be supplemented from another infestation. Although it would also be possible to use one bay for the entire experiment by dividing it into two parts, it is recommended that two similar bays are used (one each for the treatments), because of the potential interactions between the treatments. Native floating and emerging vegetation of the pond, riparian vegetation and submerged vegetation could be sampled. However, the inclusion of submerged vegetation renders the assessment much more difficult. It is not only difficult to sample on an infested pond, since the access by boat will be demanding and the comparability of the sample data between treatment and control is questionable due the access problem on the treatment pond, but there might be other risks involved, such as bilharzias or predators (e.g. crocodiles). Thus the entire native flora should be surveyed and the list of species for each pond/bay compiled. The inclusion of algae in the assessment is not recommended, because it would need a complicated sampling scheme and pose identification difficulties (Rother and Lauer, 1997). In most cases qualitative results will have to suffice. It is not recommended to

repeat this assessment, so that it can be evaluated in a quantitative way, bearing in mind the difficulties involved.

2.5.3 Approaches for assessing socio-economic impact

Since complex studies of the socio-economic effects are labour-intensive, tedious and time-consuming, it would be sensible to use a relatively straightforward questionnaire approach targeting local communities. Thus, information on the socio-economic impacts of target species in pilot sites will be based on knowledge of the local human population. A questionnaire can be administered either directly in the chosen site or outside the area to concerned stakeholders (e.g. National Parks staff or officials of interested ministries). Those administering the questionnaire can be sent to pilot site local communities to interview representatives of local authorities and inhabitants according to the questionnaire presented below. The former approach of interviewing key informants promises more detailed information, which is more objective and is more likely to include figures of increases or decreases of certain products (e.g. fish catches per unit effort and cattle carrying capacity). Some examples of key informants are representatives of fishing communities, transport corporations, energy companies, agricultural, forestry and conservation (national parks) departments, schools, hospitals, health committees, community development committees, and tourism boards. The decision who the key informants for the pilot site would be, can most reliably been taken in the concerned community itself. In many villages the head of the village will be the most influential person and the first person to contact. Their support will help ensure that the questionnaire will receive the greatest buy-in throughout the community and its institutions. The surveyed communities should be assigned to three distinct categories, as far as possible, i.e.:

a) Invasive of concern not (yet) present,
b) Invasive of concern established, and
c) Invasive of concern in high abundance.

This approach will allow comparison of results from infested areas with areas not yet infested, which will serve as a control. Without control communities it would be difficult to determine the effect of the target species on the target group. The number of villages visited per category should be around five if possible and about 100 completed questionnaires in total should be collected. It is important to have a good balance between the three categories to compare the results, i.e. interviewing similar categories of key informants and keeping to a similar approach for the interviews.

Trainer's notes: making a questionnaire

It would be advantageous to group the correspondents by their occupation, age, or gender. This might indicate a differential view of the problem and use of the invasive plant between the groups. Older people will generally have a better understanding of changes and the history of the invasive species in the particular area.

Results from questionnaires returned from key informants responsible for the site will reveal what organisations, councils and services are directly affected by the invasive species of concern. In some cases, committees might have unexpectedly been affected, as is the case with water hyacinth and farmers, who claim fields on the banks of lakes and rivers, when the water recedes. The key informants might even be able to produce some figures of the scale of the problem since the introduction of the invader and estimates of the costs in losses or mitigating efforts.

It is recommended that the questionnaire is piloted in a representative village to explore whether it will produce interpretable results. The interviewed people could be asked an additional question about what questions they would have expected in the questionnaire reflecting their specific situation. The result of that pilot could be used to change the questions accordingly prior to the main investigation.

Subsequently, during this project some of the perceived socio-economic impacts can be monitored to validate the questionnaire. Impacts that ranked high should be a priority for detailed investigations. The methods to explore these impacts depend on the impacts chosen and therefore cannot been described here.

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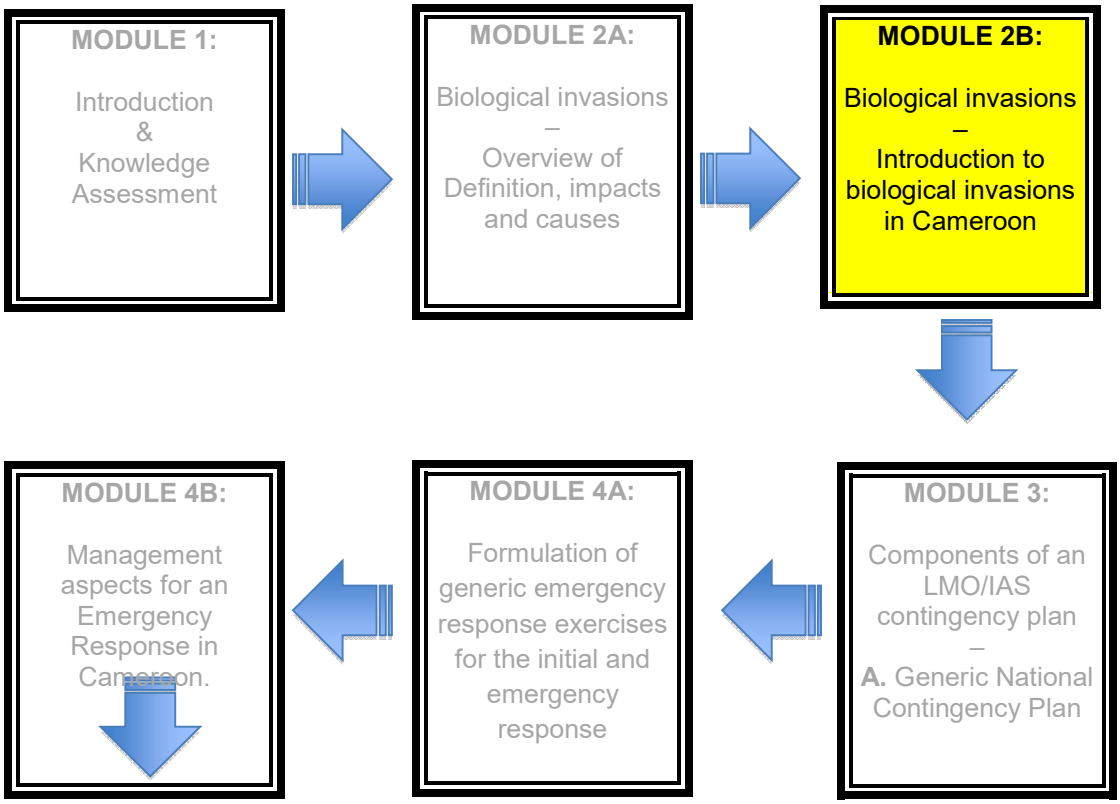
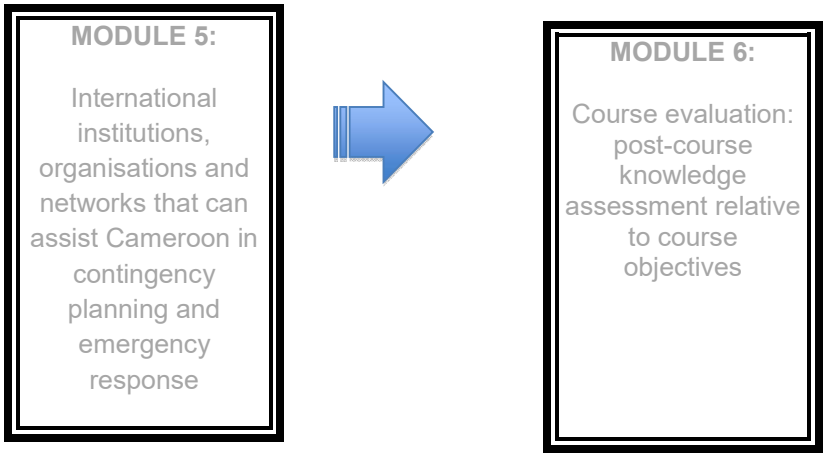
MODULE 2

2B – BIOLOGICAL INVASIONS: INTRODUCTION TO BIOLOGICAL INVASIONS IN CAMEROON

Trainer's Edition


MODULE 1:
Introduction
&
Knowledge
Assessment
MODULE 2A:
Biological invasions
–
Overview of
Definition, impacts
and causes
MODULE 2B:
Biological invasions
–
Introduction to
biological invasions
in Cameroon
MODULE 3:
Components of an
LMO/IAS
contingency plan
–
A. Generic National
Contingency Plan
MODULE 4A:
Formulation of
generic emergency
response exercises
for the initial and
emergency
response
MODULE 4B:
Management
aspects for an
Emergency
Response in
Cameroon.


MODULE 5:
International
institutions,
organisations and
networks that can
assist Cameroon in
contingency
planning and
emergency
response
MODULE 6:
Course evaluation:
post-course
knowledge
assessment relative
to course
objectives

MODULE 2B - BIOLOGICAL INVASIONS: INTRODUCTION TO BIOLOGICAL INVASIONS IN CAMEROON

By the end of this module participants should be:
- *More aware of the nature of biological invaders in Cameroon;*
- *Able to give examples of problematic species in Cameroon;*
- *Able to understand the range of species contributing to IAS in Cameroon; and*
- *Be aware of some of the management approaches undertaken.*

2.6 Introduction & Methods

This module is based on the work of Dr. John Mauremootoo and Mr Augustine Bokwe under the supervision of The Project Component 4 Interministerial Task Team done in the 2014, with the aim of producing an up to date list of major invasive species in Cameroon (MINEPDED, 2015). The list is based upon information available from Cameroon and globally. The information will be useful for those managing established invaders both in Cameroon and in the region. It will also provide valuable information for national and global databases. Experts on each of these groups were requested to examine each field of the spreadsheet and change or add information as necessary, to add species that were missing from the list and to remove species from the list that they did not consider to be invasive in Cameroon and to give reasons for this removal. This group has provided a prototype list of experts on particular groups. Like the list of species, this list of experts should be considered to be dynamic so needs regular updating (the list of experts consulted is provided in Annex 4). This work was carried out before, during and after a two day (CBP listing, database and monitoring) workshop held in June 2014.

An initial list of 168 species or groups of species (henceforth referred to as 'taxa') was drawn up by the consultants. This was based on taxa cited as being invasive on the Global Invasive Species Database (GISD) of the IUCN Invasive Species Specialist Group (ISSG), taxa listed as invasive in the Training of Trainers workshop in biological invasions held under the CBP from 23 – 25 May 2012 and taxa cited as invasive in the CBP report on the Quantification of the Social, Cultural, Economic, Environmental and Biological Impact of Priority Invasive Species in Cameroon (MINEPDED 2014).

The taxa were grouped into four categories: 1) crop pests and diseases (85 taxa); 2) plants (54 taxa); 3) animal and human diseases (20 taxa); and 4) aquatic life and vertebrates (9 taxa).
The draft list was broken down according to the four categories and circulated to national experts for evaluation both before and during a two day "CBP listing, database and monitoring workshop" held from 10-11 June 2014 in Yaoundé.

Taxa were added, removed and put on a **holding list** – a list of species that could be added to the invasive species list but for which more precise information is needed. Following the consultative process the total numbers of taxa listed changed from 168 to 164 as summarised in Table 2.3. The list produced has considerably refined that which previously existed but it is only a start and the list, because the invasions are dynamic, must be regularly updated as new

information becomes available.

The case studies are a useful basis for the compilation of a more detailed and representative invasive species list (table 2.5). They also provide a basis for illustrating the training course in biological invasions for Cameroon with local examples. They are outlined here using the following standard format:

- Species name (Scientific and common names)
- Characteristics (e.g. physical appearance, form of growth and reproduction)
- Habitat (where it lives)
- Origin (native range)
- Introduction and spread (how it was introduced to Cameroon – where it is non-native and how it has spread)
- Impact (ecological, social and economic impacts)
- Management (work undertaken to prevent and control the impacts of the species)
- References
- Contributor(s) (those who contributed the case study) All fields have not been completed for each case study.

Table 2.5: List of invasive taxa for Cameroon (MINEPDED, 2015)

Type of taxon	No. in the draft list	No. removed	No. on holding list	No. added	No. on updated list
Crop pests and diseases	85	**8**	10	25	92
Plants	54	11	9	1	35
Animal & human diseases	20	4	0	10	26
Aquatic life & animals	9	0	0	2	11
Total	**168**	**23**	**19**	**38**	**164**

2.7 Changes: Crop pests, diseases and plant

8 taxa were removed from the draft list for the following reasons:

- The experts were not convinced the taxon was invasive in Cameroon: *Achatina* spp. (giant African land snails).
- The experts considered the taxon to be of low impact in Cameroon: *Armillaria* spp.

(Armillaria root rot agent); *Coelaenomenodera* spp. (Hispine Leaf miner/beetle); *Helix* spp. (snails); and Tachypodoiulus *albipes* (millipede). □

The taxa covered a large number of species all of which were not necessarily invasive: stemborers, nematodes; and termites. The following 12 taxa were placed on a "**holding list**" – a list of species that could be added to the invasive species list but for which more precise information is needed:
Aphid; *Aphtiria* sp. Nov; Caterpillars that affect forest trees; Curculionidae; forest moth (unidentified sp.); gossypol; maize aflatoxins; tea dieback agent; paw paw fruit rot disease; wax moth, *Pythium* spp. (Damping 'off' of seedlings), and *Erwinia* spp. (Soft root rot of tubers).
These taxa were not defined to a taxonomically precise enough level to be able to identify the species with certainty. □

Three of the 77 taxa kept from the draft list also required more information in terms of invasiveness (*Oligonychus coffeae* - red spider mite) and taxonomy (the rice weevil and the tea weevil) but the two names given were less ambiguous than those taxa placed on the holding list.

2.8 Changes: Plants

Nine taxa were placed on the holding list. There was some uncertainty about the identification of the following four taxa: *Agrostis* spp., *Browallia americana*, *Cassia* sp. and *Mucuna* spp. It was not clear if the following four species were causing negative impacts in Cameroon: *Acacia mangium* (black wattle), *Adenanthera pavonina*, *Dalbergia sissoo* (Bombay blackwood, Indian rosewood), and *Oxycaryum cubense* (Cuban bulrush). The final taxon on the plants holding list, *Oxalis* sp. (Cuban bulrush), was unknown to the group.

2.9 Changes: Animal and human diseases

The 4 taxa listed below were removed from the draft list: *Aedes albopictus* (Asian tiger mosquito, forest day mosquito, tiger mosquito, moustique tigre); Mad cow disease; Scabies (la galle); and White diarrhea in piglets (diarrhea peri-natal).
The following 9 taxa were added to the list: *Brucella abortis* (Brucellosis); Ebola virus (Ebola); HIV virus (AIDS); Measles virus (Measles); Neisseria meningitidis (Meningitis).

2.10 Invasive insects

A large number of biological invasions are due to insects. Insects are particularly prominent crop pests, causing direct damage and also acting as disease vectors. Insects can also do damage to infrastructure, are nuisance pests and can spread disease to humans. As mentioned in the introduction, infectious human diseases are not covered in this report. The interviewees mentioned 33 insect pest species (Table 2.6[2]). Four of these were also listed by the ToT participants while another three were listed in the ToT but not in the interviews. This makes an overall total of 36 named species.

Table 2.6: Insect species listed as invasive (MINEPDED, 2014)

Invasive Species list for Cameroon	
Ceratitis capitata – Medfly	Forest moth species (species not named)
Dacus punctatifrons–Tomato fruit fly	Lepidopteran stem borers (species not named)
Bactrocera invadens - Asian fruit fly	*Hypothenemus hampei* - Coffee berry borer
Dacus bivittatus - African pumpkin fly *Dacus ciliatus* - Lesser pumpkin fly	*Bemisia tabaci* - The sweet potato whitefly or silverleaf whitefly
Dacus vertebratus –Jointed pumpkin fly	*Scirtothrips spp*. – Yellow tea thrips
Zonocerus variegatus – Variegated grasshopper	*Helopeltis schoutedeni* - Cocoa mosquito, tea mosquito bug
Agrostis spp. – Cutworms	*Stictococcus vayssierei* - Cassava root mealybug *Dysmicoccus brevipes* – pineapple mealybug
Helicoverpa armigera – armyworm	*Diopsis macrophthalma* - Stalkeyed fly, rice stem borer
Pheidole megacephala - bigheaded ant	*Toxoptera aurantii* - Brown citrus aphid
Solenopsis geminata - Tropical fire ant	Aphids as problems in tomatoes (species not named)
Wasmannia auropunctata - electric ant or little fire ant	Aphids as problems in potatoes (species not named)
Termites	Aphid vector of citrus tristeza virus (species not named).
Larva that attacks the roots of sugar cane (species name(s) not given)	*Coelaenomenodera spp.* - Hispid or oil palm leaf miner/beetle
Cosmopolites sordidus –Banana weevil Maize weevil (species not named)	*Phenacoccus manihoti* - Cassava shoot mealybug
Rice weevil (species not named)	*Rastrococcus invadens* - Mango mealybug
Tea weevil (species not named)	*Pentalonia nigronervosa*–Banana aphid
Weevils as stored product pests (species name(s) not given)	

2.10.1 Invertebrate Invaders – Case Studies

FRUIT FLIES

Adult female fruit flies (*Diptera: Tephritidae*) lay eggs within the flesh of ripening and ripe fruits and vegetables. When the eggs hatch, the larvae start to feed inside the fruit leading to premature ripening, rot and drop down. This damage can make the fruit inedible. More than 80 % of production lost in Cucurbits in Cameroon is through fruit fly damage.

Ce*ratitis capitata* (Wiedemann, 1824) – medfly or Mediterranean fruit fly

Figure 2.26: Ceratitis capitata

Origin and Impact

Ceratitis capitata, which originates in sub-Saharan Africa, is among the world's most destructive fruit pests, affecting a large number of commercial and non-commercial species (figure 2.26). The University of Florida Institute of Food and Agricultural Sciences has produced a host list that comprises of 84 species (42 heavily or generally affected, 17 occasionally affected and 25 rarely affected).

The Med fly is found in all regions of Cameroon on many species (among them species of *Cucurbitaceae*, mangoes and guava). It is a serious pest of hot and sweet pepper (Capsicum species) in all Cameroon's pepper producing zones. *Capsicum* fruits are attacked when they approach maturity but are still green. After hatching the larvae develop inside the immature fruit and the fruit falls before maturity. The Med fly is difficult to control when the fruit has been already attacked because the larva is inside the fruit, so it is protected. When the fruit falls down, the larva enters the first centimetre of soil and then develops underground. When the adult emerges from the soil, it flies towards uninfected fruits. Young males mate with young females, and the cycle starts again.

Risk of Introduction

The major risk is from the import of fruit containing larvae, either as part of cargo, or through the smuggling of fruit in airline passenger baggage or mail. For example, in New Zealand, Baker and Cowley (1991) recorded 7-33 interceptions of fruit flies per year in cargo and 10-28 per year in passenger baggage. Private individuals who successfully smuggle fruit are likely to discard it when they discover that it is rotten. This method of introduction has been suggested to account for the discovery of at least one fly in a trap in California every year (Foote et al., 1993), although this notion has been strongly criticized by others that suggest the presence of a barely detectable, establish population (Papadopoulos et al., 2013).

C. capitata is an EPPO A2 quarantine pest, and is also of quarantine significance throughout the world (CPPC, NAPPO, APPPC), especially for Japan and the USA. Its presence in Hawaii, but not in mainland USA, has contributed to its high international profile as a quarantine pest. It has reached all tropical and warm temperate land masses with the exception of Asia. Its presence, even as temporary adventive populations, can lead to severe additional constraints for export of fruits to uninfested areas in other continents. In this respect, *C. capitata* is one of the most significant quarantine pests for tropical or warm temperate areas in regions where it is not yet established. Worner (1988) used a climate-matching system, CLIMEX, to evaluate areas of potential establishment of *C. capitata* in New Zealand. The suitability of regions in Australia, Europe and South America has also been identified using CLIMEX (Vera et al., 2002) and correlative bioclimatic methods (De Meyer et al., 2007). Consignments of fruits from countries where *C. capitata* occurs should be inspected for symptoms of infestation and those suspected should be cut open in order to look for larvae.

Management

One can treat the fruits preventively with Cypercal 50 EC (50 ml of Cypermethrin/litre of commercial product) that repels fruit flies. Although this is not 100% effective, it can appreciably reduce the incidence of fruit fall. Alternative means of reducing the severity of an infestation involve using attractant traps to reduce the population of insects, or the release of sterile male populations. Such methods require an area-wide approach which is a challenge to implement in Cameroon because of the small size of plots. The use of insecticide can also be problematic because of the safety period (the minimum length of time you must wait after applying the pesticide before it is safe to harvest the crop) as harvesting is undertaken weekly.

The *Capsicum* farmers group around Njombe are very well organised although the organisation is informal and there is no national programme for *Capsicum* producers. Now they have a fairly advanced level of expertise. They have spraying equipment, they know the correct application doses, and mode of application and they know how to communicate, e.g. as a method of warning (14). Further information Further information can be found the CABI Invasive Species Compendium datasheet for *Ceratitis capitata.*

***Dacus punctatifrons* Karsch, 1887 – Tomato fruit fly**

Figure 2.27: Dacus punctatifrons.

Origin and impact

Dacus punctatifrons, which originates in sub- Saharan Africa, is a major pest on tomatoes, notably in Southern Cameroon (Tindo and Tamo, 1999). It is having a great impact but people do not always notice. It is also a serious pest of many cultivated and wild cucurbits.

In the Lekié region of southern Cameroon, where tomato is the most important cash crop, many pest and diseases limit its production, including a fruit fly identified as *Dacus punctatifrons* (figure 2.27). Surveys were carried out in tomato fields in 1996 and 1997. At peak harvest, 30 plants were inspected for fruit health assessment. In order to assess the quality of marketable fruits, a sample of 250 fruits was bought from each farmer. In the fields, 9.8±9.8% (1996) and 42.6±33.1% (1997) of tomato fruits had at least one oviposition puncture, while 12.2±11.2% (1996) and 16.0±12.1% (1997) of the marketable fruits had punctures. The pest was observed for the first time by farmers in 1987 and recognized as a pest problem in tomatoes in 1990.

Further information

Further information can be found the CABI Invasive Species Compendium datasheet for *Dacus punctatifrons.*

***Bactrocera invadens* Drew, Tsuruta & White, 2005 – Asian fruit fly**

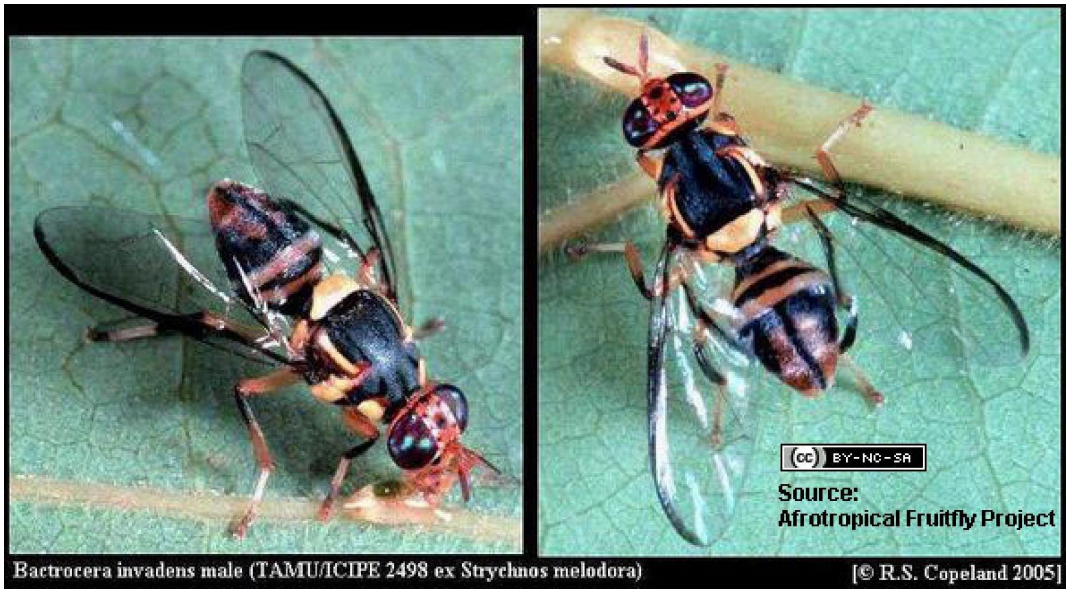


Figure 2.28: Bactrocera invadens

Origin and impact

Bactrocera invadens, which originates in Asia, was first detected in Cameroon in 2004 (Goergen et al., 2011), has more than 40 known cultivated and wild hosts (Vayssières et al., 2009). See figure 2.28. It is the main pest on mangoes in Yaoundé, the Western Region up to Koutaba and in the Littoral region. It is has also been found in the North. It is present everywhere in Cameroon where we find mangoes. It has real potential to spread tomany plant species. Damage levels due to this species appear to be increasing.

Further information

Further information can be found in the CABI Invasive Species Compendium datasheets on *Bactrocera invadens.*

The following species are serious problem in cucurbits – and no protective measures are taken in cucurbit systems:

- *Dacus bivittatus* (Bigot, 1858) - African pumpkin fly (Origin: sub-Saharan Africa)
- *Dacus ciliatus* Loew, 1862 - Lesser pumpkin fly (Origin: sub-Saharan Africa)
- *Dacus vertebratus* Bezzy, 1908 - Jointed pumpkin fly (Origin: sub-Saharan Africa)

BITING AND CHEWING INSECTS

Insects in this group have mouthparts that are specifically made for biting and eating plants. They include grasshoppers and armyworms.

***Zonocerus variegatus* (Linnaeus, 1758) - variegated grasshopper**

Origin and impact

Zonocerus variegatus is native to west and equatorial Africa and is a problem throughout Cameroon (figure 2.29). It is a generalist feeder that can attack all annual crop species. Its food range on perennial crops is more restricted. It is seasonal and its attacks are more severe in the dry season.

Figure 2.29: Zonocerus variegatus

It is a pest of maize where it can kill young plants in their first 1-2 months. If the plants survive this they can grow well. In a study on farmers' perception on the importance of *Z. variegatus* in agricultural production systems of the humid forest zone of Southern Cameroon, Kekeunou et al. (2006) found that it ranked as the third most economically important insect pest of agriculture (after borers and scale insects) and its importance had increased over the previous ten years. This is likely to be as a consequence of deforestation and the growth in area under herbaceous fallow. Damage by *Z. variegatus* was greater in fields next to *Chromolaena odorata* and herbaceous fallows compared to plants next to forests and shrubby fallows.

Management

Kekeunou et al. (2006) found that farmers mainly used physical control – collection for human consumption and for use as fishing bait (77% of groups). The 27% of those surveyed used chemical control. No biological or cultural techniques were utilised.

One way of managing *Z. variegatus* in maize is to estimate the period of attack and time planting accordingly.

Further information

Further information can be found in the CABI Invasive Species Compendium datasheets on *Zonocerus variegatus.*

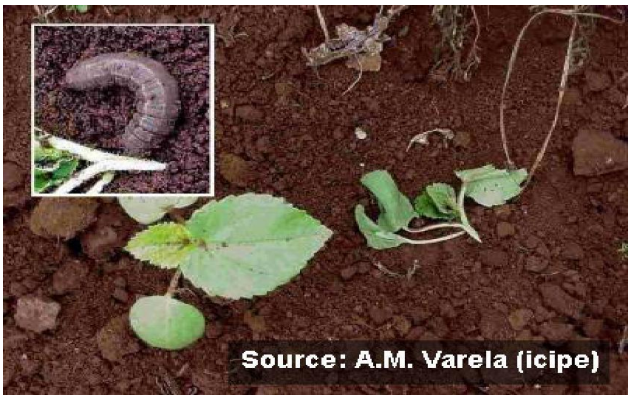


Figure 2.30: Seedling damaged by cutworm caterpillar (right). Note healthy seedling on the left. Close up of cutworm (inset) from infonet bivision.

***Agrostis* spp. - Cutworms**

Origin and Impact

Cutworms originate in the Old World but their precise origins are unknown. They are caterpillars that feed on a range of plants including amaranth, beans, cabbage/kale, brassicas, carrot, coffee, cotton, eggplant, maize, okra, peas, peppers, pigeon pea, potato, sesame, sorghum, tea, and tomato (infonet-biovision).

In Cameroon the cutworms are a particularly serious problem on potatoes (figure 2.30). Young larvae feed on leaves and stems. Older caterpillars, which cause the most damage, can eat entire plants. The damage caused by cutworms on potatoes is sometimes not noticed until it is too late to do much about them.

Management

There are insecticides that can be applied (products not named by interviewees) but farmers do not always have the money to purchase the products. When they do apply they do not simply spray prophylactically but see the symptoms first.

Further information

Further information can be found in the infonet-biovision datasheet on cutworms.

***Helicoverpa armigera* Hübner, 1827 – cotton bollworm, corn earworm or Old World bollworm**

Figure 2.31: Helicoverpa armigera

Origin and Impact

The precise native range of *Helicoverpa armigera* unknown but it is a migrant species so it is likely to have been able to naturally colonise a wide range of suitable habitats in Africa, Asia and Southern Europe (figure 2.31). *H. armigera* is a moth that as a caterpillar feeds on a wide range of important cultivated crops such as tomato, pepper, pigeon pea, chickpea, sorghum, lettuce, okra and many other plants. It is very widely distributed in many cropping systems in Cameroon where it is best known as a pest of cotton.

Management

Insecticides are widely used to manage *H. armigera* in cotton along with other species in the bollworm complex (Achaleke et al., 2009). However, there is widespread resistance to pyrethroids, while endosulfan, a suitable alternative to pyrethroids, has been banned for cotton pest management (ibid). Pest management issues have stimulated the demand for genetically modified Bacillus thuringiensis (Bt) cotton. Bt is a soil bacterium that has many natural strains which produce a range of proteins that are harmful to insects.

Further information

Further information can be found in the CABI Invasive Species Compendium datasheet for *Helicoverpa armigera.*

Ants (*Formicidae*)

Ants were a problem but could not name the species.

Occurrence and impact

A range of ant species can cause negative impacts in Cameroon in a variety of land use systems (figure 2.32). Ants can be pests in buildings (e.g. by taking food, and biting people and domestic animals), in gardens (e.g. by disturbing the soil and damaging plants), agriculture (e.g. by tending sucking pest insects and destroying bee hives) and can negatively affect biodiversity (e.g. by preying on arthropods and even small vertebrates). The following three species were named as invasive ant species in our interviews: *Pheidole megacephala* (Fabricius 1793) - bigheaded ant; *Solenopsis geminata* (Fabricius, 1804) - tropical fire ant and; *Wasmannia auropunctata* (Roger, 1863) - electric ant or little fire ant.

Figure 2.32: Ants. From left to right: Pheidole megacephala, Solenopsis geminata and Wasmannia auropunctata.

Pheidole megacephala has been listed as among 100 of the World's Worst Invasive Alien Species by the IUCN Invasive Species Specialist Group (ISSG). Thought to be indigenous to southern Africa, *P. megacephala* is now found in temperate and tropical zones around the globe. It is an agricultural pest because it tends sap-sucking insects that reduce crop productivity, can infest houses and threatens biodiversity by displacing native invertebrates. *P. megacephala* can also chew irrigation and telephone cables and electrical wires. It appears to be becoming increasingly abundant in anthropogenic ecosystems in Cameroon.

Solenopsis geminata is thought to be native to southern USA, Central America and tropical South America. It has since colonised many parts of the tropics, notably in tropical Asia, in many tropical islands and in West and Central Africa. It mostly invades open areas but can also readily colonise buildings and agricultural systems, for example coffee and sugarcane plantations where it tends sap- sucking insects. It is known for its painful sting. *S. geminates* likely to have arrived in Cameroon along with sea freight brought in through Douala. It is present in Douala and has colonised from the coast region, moving up to Bipindi (about 60 km east of Kribi in the Southern Region).

Wasmannia auropunctata is invasive in various ecosystems in Cameroon and is progressively spreading, albeit slowly, in the country. *W. auropunctatais* very voracious predator of a range

of arthropod species and one finds a very low arthropod diversity where W. *auropunctatais* present. Because it predates on many arthropod species, *W. auropunctata* has been deliberately moved by people from place to place. It was introduced to areas around Kribi to control Mirids (capsids) in cocoa. Ironically *W. auropunctatais* now is a pest of cocoa plantations. In areas with *W. auropunctata* populations of most insects, have been reduced but populations of plant-feeding bugs (Homoptera) tended by the ants tends, such coccids and psyllids, increase (Bruneau de Miré, 1969). There have been a number of subsequent studies on this species in Cameroon. In addition to agricultural problems *W. auropunctata* causes problems to wild fauna. Walker (2006) surveyed ants at several sites in Lopé National Park in Gabon and found a highly significant inverse correlation between native ant diversity and length of time that the site had been infested by *W. auropunctata*. This species is now invading houses in towns causing problems. There are small patches around Kribi, it is also found in Yaoundé. *Wasmannia auropunctata* has been listed as among 100 of the World's Worst Invasive Alien Species by the IUCN Invasive Species Specialist Group (ISSG).

Management

No management information was given by 30 apart from the statement that control is difficult for these species and that chemical methods are used to control *W. auropunctata*. A Yaoundé University student (Mr Mbenoun Masse) is currently working on geographical distributions and the chemical control of this species. For bee hives the best management method is good sanitation to ensure the area around the nest is clean.

Further information

Further information can be found in the CABI Invasive Species Compendium datasheets on P. megacephala, S. geminata and W. auropunctata.

Termites (*Isoptera*)

Termites were a problem for bee hives but could not name the species.

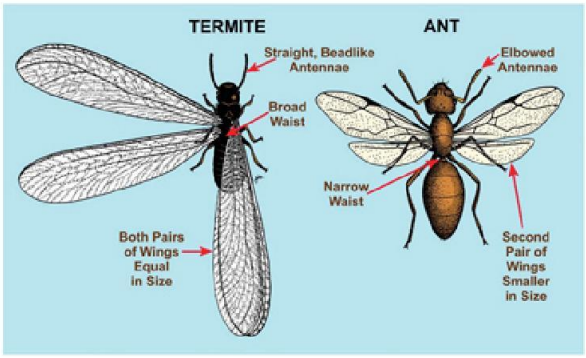


Figure 2.33: Differences between ants ("black ants") and termites ("white ants").

Occurrence and impact

Termites, which are native to the Old World, may damage the wooden parts of bee hives including the hive stands. The termites do not affect the bees directly. If there are a lot of shrubs close to the hive termites will be able to access the hive. Termites can also get access to the hive if it touches the ground. Termites (along with lizards) are a particular problem in the forest region.

Management

Termites can be tackled by keeping the area around the nest clean, i.e. good sanitation. To prevent termite incursion you can paint the hive stands with used engine oil.

Further information

Further information can be found in Kamble (2006).

Weevils (*Curculionidae*)

Occurrence and impact

Weevils are a group that cause a range of negative impacts in Cameroon in a variety of agricultural systems – both in the field and on stored products. They can affect crop yields and quality through direct feeding and as virus vectors.

The following species were cited as pest species: *Cosmopolites sordidus Marshall*, G.A.K., 1930 (banana weevil); the maize weevil (possibly *Sitophilus zeamais* (Motschulsky), 1855 but the scientific name was not given by the interviewee); the rice weevil (possibly *Sitophilus oryzae* (Linnaeus, 1763) but the scientific name was not given by the interviewee) and; the tea weevil (possibly *Myllocerinus aurolineatus*) The banana weevil, which originates in South-east Asia, is a serious pest on bananas and plantains in much of Africa. The larvae burrow into the corm (swollen underground plant stem from which the plant grows), which weakens the plant causing reduced yield. Losses of up to 100% have been reported in the case of severe infestations in Uganda (Sengooba, 1986).

Figure 2.34: *Cosmopolites sordidus* (banana weevil), body length: 10-16 mm.

Weevils were cited as the biggest post-harvest pest of maize in Cameroon. The percentage loss can be above 40-50% and in some cases the damage levels are 70% or even 100%. When maize is damaged by weevils it can still be eaten and used for animal feed but it is not clean.

Figure 2.35:

Weevils were cited as a post-harvest problem for rice with small but significant losses (0.5%) of stored rice to "weevils and rats" in modern storage facilities. Those who store their rice at home (for home consumption, or for sale – "speculation" to get a better price than that offered at present) may end up with much higher post-harvest losses (but levels were unspecified).

Management

Maize crib storage facility, Ndop

Banana: Banana weevil management is based on the application of cultural practices, such as the use of clean planting material, systematic trapping of adult weevils, and field sanitation - the removal of plant residues that may form breeding areas for the weevil. The use of pesticides is usually not economically feasible for subsistence producers and the banana weevil has developed resistance to a range of commonly used pesticides. The most sustainable strategy for the long-term management of the banana weevil is to develop resistant varieties. The African Centre for Banana and Plantain (CARBAP) is developing weevil-resistant varieties by conventional methods. However, the challenge of conventional banana and plantain breeding has prompted efforts to breed for resistance using modern biotechnology (Kiggundu et al., 2003).

Tea: In Tolethey treat for weevils using Permethrin. The weevils come to surface at night so treatment is undertaken (and “is very effective”) when done early in morning. The area around the field is sprayed as well to control beetles that escape from the tea planting areas.

Stored products: Traditionally maize cobs are stored in the kitchen where pests are discouraged to some extent by cooking fires. Others store the maize cobs in barns. Maize storage cribs are a way to reduce post-harvest loss (figure 2.35). They are simple structures elevated about a metre off the ground with guards to prevent rodents from climbing up the support poles. Side slats or wire mesh fencing allow the breeze to flow through and dry the maize. They are a recent storage development that can help to reduce post-harvest losses but they are expensive. Not even 5% of farmers in the area known to 20 had cribs. Small planters will use them if they are provided through a project but most do not do so because of the cost. Many planters burn cypress leaves in the house before they start harvesting. They also clean the barns and spread the burned cypress against weevils in the store. The cypress leaves are 60-70% effective. A small minority mill the maize and store it in sacks. Improved storage facilities can dramatically reduce post-harvest losses. UNVDA (Upper Nun Valley Development Authority) is planning to build a new silo by 2015, which will reduce post-harvest losses from weevils and rodents to close to zero.

Further information

Further information on banana weevil can be found in the Plantwise Knowledge Bank Cameroon Datasheet.

Hypothenemus hampei (Ferrari, 1867) - Coffee berry borer

Figure 2.36: Coffee berry borer (*Hypothenemus hampei)*.

Origin and Impact

The coffee berry borer (CBB) is a small beetle, (figure 2.36) native to Africa that is considered to be the most devastating pest of coffee in the world (Vega et al., 2009). Adult females bore a hole in the coffee berry in which they lay their eggs. The larvae that emerge feed upon the coffee seeds inside the berry, reducing yield and quality. Severe infestations may result in over 60% of berries being attacked. A study published in 2009 reported that coffee producers in Cameroon felt that CBB impacts were increasing (Kucel et al., 2009)

Management

The fact that the CBB spends most of its life inside the coffee berry makes it extremely difficult to control through pesticides. A great deal of effort is being made to develop biological control agents (Vega et al, 2009). The IRAD Barombi Robusta Coffee Programme is trying to develop 2 – 3 coffee clones which can flower early before the cycle of the borer is complete so that when the borer matures, the coffee beans would have been harvested and the borers would then have nothing to feed on.

Further information

Further information can be found in the CABI Invasive Species Compendium datasheet for CBB.

SUCKING INSECTS

Sucking insects puncture the external layers of plant and animal tissues and feed on the juices of their host. They can impact upon their host through direct feeding damage, through disease transmission and sometimes through the production of honeydew. Honeydew is a sticky liquid produced by many sucking insects which can encourage the growth of sooty molds which contributes to poor plant vigour.

***Bemisia tabaci* (Gennadius, 1889) - The sweet potato white fly or silver leaf whitefly**

Origin and Impact

B. tabaci (figure 2.37) probably originated in India and it has now spread to many locations in the tropics and subtropics as well as to plants grown in glasshouses in temperate areas. It is a pest of a very large number of plants including cotton, cassava, cucumber, peppers and tomatoes. The latter two species were the only host species mentioned by interviewees. *B. tabaci* can cause direct feeding damage with affected areas developing chlorotic spots, withering or losing leaves. It produces honeydew which encourages the growth of sooty molds. In addition *B. tabaci* is a major vector of more than 110 virus species. *Bemisia tabaci* has been listed as among 100 of the World's Worst Invasive Alien Species by the IUCN Invasive Species Specialist Group (ISSG).

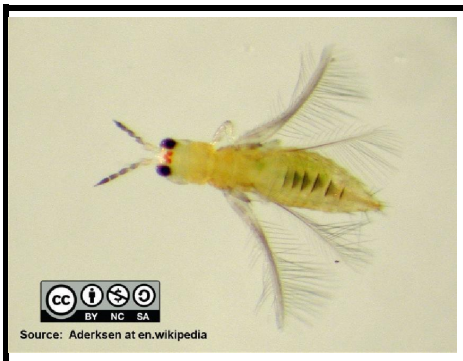
Figure 2.37: Bemisia tabaci

Management

No control measures were outlined by interviewees.

Further information

Further information can be found in the CABI Invasive Species Compendium datasheet for *B. tabaci.*



***Scirtothrips* spp. - Yellow tea thrips**

Origin and Impact

Scirtothrips spp. are a common pest of tea in dry weather. The nymphs and adults feed on the tender growing parts of the shoot unlike most other pests of tea that attack the leaves and stems. This causes new leaves to remain small and curled while growing shoots are visibly stunted.
Scirtothrips dorsalis is believed to have originated in the Indian subcontinent or in Southeast Asia (figure 2.38).

Figure 2.38: Scirtothrips dorsalis

Management

Plants on the Tole Tea Estate are sprayed using Dimethoate.

Further information

Further information can be found in the CABI Invasive Species Compendium datasheets on Scirtothrips dorsalis.

Helopeltis schoutedeni Reuter, 1906 - Cocoa mosquito, tea mosquito bug or mirid bug

Origin and Impact

Helopeltis schoutedeni (cocoa mosquito or tea mosquito bug) is likely to be of African origin. See Figure 2.39. In spite of its common names, it is actually a mirid bug that affects cocoa, tea, cotton and mango among other economically important species. The following information relates to the effects of H. *schoutedeni* on tea. Nymphs and adults feed on tender stems and inject toxic saliva which causes leaves to curl up and die. Leaves get black spots and look flaccid and weak.

Figure 2.39: Helopeltis schoutedeni

Management

Plants on the Tole Tea Estate are sprayed using Dimethoate but Permethrin can be used if Dimethoate is not available.

Further information

Further information can be found in the infonet-biovision datasheet for cocoa.

***Stictococcus vayssierei* (Richard, 1971) - Cassava root mealybug**

Origin and Impact

Stictococcus vayssiereiis a dark-red scale insect native to Cameroon. As well as cassava, it feeds on cocoyam, groundnut, banana, some weeds and native plants. The larvae and adults attack young feeder roots of germinating cassava cuttings, leading to extensive leaf fall, wilting and eventual plant death (figure 2.40). Tubers of plants that escape early infestation develop normally but are small and become covered with the root scale so fetch a low price at the market. *S. vayssierei* is considered to be the major cassava pest problem in the humid forest zone of Cameroon (Essono et al., 2008). It was common in South Cameroon by 1984 and has since spread in the region.

Figure 2.40: Cassava shoot mealybug damage (Photos: IITA – left J. Ngeve – right)

Management

Monocropping helps to reduce the incidence of the pest (Ngeve, 2003). 01 stated that it is not advisable to use chemicals against this pest and that an effective way to minimise its impact is to harvest when the cassava is ready. Based on observations in the field it appears that the longer the plant stays in the ground the more susceptible it is to damage from *S. vayssierei*.

The authors are not aware of any work that has been undertaken to breed or test for non-susceptible varieties.

Further information
Further information can be found in Ngeve, 2003.

***Dysmicoccus brevipes* (Cockerell, 1893) Pineapple mealybug**

Origin and Impact
Dysmicoccus brevipes is found throughout the tropics wherever pineapples are produced. They can cause direct feeding damage and are vectors of the Mealybug or Pineapple Wilt Virus. The mealybug is common on the roots of pineapple and large colonies develop on the stems just above ground level (figure 2.41). Ant species, notably the bigheaded ant, *Pheidole megacephala*, commonly tend mealybug colonies, feeding from their honeydew, protecting the mealybug and moving them from plant to plant.

Figure 2.41: Severe infestation of *Dysmicoccus brevipes* on the pineapple fruit.

Management
Growers in Njombe try to control the mealybugs with an insecticide using Dursban (Chlorpyrifos - ethyl), Callidim (Dimethoate) but prevention is most important management measure (see section on mealybug wilt of pineapple).

Further information
Further information can be found in the CABI Invasive Species Compendium datasheets on *Dysmicoccus brevipes.*

***Diopsis macrophthalma* Dalman, 1817 – Stalkeyed fly, rice stem borer**

Origin and Impact

Diopsis macrophthalma, which may be native to Africa, looks like a reddish mosquito. It sucks the sap of the plant and reduces the growth of young plants which can, in some cases, wither and die. It is difficult to estimate the level of loss. The delay in maturity results in the loss of yield through reduced tillering. Studies from Malawi show that *D. macrophthalma* can have negative or positive effects on rice yield depending on the time and level of attack, growing conditions and rice variety. Under normal conditions the effects were positive but when poor growing conditions were combined with a late, heavy attack the effects were negative (Feijen, 1979).

Figure 2.42: stalk-eyed fly of the species *Teleopsis dalmanni.* Note that this is NOT *Diopsis macrophthalma* but is in the stalk-eyed fly family (*Diopsidae*)

Management

Farmers in Ndop spray with any insecticide they find against *D. macrophthalma.* They receive no external support from an external expert organisation. The spraying is effective but the chemicals are expensive. Probably 25% spray. According to those who do not would spray if they could afford it.

A practice that is detrimental to the rice but is effective for controlling pest is to allow the seedlings to season too long in the nursery. In such cases the insect will struggle to penetrate the cuticle. However, it negatively affects crop yield. This practice is discouraged by UNVDA.

Further information

Further information can be found CABI Invasive Species Compendium datasheets on *Dysmicoccus brevipes.*

Aphids (Aphididae)

Occurrence and impact

Toxoptera aurantii (Fonscolombe, 1841) (brown citrus aphid) is a pest in tea. See Figure 2.43. It sucks the sap of leaves buds and tender stems which curl up and plant growth is retarded. It also deposits honeydew which encourages black sooty molds. It is common in young tea or tea that has been pruned and regenerating or in nurseries.

Figure 2.43: Toxoptera aurantii

Interviewees also cited aphids (scientific name(s) not given) as problems in tomatoes and as a "big problem" in potatoes. Aphids were also cited as a vector of *citrus tristeza virus* which causes major losses for citrus fruit growers.

Management

Plants on the Tole Tea Estate are sprayed for *T. aurantii* using Dimethoate but Permethrin can be used if Dimethoate is not available. Permethrin is more effective. The potato farmers would spray if they had the means. No other management measures were outlined.

Further information

Further information can be found in the *University of California Pest Management Guide for Toxoptera aurantii.*

LEAF MINING INSECTS

Leaf mining insects are a group of biting insects that bore holes into plants and live inside, feeding on the interior of the plant.

***Coelaenomenodera* spp. - Hispid or oil palm leaf miner/beetle**

Origin and Impact

Source:
Hispines of the World

The authors could not find any information on the origin of this group but judging by its distribution it seems likely that the group is of West African origin. *Coelaenomenodera* spp. attack oil palm plants of more than 3-4 years in age (figure 2.44). Larvae mine oil palm leaves making them look blistered and causing them to wither. Adults feed on the lower surface of the leaves. Percentage loss figures are not available but it is estimated yield loss of about 10%. However, if left untreated the beetle is likely to kill the plant in the long run. Coelaenomenodera spp. is only really a problem at the Iloani Palms Estate (in the Southwest Region). It was previously more widespread but has been reduced due to systematic control efforts.

Management CDC is using "avisec" which is applied by fogging. The pest will return from untreated reservoirs if it is not managed on an area-wide basis. The treatment is expensive so CDC assists the small planters in the surrounding villages as part of its social responsibility and because it makes long-term sense.

Figure 2.44:

***Coelaenomenodera* sp. This may not be the same species as found in Cameroon**

Further information

Further information on *Coelaenomenodera elaeidiscan* be found in the in the Plant wise Knowledge Bank Cameroon Datasheet.

2.10.2 Results – Plant invaders

Plant invaders are probably the best known invasive species group on account of their impacts but also because of their high visibility. Plant invaders have contributed to a variety of impacts: to agriculture – e.g. loss of crop yield and livestock poisoning; the environment – e.g. loss of biodiversity and eutrophication of water bodies; and human health – e.g. poisoning, acting as a reservoir for disease vectors, etc.

The plant invaders identified were classified as follows:

- Herbaceous weeds
- Shrubs
- Water weeds
- Climbers
- Parasitic weeds
- Woody weeds

HERBACEOUS WEEDS

***Commelina benghalensis* (L.) Raeusch. Bengal dayflower.**

Figure 2.45: Commelina benghalensis

Origin and Impact

Commelina benghalensis (figure 2.45) native to tropical and subtropical Asia and Africa and is a problem in agricultural systems. CDC formerly used it as a cover crop but it is no longer used for this purpose because of its tendency to persist and spread.

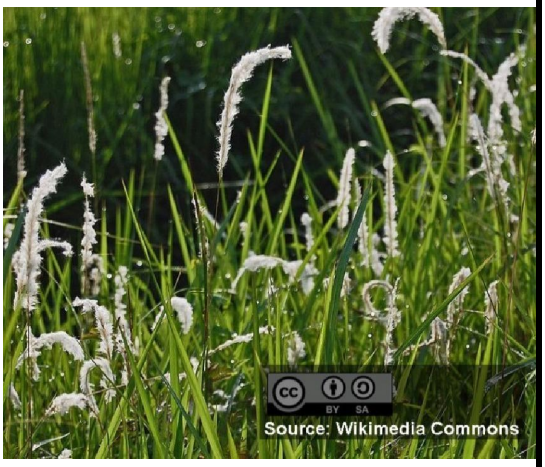
Management

C. benghalensis can be uprooted manually. Chemical control is used (product not specified). Plastic mulching is effective but it is not available on the local market.

Further information

Further information can be found in the CABI Invasive Species Compendium datasheets on *Commelina benghalensis*.

***Imperata cylindrical* (L.) Beauv. Cogon grass**



Origin and Impact

The precise origin of *Imperata cylindrica* is not known (figure 2.46). But now it is naturalised throughout the tropics and warm temperate locations although it has a limited distribution tropical America. It is a weed of 35 crops worldwide with most crops in the humid tropics affected. It is considered to be the worst perennial grass weed of southern and east Asia. Millions of hectares of farmland are abandoned because of I. cylindrica grass in West and Central Africa each year. It is also thought to negatively impact upon biodiversity as it is an inferior forage grass. *I. cylindrica* has been listed as among 100 of the World's Worst Invasive Alien Species by the IUCN Invasive Species Specialist Group (ISSG).

Management

I. cylindrica can be uprooted manually or a tractor can be used and the plant then removed and dried. Hand-weeding and Round-up (glyphosate) is used to manage *I. cylindrica* in the Tole Tea Estate.

Figure 2.46: Imperata cylindrica

Further information

See on the CABI Invasive Species Compendium datasheets on *Imperata cylindrica.*

***Urochloa maxima* (Jacq.) R. Webster (alternative name: Panicum maximum L.) - Guinea grass**

Figure 2.47: Urochloa maxima

Origin and Impact

Urochloa maxima (See figure 2.47) is native to Africa but has been introduced to many countries as a pasture crop and now is found throughout the tropics. It is a weed of many cropping systems. In Cameroon it is mainly a problem on the east coast.

Management

Roundup (glyphosate 360) is commonly used in rubber estates and is very effective. However, it will also kill the cover crop. Manual weeding is used in some cases so that the cover crop survives.

Further information

The plant and uprooted in the garden but it is a challenge to use chemicals as the infestations are close to a river. There used to be a horse present in the garden and when it was there the weed was much less of a problem. In sugar cane, *P. purpureum* and other weeds require regular weeding. They spray with Gramoxone (paraquat) and Gamaline (lindane).

***Pennisetum purpureum* Schumach. 1827 - Elephant grass**

Origin and Impact

Pennisetum purpureum is native to sub-Saharan Africa and has been introduced to many warmer parts of the world as an ornamental plant and for erosion control. It is the biggest invasive species problem in the Limbe Botanic Garden. It is found just along river bank and it multiplies in swampy areas. The problem is increasing in the garden and if nothing is done the species will still continue to spread. *P. purpureum* was also cited as a problem in sugar cane. See Figure 2.48.

Further information

Further information can be found in the CABI Invasive Species Compendium datasheets on *Pennisetum purpureum*.

Figure 2.48: Pennisetum purpureum

Pteridium aquilinum.

Figure 2.49: Individual Plants and infested area with *P. aquilinum*. Ph Tadu (North West Region of Cameroon)

Origin and Impact

Pteridium aquilinum is a cosmopolitan species that is possibly native to Cameroon. See Figure 2.49. It is found at very high densities in rangelands in the western and northern Cameroon. It is poisonous to cattle, causing them to pass blood in their urine – “your best friend is now the butcher as [if left alone] the cow will weaken and die”. It began to become a serious problem in the mid 1980s. *P. aquilinum* fern is now degrading about 70% of the land in the pastoral areas in the Western Highlands of Cameroon (North West & Adamawa

Regions).

Management
Rehabilitation is undertaken by spot weeding or night paddocking (for Kikuyu grass - *Pennisetum clandestinum*). The technique of restricting cattle, through fencing, to feed in one area over-night and then releasing them onto a pasture spread the seeds of the desirable species from the paddock to the field. *Brachiaria* sp. (full species name not given) is also used to rehabilitate areas infested by *P. aquilinum*. The methods used are very effective but the areas managed in this way have been limited by the cost of fencing.

Further information
Further information can be found in the CABI Invasive Species Compendium datasheets on *Pteridium aquilinum.*

***Bambusa vulgaris* Schrad. - Common bamboo**

Impact
The origin of *Bambusa vulgaris* (figure 2.50). Is unknown but it is believed to have originated in Southern China. It is invasive in high forest regions of Cameroon. People plant it as a live hedge but it will encroach upon neighbouring unplanted areas is if is not cut back.

Management
Cutting by hand was the only management method mentioned.

Further information
Further information can be found in the ISSG Global Invasive Species Database datasheets.

Figure 2.50: Bambusa vulgaris

***Chromolaena odorata* (L.) R. M. King & H. Rob. - Bokassa grass, triffid weed**

Origin and Impact

Chromolaena odorata is native to the warmer parts of south-eastern USA, Mexico, the Caribbean and tropical South America (figure 2.51).

Figure 2.51: Chromolaena odorata

Chromolaena odoratais common, mainly in fallow land. We see it in the humid tropical systems. Now many fallows are invaded by *C. odorata*. It inhibits forest regeneration. In addition to being a threat to biodiversity, it causes a serious problem to the fertility of soils. IITA have made a great number of studies in regard to biological control introductions in Cameroon. *Chromolaena odorata* has been listed as among 100 of the World's Worst Invasive Alien Species by the IUCN Invasive Species Specialist Group (ISSG).

Management

People uproot it and then it can be controlled but it must be removed before flowering or it will spread profusely. In oil palm plantations, prior to planting hand weeding and chemical control is undertaken several times before the crop is planted but even then it takes some time to get the weed under control as the seeds last in the seedbank.

Further information

Further information can be found in the CABI Invasive Species Compendium datasheets on *Chromolaena odorata*.

***Mimosa diplotricha* C. Wright (alternative name: mimosa invisa L.) - Giant false sensitive plant**

Mimosa invisa is a commonly-used synonym for *Mimosa diplotricha*.

Origin and Impact

Mimosa diplotricha (figure 2.52) is native to the much of South and Central America and the Caribbean. It is a serious weed of cropping systems and can spread very easily.

Management

It is very difficult to control on account of its thorns. No specific management method was mentioned by the interviewee.

Figure 2.52: Mimosa diplotricha

Further information

Further information can be found in the CABI Invasive Species Compendium datasheets on *Mimosa diplotricha*.

***Tithonia diversifolia* (Hemsl.) A. Gray - Mexican sunflower, la fleur Margarette, la fleur jalousie.**

Origin and Impact

Tithonia diversifolia is native to Mexico and Central America (figure 2.53). It has been planted along field edges and on slopes for use as a live fence and for erosion control. It has spread to fallow areas and grazing lands where it can be very difficult to remove.

Management

No specific management method was mentioned by the interviewees.

Further information

Further information can be found in the ISSG Global Invasive Species Database datasheets.

Figure 2.53: Tithonia diversifolia

***Eichhornia crassipes* (Mart.) Solms - Water hyacinth, jacinthe d'eau.**

Origin and Impact

Eichhornia crassipes is widely regarded as Africa's most damaging water weed (Matthews and Brand, 2004) and is listed as among 100 of the World's Worst Invasive Alien Species by the ISSG (figure 2.54). Native to the Amazon Basin, *E. crassipes* has been introduced to many parts of the world as an ornamental plant, and today is found in more than 50 countries on five continents. The plant grows rapidly from seeds as well as vegetatively and forms dense mats. These mats reduce light penetration which affects aquatic food chains. Rotting plants deplete oxygen levels, with further effects on biodiversity. The mats impede access for fishing and water transport. The biomass can damage road and rail bridges and can block hydro-electricity producing turbines.

Figure 2.54: *Eichhornia crassipes* flower shown in inset.

E. crassipes is found along the Wouri River close to Douala and in creeks. The infestation in the Wouri is a particular problem because it close to the country's main port and the weed causes problems for access and navigation. *E. crassipes* was pinpointed as a problem above the Mungo River towards Idenau where it has a direct effect on aquatic life. Eutrophication may result from colonisation by this species.

Management

Cutting by hand was the only management method mentioned by interviewees. This can be effective for small infestations but is not sufficient when infestations become large. Some people are trying to use the removed biomass for the production of paper. None of the interviewees mentioned mechanical harvesting or biological control which have been used elsewhere.

Further information

Further information can be found in the CABI Invasive Species Compendium datasheets on *Eichhornia crassipes*.

Nypa fruticans (Thunb.) Wurmb. - Nipa palm.

Figure 2.55: Nypa fruticans

Origin and Impact

Nypa fruticansis native to the coastlines of the Indian and Pacific Oceans. See Figure 2.55. It can take over waterways thus reducing access and affecting movement. Fisher folk claim that it reduces catch both through lack of access and actual reductions in fish stocks.

The percentage under *N. fruticans* is difficult to tell but it is increasing & people are concerned.

There are two mangrove zones – estuarine and creek. *N. fruticans* is a common problem to both but the levels of invasion are greater in the creek areas as they have had more human intervention.

Management

There are efforts to see how people can make use of *N. fruticans*. The fruits are quite fibrous and can be incorporated into fish smoking, etc.

Further information

Further information can be found in the CABI Invasive Species Compendium datasheets on *Nypa fruticans*.

Livestock diseases

Livestock diseases are a major problem in Cameroon. Our interviewees gave reasonably detailed accounts of the impacts of livestock diseases in the poultry and pig sector but accounts of diseases from other sectors were minimal (Table 2.7).

Table 2.7: Livestock diseases listed as invasive in Cameroon.

Species
Poultry diseases
Corona virus (infectious bronchitis disease agent)
Newcastle disease
Infectious bursal disease - Gumboro
Cocsidiosis
Avian cholera
Avian influenza (bird flu)
Marek's Disease
Pig diseases
African swine fever virus
Erisipelothrix isidioda (swine erysipelas)
White diarrhoea in piglets (diarrhoea peri-natal) (species name of disease agent not given)
Scabies or mange ("lagalle") (species name of disease agent not given)
Honey bee diseases
Unamed disease
Cattle diseases
Foot and Mouth Disease Virus (FMDV)
Contagious Bovine Pleuropneumonia (Mycoplasma mycoides mycoides)
Trypanosomosis (Trypanosomiasis)
Black Quarter (Clostridium chauvoei) Anthrax (Baccilus anthracis)
Other diseases
Peste des petits ruminants
Rabies
African Horse Sickness

Poultry diseases

Corona virus (infectious bronchitis disease agent)

Impact

According to 16 the greatest economic disease problem of poultry in Cameroon is avian infectious bronchitis (IB). This disease affects both small and large production systems. Corona virus or infectious bronchitis virus (IBV) is responsible for IB. IB is a highly contagious respiratory disease. It can damage the kidneys and oviducts and result in reduced weight gain and mortality from secondary bacterial infections.

Management

You can use antibiotics to treat secondary infections but this can cause a great deal of pollution and problems of resistance in the livestock. Good ventilation and reduced dust levels can help reduce losses.

Further information

Further information can be found in the CABI Invasive Species Compendium datasheets on avian infectious bronchitis.

Newcastle disease

Impact

Newcastle disease, a very contagious viral disease, affects birds throughout the world. See Figure 2.56 According to 16 Newcastle disease is the second most destructive disease of poultry in Cameroon after infectious bronchitis. Newcastle Disease has been present in the country for much longer. The exact symptoms vary according to the strain and path type of the virus and environmental factors such as secondary infections.

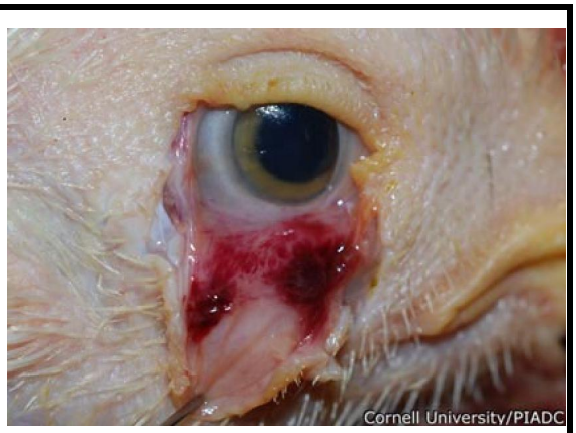


Figure 2.56: Newcastle Disease symptoms. Congested conjunctivae and hemorrhagic lesions on the mucous membranes.

Management

Vaccines have been produced and there is an annual vaccination campaign organised by MINEPIA.

The following is an account of The Newcastle Disease Project is being implemented by HEIFFER International to help those rearing poultry under traditional systems in the Extreme North. Poultry is a big livelihood issue especially in marginal groups – women and children. There is a huge production but at a certain period of the year the village poultry is wiped out. The critical health condition was the Newcastle Disease. It was clear that vaccination could really help poultry production in the Extreme North. HEIFFER strengthened the lab in Garoua – buying equipment and Eliza to produce vaccines. They trained the villagers in maintaining the cool chain to keep the vaccines viable. They equipped them with solar fridges and they in turn trained the community.

The first vaccination campaign was in June-July 2012. The second was in October and the campaign is on-going. Animals are exposed to three doses in a year. HEIFFER are putting in a structure for sustainability. The vet nurses now buy the drug and maintain the changes. They hope by third campaign they will be self-sufficient. There were some problems of production of the vaccine at first but we hope they can now produce it in more appropriate

quantities.

Further information
Further information can be found in the CABI Invasive Species Compendium datasheets on Newcastle disease virus.

Infectious bursal disease – Gumboro

Impact Infectious bursal disease (IBD) is an acute, highly contagious disease of young chickens, caused by infectious bursal disease virus (IBDV) that is found throughout the world. The Bursa of Fabricius (component of the immune system) becomes enlarged and finally atrophies. This can cause serious immune suppression with earlier infection generally causing the most severe effects.

Figure 2.57: Normal bursa and atrophied bursa post IBDV infection

Management
No information was given on the management of IBD in Cameroon. There is an annual vaccination campaign by MINEPIA with the LANAVET produced vaccine Gumbovax.

Further information
Further information can be found in the CABI Invasive Species Compendium datasheets on infectious bursal disease.

Other poultry diseases were cocsidiosis, avian cholera and Maladie de Marek.

Pig diseases

African swine fever virus.

Origin and Impact

African swine fever virus (ASF) is believed to originate in sub-Saharan Africa and has spread to several locations outside the African continent. The ASF virus, which affects wild and domesticated pigs, is transmitted by the tick species *Ornithodoros moubata* in the genus *Ornithodoros*. It can be extremely damaging and can sweep the whole area. ASF, which was first described from Kenya in 1921, was first noted in Cameroon in 1982. One of the reasons for its spread is believed to be the disposal of pig meat in dustbins. See figure 2.58. ASF is everywhere is Cameroon.

Figure 2.58: ASF. Dead pig with general reddening of the skin.

Management

Control of the disease is more difficult in outdoor systems than indoors, as this is usually achieved by the control of vectors. One way of reducing the spread of the disease is to stop live transport that is a prevalent practice in Cameroon today. No effective vaccines are available. What do they do for control? Some people are administering aprobiotic but nobody has been able to do a classic randomised control trial. It is not always certain that what is identified as ASF in Cameroon is actually ASF. In certain cases the reported symptoms could be caused by other diseases (see below). It was pointed out that it is not the disease alone that is limiting the production.

Specifically it was suggested that the country needs to build a real pyramidal structure in which every partner understands their position - producers, breeders, and researchers. Good practices need to be defined. It may then be possible to understand at what level the problem is and to communicate the action to be undertaken by and through the distribution system.

Further information

Further information can be found in the CABI Invasive Species Compendium datasheets on African swine fever.

Erisipelothrix isidioda (swine erysipelas).

Impact

Erisipelothrix isidioda (*Erisipela porcina*) is a bacterial disease with almost the same symptoms as ASF but erisipela can be is vaccinated against so there is a level of control.

White diarrhoea in piglets (diarrhoea peri- natal) (species name of disease agent not given).

Impact

At birth you will get about 12 piglets of which 8 survive and 3 stay small because of the disease – they don't grow. Therefore we get only 5 in the end. These little ones are released into the wild and they spread the disease.

Management

No information was given on the management of White diarrhoea in piglets in Cameroon

Scabies or mange (species name of disease agent not given)

Figure 2.59: Sarcoptic mange infection in ear. http://www.thepigsite.com/articles/3457/smaller-producers-pig-health-course-parasites-part-1mange-and-lice

Impact

According to 16 Scabies ("la galle") is found on all farms. The parasite is an external mite. There are chemicals to control the mite.

Management

No information was given on the management of scabies in Cameroon.

Further information

Further information on sarcoptic mange can be found in the Pig Site Smaller Producers Pig Health Course: Parasites Part 1 – Mange and Lice.

Cattle disease

Bovine pleuropneumonia CBPP)

The causative agent of contagious bovine pleuropneumonia (CBPP) is *Mycoplasma mycoides* subsp. *mycoides* SC (bovine biotype). This disease is widespread in Africa and is also present in other regions of the world, including Southern Europe, the Middle East and parts of Asia.

Contagious bovine pleuropneumonia (CBPP) is widespread in Africa and in other regions of the world This disease is particularly important in the semi-arid, sub-humid and arid zones of tropical Africa, but CBPP incidence seems to be increasing in some parts of East Africa. The epidemiology of CBPP is characterised by the occurrence of sub-acute and symptomless infections, and the persistence of chronic carriers. Spread of the disease is associated with cattle movement.

The major obstacles to eradication of CBPP are the difficulties in controlling cattle movement and applying quarantine and slaughter policies. Other difficulties arise due to the absence of a field test for diagnosis, the relatively short duration of post-vaccinal immunity and the lack of data on the economic impact of the disease.

The Pan-African Rinderpest Campaign (PARC) strategy for CBPP control and eradication conforms with national control programmes, which include cost/benefit analysis. It is planned to perform blanket vaccination against the disease for three to five years, depending on the economic situation of each country. Stringent control of cattle movement will complement vaccination campaigns. The eradication phase, including slaughter measures, will be instituted following reduction of CBPP incidence. Regional and international coordination will be instituted to control international cattle movement and harmonise control strategies (Masiga and Domenec, 1995).

The national veterinary Laboratory (LANAVET), Garoua (Cameroon) has been carrying out rinderpest sero-surveillance since 1989 as part of an effort made by the Panafrican Rinderpest Campaign to control rinderpest in Africa. In 1993, 8517 serum samples collected from 286 cattle herds (from 0 to 3 years old) randomly chosen from six provinces with large cattle population (Far-North, North, Adamaoua, East, West, North-West) were tested using the rinderpest competitive ELISA technique; the herd immunity level was 54%. Out of 2010 serum samples from 68 non-protected cattle herds tested using the peste des petits ruminants (PPR) ELISA technique, 91 samples were positive (4.5%): this does not significantly increase the cattle immunity level against rinderpest. Significant differences in the immunity rates between provinces were observed. Suggestions to increase the immunity level are discussed (Ngangnou et al., 1996).

Honey bee diseases

Impact

There is an unknown disease for which nobody knows the cause with certainty. People believe it is caused by the nectar or pollen of a particular species of plant, which flowers every nine years in the Oku forest in the Northwest Region of Cameroon. The whole colony is killed but the honey in the hive remains intact. The plant's name is *Plectranthus insignis* locally known as Bum. We don't know the exact impact – but it is a serious problem once in nine years. The last

time it happened? It should be the problem this coming year since the species has flowered. - The main harvest season for honey in the North West Region is mostly March – June of each year.

Management
No management has been undertaken. The Apiculture and Nature Conservation Organization (ANCO) have approached researchers but have never had any reaction.
Further information on diseases of bees can be obtained from the service for diseases of bees, fish and non-conventional livestock in the Department of Veterinary services of MINEPIA.

2.10.3 Vertebrate invaders

Rats and mice
Rats and mice are considered to be important invasive species the world over with the impact of rats on biodiversity, food production and human health usually being more serious. The interviewees did not clearly distinguish between rats and mice and for this reason they are considered together in this section.

Rats and Mice (scientific names not given)

Impact
Rats and mice were cited as pests in maize, potatoes, rice and stored products. Potatoes: The mice which eat the tubers are a problem. Rats that destroy maize in storage. In rural areas that are close to farms the level of damage is very high. The rats come from the bush to the house. They are the same species that eat the maize in the farms. See Figure 2.60 and 2.61.

Management
People set traps for rats. Poison baits are also used against rats. Rats eat and die and maybe the smell of the rat deters others but later they still come in so they have to put out more poison baits. One can use crayfish, grape or soft fruit as bait (more attractive than maize – they die on the spot or move only a little bit away from where the bait was put. People use endozine (tablet). It is poisonous to rats but not to people and it is readily available at the pharmacy.

Further information
Further information on rats and mice can be found in the CABI Invasive Species Compendium datasheets on *Rattus rattus* (black rat) and *Mus musculus* (mouse).

Grass cutters or cane rats (Thryonomys spp.)

Impact
Grass cutters were cited as pests in maize and sugar cane growing systems. Damage levels in maize can be high (exact percentages not given). They are only a problem in maize when they have cobs (a 6-8 week period) and not when the crop is green.

Management
Cane rats are trapped and eaten. Traditional traps can be effective, e.g. the use of iron traps and leg-hold traps. However, the animals learn to avoid the trap so they are often only 30-40% effective. Grass cutters are eaten so harvesting them for food constitutes a form of control.

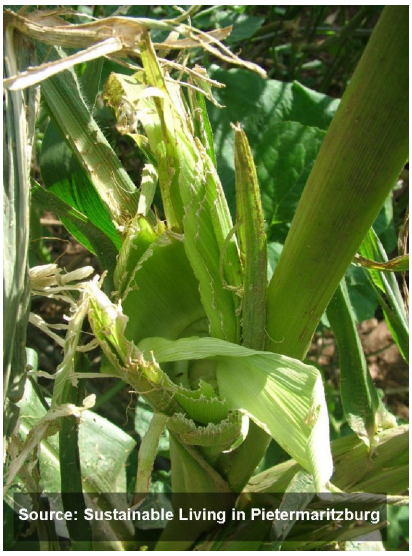


Figure 2.60: Rat damage on maize

Figure 2.61: Greater cane rat (*Thryonomys swinderianus*)

Birds

Impact
Birds were cited as a problem in maize, especially where the farm is a long way from people's homes. Weaver birds are commonest bird species that destroy maize and also rice. Management People construct scare-crows in farms and hang cloths to scare the birds. Some keep children away from school to scare the birds. The level of success from using children to scare the birds can be 70-80% However, it is very costly to have children staying in the farm and hiring child labour. There are the issues of child labour, poor education and spending money. Other methods can be very effective if they are done well.

Lizards

Impact□
Lizards (scientific name(s) not given) can affect bee hives. They can get into the hive area and feed on the bees.□Management□For bee hives the best management method is good sanitation to ensure the area around the nest is clean so reducing ease of access. Bee keepers sometimes prevent lizards and rats from accessing hives by attaching zinc cones to the stands which prevents them from climbing further.

Fish

Impact
Although we spoke to fish farmers in the Meme Division, Kumba (Southwest Region) we did not receive any information on the existence of any invasive fish species. Clearly this is a gap that needs to be filled. There are many examples of invasive fish species in the African continent, including the Nile perch (*Lates niloticus*) in Lake Victoria, and the common carp (*Cyprinus carpio)* and Nile tilapia (*Oreochromus niloticus*) in many water bodies. It is exceedingly unlikely that all water bodies in Cameroon are unaffected by fish invasions. The work that will build on this activity (4.3.1. and associated activities) will target information on fish invasions in Cameroon to explicitly address this gap.

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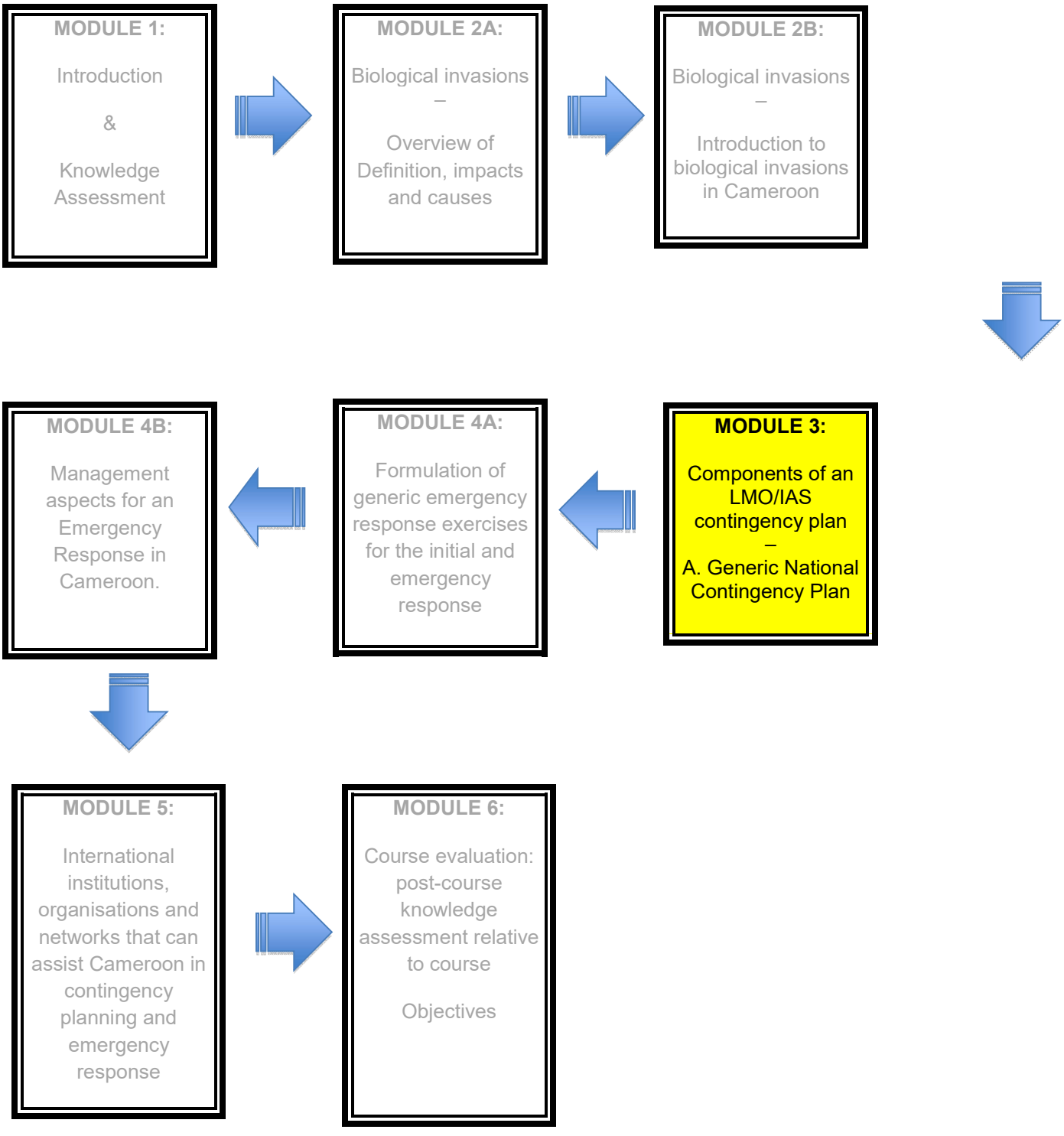
MODULE 3

COMPONENTS
OF AN LMO/IAS CONTINGENCY PLAN

(Pre-event, trigger, scope of the problem, operational response and stand down)

"It is better to plan when it is not needed, than not to have planned when it was necessary"

Trainer's Edition


MODULE 1:
Introduction
&
Knowledge Assessment
MODULE 2A:
Biological invasions – Overview of Definition, impacts and causes
MODULE 2B:
Biological invasions – Introduction to biological invasions in Cameroon
MODULE 3:
Components of an LMO/IAS contingency plan – A. Generic National Contingency Plan
MODULE 4A:
Formulation of generic emergency response exercises for the initial and emergency response
MODULE 4B:
Management aspects for an Emergency Response in Cameroon.
MODULE 5:
International institutions, organisations and networks that can assist Cameroon in contingency planning and emergency response
MODULE 6:
Course evaluation: post-course knowledge assessment relative to course
Objectives

MODULE 3 - COMPONENTS OF AN LMO/IAS CONTINGENCY PLAN

By the end of this module you should be able to:

- *Understand the process of Contingency Planning;*
- *Understand the who to notify in a CP process;*
- *Understand benefits and outcomes linked to a good CP activity;*
- *Understand the need for Contingency Planning; and*
- *Know the major components of Contingency Planning.*

Authors notes:

As an indicative guide for local government to undertake their own contingency planning, this module outlines the rationale and processes, and provides illustrations of how contingency planning works. It is critical that this module be treated as such. Information to supplement the contents of this module may be acquired from individuals and groups who have undergone either orientation or facilitators' training. More helpful is the actual conduct of a contingency planning with a person who has undergone either an orientation or a training of facilitator and preferably those who have participated or conducted actual contingency planning workshops.

Trainer notes

Various kinds of contingencies can arise in your area and you can formulate plans for each type of critical event. Your area might experience more than one contingency. In which case you might need to do contingency planning for each event. Below are possible events for which contingency plans can be formulated:

- Sudden increase of displaced population
- Sudden shortages of funding, food or other commodities
- Outbreak of an epidemic or serious health problem
- Natural disaster
- How do you know when contingency planning should be initiated?

3.1 What is a Contingency Plan

A Contingency Plan (CP) is a plan prepared to assist personnel to deal with an unpredictable event. Countries need to have in place well-documented contingency action plans for specific, high-priority emergency diseases, together with a series of generic plans for activities or programmes common to the various specific disease Contingency Plans (e.g. setting up national and local animal disease control centres). They also need to have resource and financial plans and proper legislative backing for all actions. These Contingency Plans need to be considered and agreed upon in advance by all major stakeholders, including the political and bureaucratic arms of government and the private sector, particularly livestock farmer organizations. The Contingency Plans should be refined through simulation exercises and personnel should be trained in their individual roles and responsibilities.

It must be:

- Realistic, practical and easy to use;
- Agreed and understood by all involved parties; and

- Tested, evaluated and updated regularly.

The need for pre-determined and properly structured Contingency Plans is clear when one considers the pressures and multiple tasks facing personnel may be exposed to increasing hazards and greater environmental damage may occur.
Effective planning will ensure the necessary actions taken in a structured, logical and timely manner. Routine exercises involving all interested parties will ensure that the involved personnel are familiar with the contents of the Contingency Plan and that any deficiencies in it are highlighted and corrected. The CP cannot be issued and ignored, but must be routinely reviewed and updated in order to preserve accuracy of the data and the information that it contains. In summary, an effective Contingency Plan will serve to promote a trained and practiced response when personnel are faced with emergency situation.

3.2 Benefits of a Contingency Plan

The **strategic objectives** of a Contingency Plan are the following:

- To improve surveillance, and maintain robust preventative controls and Contingency Plans for preventing and controlling major epizootic animal, and fish diseases and plant pest and disease outbreaks;
- To ensure that all future incidents of a non-indigenous exotic pests or diseases are managed consistently and promptly in order to contain and/or eradicate any exotic pest or disease that could enter in the Country;
- To minimise the risk of notifiable exotic pests or diseases becoming established, in order to protect Cameroon's economic sector and the wider environment;
- To maximise the benefit to Cameroon and national policies which impact on the agri-food, fishing and forestry sectors;
- To ensure that all relevant members of MINADER and other involved institutions are fully conversant with this procedure so that in the event of a biological invaders introduction and spread can take effective and immediate action; and
- To maintain and improve Cameroon's animal, fish and plant health status;

In support of these benefits, the **operational objectives** are:

- To increase capacity to prevent and control the introduction, establishment and spread of new biological invasions and management of LMOs in Cameroon through the implementation of a risk-based decision making process;
- To control the spread of notifiable endemic diseases through inspection and implementing control measures on positive findings and to identify and manage the risk associated with exotic new pests and diseases that may be introduced into Cameroon; and
- To provide a framework to allow the identification, control and eradication where feasible of notifiable exotic pests and diseases invaders of Cameroon.

3.3 Principal outcome of the Contingency Plan

The establishment of management procedures in accordance with international procedures in place for IAS and LMOs to minimise the risk of negative social, cultural, economic, environmental and biological impact of the biological invasions in Cameroon.

3.4 Who to notify

The CP should provide details of all parties to be advised in the event of an incident and this information may be provided in the form of a contact list. In compiling that list it should be remembered that, in the event of a serious incident the personnel will be fully engaged in saving life and taking steps to control and minimize the effects of the casualty. Procedures will vary between companies but it is important that the CP clearly states who will be responsible for informing the various interested parties.

3.5 Steps needed to formulate Contingency Plan in the relevant sectors

- PLANT AND PLANT PRODUCTS: (preparation, testing, updating, triggers, execution);
- ANIMALS AND ANIMAL PRODUCTS: (preparation, testing, updating, triggers, execution);
- TIMBER AND TIMBER PRODUCTS: (preparation, testing, updating, triggers, execution);
- VEHICLES AND MACHINERY: (preparation, testing, updating, triggers, execution);
- BALLAST WATER: (preparation, testing, updating, triggers, execution); and
- MOVEMENT OF PEOPLE: (preparation, testing, updating, triggers, execution);

3.6 When to do Contingency Planning

Contingency planning is a prerequisite for rapid and effective emergency response and can be developed any time before information on the introduction of an invader is obtained. Without prior contingency planning, much time will be lost in the first days of an emergency. However, where this has not been done, a Contingency Plan is still required when information on the introduction is known, just before the event or right after the exact damage is known (figure 3.1). Contingency planning builds organizational capacity and should become a foundation for operation planning and emergency response.

Activity 3.1
Self assessment exercise on CP - respond to questions on sheet

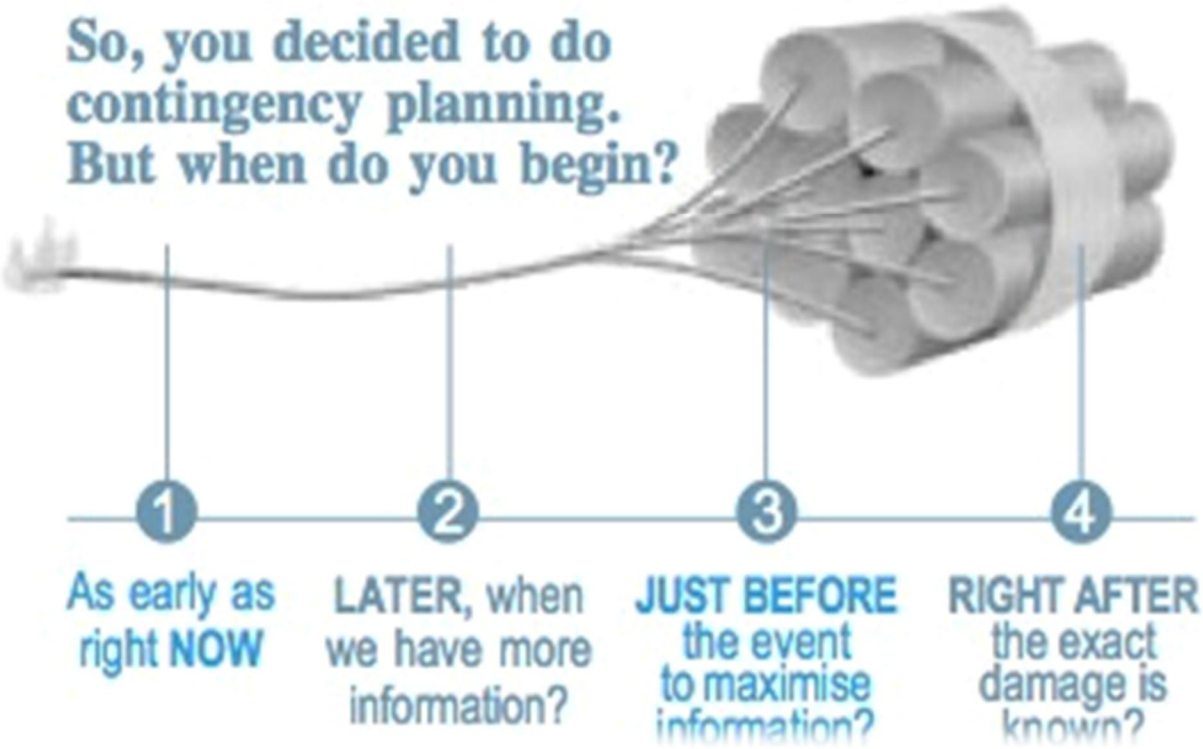


Figure 3.1: When to Begin Contingency Planning

3.7 Technical Contingency Plans

Technical Contingency Plans should consist of four sets of complementary documents:

1. Specific disease Contingency Plans that document the strategies to be followed in order to detect, contain and eliminate the disease.
2. Standard operating procedures for activities and programmes that may be common to several or all emergency disease campaigns.
3. Enterprise manuals that set out zoosanitary guidelines for enterprises that may be involved in an emergency animal disease outbreak.
4. Simple job description cards for individual officers.

These plans should be written in straightforward language that can be understood and followed by all those who have to implement them. There is no need to replicate the last three sets of documents in the specific disease Contingency Plans. There should, however, be cross-referencing.

3.8 Specific Disease Contingency Plans

These should be prepared for each of the diseases that have been identified as being of high risk. They should not be very long, but should be clear, authoritative documents that provide sufficient information to allow authorities to make informed decisions on what policies and procedures should be used to control and eradicate an outbreak of that disease, and which are enforceable in law.

The format and contents of the disease Contingency Plans should be tailored to meet the requirements and circumstances of individual countries. However, the following model format, may serve as a guide:

Nature of the disease

- Aetiology;
- Susceptible domestic and wildlife animal species;
- World distribution and previous occurrences in the country;
- Epidemiology (including likely pathways for spread within the country); and
- Clinical signs and pathology.

Risk assessment (including potential consequences)

- Risk profile of the disease for the country;
- Likely methods of introduction and geographical areas at high risk; and
- Potential consequences for food security and poverty alleviation, production losses, trade losses and public health.

Diagnosis and surveillance

- Early warning mechanisms for disease introductions/outbreaks;
- Disease reporting procedures;
- Field and laboratory diagnostic strategies;
- Linkages with international reference laboratories; and
- Surveillance strategies during different phases of eradication.

Principles of control and eradication

- Methods to prevent spread of infection and to eliminate the pathogen;
- Factors that may affect control and eradication: agricultural production systems; epidemiological, social and economic; and
- Feasibility of control and eradication in the country.

Policy and rationale

- Overall policy;
- Zoning policy;
- Disease control and eradication strategies and procedures in each zone;
- Alternate disease control and eradication strategies and the general circumstances in which these other options would be used;
- Strategies for dealing with special circumstances: disease in wildlife or feral animals, areas with nomadism or transhumance and difficult or relatively inaccessible areas; and
- Criteria for proof of freedom.

Appendixes

- Criteria for defining infected areas and disease control zones
- Summary of disease control actions in infected areas and other zones
    - quarantine;
    - livestock movement controls; and
    - stamping out, vaccination or other disease control procedures.
- International Animal Health Code for the disease.

Activity 3.2
List possible specific Biological Invaders for which Cameroon may need a contingency plan

3.9 Standard operating procedures

These are detailed sets of instructions for key programmes and activities that tend to be generic rather than disease specific. They should be cross-referenced to the specific Disease Contingency Plans. Standard operating procedures may be prepared for:

- Organization and operation of the national disease control centre;
- Organization and operation of local disease control centres;
- Emergency disease reporting and information systems;
- Laboratory diagnosis and surveillance;
- Field diagnosis and surveillance;
- Zoning;
- Quarantine and livestock movement controls;
- Livestock destruction and disposal of carcasses;
- Cleaning and disinfection;
- Planning and performance of vaccination programmes;
- Valuation and compensation; and
- Extension and public awareness campaigns.

3.10 Enterprise manuals

These are codes of zoo sanitary practice and instructions for action in what could be deemed as risk enterprises in a disease emergency. They should cover acceptable and unacceptable zoo sanitary practices when these enterprises find themselves located in infected areas, disease control zones, or disease-free areas. They may be prepared for:

- Livestock markets;
- Livestock shows, race meetings and other congregations of animals;
- Abattoirs and knackeries;
- Small goods (meat) processing plants;
- Dairy factories;
- Feedlots;
- egg hatcheries;
- Artificial breeding centres;
- Animal quarantine stations;
- Livestock traders and transporters;
- Zoos, wildlife parks and commercial aviaries; and
- Veterinary practices.

3.11 Support plans

Support plans are for the provision of the vital backing that will make the implementation of the disease contingency action plans possible. They may be specific for each disease Contingency Plan but tend to be more generic in nature.

- **Financial plans**: Experience has shown that delay in obtaining finances is one of the major constraints to the rapid response to emergency disease outbreaks. The application of even modest funds immediately will certainly save major expenditure later. Forward financial planning is therefore an essential component of preparedness.
  Financial plans need to be developed which provide for the immediate provision of contingency funds to respond to disease emergencies. These are for the necessary funds required over and above normal operating costs for government veterinary services. The plans should be approved by all arms of government, including economic planning authorities and the department of finance. The funds may cover the cost of the whole eradication campaign but more usually will cover the initial phases of the campaign, pending a review of the outbreak and the control programme and of the funds required to finalize eradication. The conditions under which funds may be released should be specified in advance. Normally they would be provided when he or she advises that the emergency disease has been diagnosed or there are reasonable grounds to suspect that the disease is present;
    - The outbreak is capable of effective control and/or eradication; and

- There are approved plans in place to do so.

The financial plan should also include the provisions for compensation to owners for any livestock or property destroyed as part of the disease eradication campaign. The payment of inadequate compensation is not only inherently unfair, but is also counterproductive to the campaign. Inadequate compensation fosters resentment and lack of cooperation and encourages farmers to hide the presence of the disease.

- **Resource plans:** the first step in preparing a resource plan is to make a resource inventory, listing all the resources that will be needed to respond to a moderate sized outbreak of each of the high-priority emergency diseases. This includes personnel, equipment and other physical resources.

The following resource lists required for different operations should be regarded as indicative rather than exhaustive:

- National animal disease control centre: senior disease control veterinarians and epidemiologists, financial and administrative officers and extra staff for recording and processing epidemiological and other information; maps (1:50 000 and 1:10 000), computers and communication equipment to local headquarters (e.g. facsimile, e-mail);
- Local animal disease control centres: senior disease control veterinarians and epidemiologists, technical support and suitable administrative offices, office equipment, maps, computers, communication equipment with headquarters (facsimile, e-mail) and field staff (radio) and proformas for various disease control operations;
- Diagnostic laboratories: trained laboratory staff, standard laboratory equipment plus any specialized equipment for key emergency diseases and diagnostic reagents for antigen and antibody detection;
- Diagnostic/surveillance: veterinarians and support veterinary auxiliary staff, transport, maps, communications equipment, leaflets or posters on the disease(s), diagnostic collection kits and transporters, blood collection equipment and animal restraint equipment;
- Vaccination: vaccination teams, vaccines, central and local refrigeration storage, transport, maps, cold storage transporters, vaccination equipment and animal restraint equipment;
- Slaughter, burial and disinfection: supervising veterinarian, personnel, transport, humane killers, ammunition and other approved means of killing (e.g. carbon monoxide gassing of poultry), protective clothing, animal restraint equipment, front-end loaders and earth-moving equipment, approved disinfectants, soaps and detergents, shovels, scrapers and high-pressure spraying equipment; and
- Quarantine and livestock movement controls: enforcement teams, transport, roadblocks (if necessary), signs and posters.

Next, a list of existing resources is prepared, including their specifications, quantities and locations. A register should be maintained of specialized staff, together with their qualifications

and expertise/experience with key emergency diseases. These resource lists and staff registers should be maintained at the national disease control centre and, where appropriate, at regional offices. Comparison of the inventory lists of needed and available resources will inevitably highlight many deficiencies. The resource plan should identify how these deficiencies will be rectified in an emergency. The resources plan and associated inventory lists need to be regularly updated.

Activity 3.3
List possible Standard Operating Procedures for which Cameroon may need a Contingency Plan

3.12 Simulation Exercises

Simulation exercises are extremely useful for testing and refining Contingency Plans in advance of any disease emergency. They are also a valuable means of building teams for emergency disease responses and for training individual staff.

Disease outbreak scenarios that are as realistic as possible should be devised for the exercises, using real data where possible (e.g. for livestock locations, populations and trading routes). The scenario may cover one or more time phases during the outbreak with a possible range of outcomes. However, neither the scenario nor the exercise should be overly complicated or long. It is best to test just one system at a time (e.g. operation of a local disease control centre).

Simulation exercises may be carried out purely as a paper exercise or through mock activities - or a combination of both approaches. At the completion of each simulation exercise there should be a post-mortem of the results. This review should identify areas where plans need to be modified and further training is needed.

A full-scale disease outbreak simulation exercise should only be attempted after the individual components of the disease control response have been tested and proved. Earlier exercises of this nature may be counterproductive.

3.13 Training

All staff should be thoroughly trained in their roles, duties and responsibilities in a disease emergency. Obviously more intensive training will need to be given to those who will be in key positions. It should also be borne in mind that any staff member, from the Chief Officer downwards, may be absent or may need to be relieved during a disease emergency for one reason or another. Back-up staff should therefore be trained for each position.

3.14 The need for regular updating of Contingency Plans

Contingency Plans, once prepared, should not be treated as static documents. They should be regarded as living documents that need to be regularly reviewed and updated as warranted by changing circumstances. This should be the responsibility of the national animal disease emergency planning committee. In reviewing and updating Contingency Plans, the following factors should be taken into account:

- Changing epidemiological situations, both within the country and externally;
- New disease threats;
- Changes in livestock production systems and internal or export trade requirements;
- Changes in national legislation or in the structure or capabilities of government veterinary services (or other government instruments); and
- Experiences (both within the country and in neighbouring countries), results from training or simulation exercises and feedback from major stakeholders including farmers.

Activity 3.4
List possible Enterprise Contingency Manuals which Cameroon may need

3.15 Introduction Pathways

There are a variety of risk pathways and vectors for the introduction of potentially biological invaders into Cameroon. Agricultural commodities, such as maize, whole grain and milled flour, rice, soybean, sorghum, wheat and barley and fresh fruit and vegetables are sourced from many countries. Cameroon ports are also used for the trans-shipment of food aid to countries as far away as Sudan, the transit of which creates a biological invasion risk.

The Current Biosecurity Profile from Trade and other Activities of Cameroon based on the best of the consultants' knowledge the most thorough investigation into the biosecurity profile of any Central African country to date, provides a comprehensive report on the current biosecurity profile through trade and other activities of Cameroon through the identification of the main pathways for species introduction that currently apply (the 4-Ts: trade, transport, travel and tourism) (MINEPDED, 2013).

Trade from South America and Asia may present the main threat as they are areas far away from Cameroon that may have different pest profiles.

Planting materials – plants, tubers, cuttings and seeds are also imported and carry risks as does unprocessed and processed timber. Cameroon exports also live animals to Congo, Gabon, Equatorial Guinea and Nigeria. It does not satisfy Nigeria's huge demand. This gap is filled by transit animals from Chad, Central African Republic and East Africa (MINEPDED, 2014a).

The introduction of animal diseases is a risk when animals and animal products are imported. This includes live animals, semen and eggs, fresh meat and fish and processed goods such as

dried and canned meats. In certain cases the animals themselves may become invaders as illustrated by a number of introduced fish species that have become invaders in Africa (Matthews and Brand, 2004).
Semen is imported for crossbreeding purposes aimed at genetic improvement. In the past, a lot of semen and breeding animals (cattle, pigs, rabbits, poultry, sheep and goats) came from the USA and were imported by Heifer Project International (HPI), the Institute of Agricultural Research for Development (IRAD) and the Tadu Dairy Cooperative for genetic improvement programmes.
About 15 years ago, HPI imported Boran cattle from Kenya. Importation of semen constitutes a much lower biosecurity risk than the importation of live animals.
The importation of timber and timber products is also likely to constitute an invasion risk to Cameroon. Travellers of various kinds could carry goods that constitute a biosecurity risk or unwittingly act as vectors for the introduction of biological invaders, and invaders can be introduced through the importation of new and second-hand machinery and other products.
The exchange of ballast water and hull fouling constitute a risk to marine ecosystems. All these pathways are likely to become increasingly important with rising levels of trade, transport, travel and tourism (the 4-Ts).

3.16 Initiatives towards the prevention and early detection of biological invasions in Cameroon

Cameroon has borders with six neighbouring countries. To the south the country is bordered by Equatorial Guinea, Gabon and Congo; to the west by Nigeria; to the east by the Central African Republic and Chad; and finally to the north by a narrow position of Lake Chad. As shown in the figure 2, Cameroon has 28 phytosanitary Inspection Posts including one at the seaport in Douala, three at the airports in Douala, Yaoundé and Garoua, and two at the Parcel Posts in Douala and Yaoundé. Under these operations there is no assessment of the invasiveness of animals and no work on invasive fish or the threats posed by the introduction of marine biological invasions in ships' ballast water or measures including capacity put in place for the management of LMO land-based animals or aquatic species. There are phytosanitary inspectors at land border entry points, seaport and airports to conduct surveillance and inspection upon arrival of any goods that are potential vectors.
Phytosanitary Brigades and Bases are found at the divisional and regional levels respectively, and have field staff who can signal the presence of pests, furthermore there is the existence of regulatory texts.
Importations are authorised through acquisition of an import permit from the MINADER/DRCQ, service in charge of plant quarantine (case of plants and plant products), phytosanitary requirements are spelt out for compliance by exporting country.
There is inspection upon arrival where by a phytosanitary certificate of exporting country is presented (document control) attesting freedom of any pests and inspection upon arrival at the point of entry, of the commodities (documentation control, sampling for further analysis in case infection/infestation is suspected).

There is a plant quarantine laboratory at MINADER/DRCQ that was provided by the Food and Agriculture Organisation (FAO) through the Technical Cooperation Programme (TCP) (FAO project TCP/CMR/4451, *Support to the Plant Quarantine Service*) provided training for 58 phytosanitary inspectors, basic equipment for the laboratory, reformulation of legislation and general consultancy to strengthen the Plant Quarantine Service. The laboratory needs to be upgraded; The service in charge of plant quarantine works in collaboration with IRAD and International Institute for Tropical Agriculture (IITA), and the African Research Centre on Bananas and Plantains (CARBAP) to follow up in the field especially in case of seeds and also cases of biological control agents.

Within the framework of the TCP/CMR/3303 "*Pilot project to put in place phytosanitary information on integrated crop protection in the forest zone of Cameroon (Centre, South and East Regions) (2011-2013)*" an FAO-MINADER project, field staff and phytosanitary inspectors were trained in surveillance techniques and on phytosanitary measures (Phytosanitary Standards). Farmers were also trained using the farmer field school approach on Integrated Pest Management (IPM), (scouting, recognition of pests and decision-making). The pilot phase ended and a pest list and distribution has been established on four crops (banana-plantain, tomato, cassava, maize) and possible control measures prepared. Result: A technical brochure has been prepared and a portal created (visit: www. Infophyto.minader.cm)

There are also countless places where the national border is routinely crossed by people going about their day-to-day business. Regular unofficial border crossings are commonplace in Africa. It is, therefore very difficult to police most land borders.

All cross-border movements of commodities and persons pose species invasion risks. In Cameroon, the leakiness of many land border crossings allows people to cross at unofficial entry points along the border in order to avoid biosecurity procedures. In addition, since cross border trade uncontrolled, has persisted for many years the likelihood of the introduction of IAS would be remote. Also it is not possible to control all IAS across land borders.

It has to be recognised, however, that risks posed by movements over Cameroon's land borders are relatively small. In most cases these national boundaries do not coincide with geographical barriers and the ecosystems on one side of the border are essentially the same as those on the other side.

Activity 3.5
List possible Support Plans Cameroon may need to facilitate Implementation of Contingency Plans

3.17 Control Strategies

Control strategies are commonly grouped into three categories: eradication, containment and suppression. Eradication, containment, and suppression may not be mutually exclusive in some instances (Hulme, 2006).

Eradication and containment employ similar tactics, but have different goals. Often, the goal of a control project may be to contain and suppress an invasive plant. We use the following definitions to identify the general goal of each strategy and to structure the decision tool.

The goal of eradication is to eliminate all individuals and the seed bank from an area with low likelihood of needing to address the species in the future. The term eradication in its strict definition applies only to the scale of a continent or island. However, eradication tactics are often applied at smaller project scales.
Eradication is considered successful when no plants are recovered from the initial infested area for three consecutive years (Rejmánek and Pitcairn, 2002). Eradication is practical only for small-scale infestations, generally in the introduction phase. In this cases, the early detection of an invaders when the infestation is small can mean the difference between a successful eradication project and implementing a containment strategy that usually means an infinite financial and time commitment.

3.17.1 Eradication

In order to be successful long term, the cause of the invasion must be addressed and all potential materials sources removed. In case of plants, or weeds, it is also essential to avoid replenishment of the seed bank (Panetta, 2009). The likelihood of reinvasion of an eradication site from outside seed sources is based on the predicted rate of spread of the species from the nearest known occurrence to the project area.
An example of a large-scale successful eradication project is the eradication of *Caulerpa taxifolia* in California. That effort cost over $5 million (Walters et al., 2006) but was justifiable based on the severe impacts of this “killer alga.” Success may be uncertain in the long term due to continued Internet availability of the genus *Caulerpa*, despite state and federal laws forbidding its sale and transport. Aquarium dumping into storm sewers likely caused the invasion.

3.17.2 Containment and Exclusion

The goal of containment is to prevent an infestation that can’t be eliminated from spreading into an uninfested portion of the project area (Hulme, 2006). Containment may involve methods that prevent reproduction and dispersal, treating the perimeter of a large infestation, and/or eliminating small satellite infestations. Containment is most effective with species that spread slowly, move short distances, and for which effective barriers can be established (Hulme, 2006).
Exclusion is the reverse of containment: the goal is to eliminate any occurrences within the project area and/or prevent the invasive species from spreading into the project area from the surrounding landscape. In Hawaii, a containment program has been implemented at Volcanoes National Park since 1985. The National Park Service established management units to contain high threat invasive plant species that were too widespread to eradicate.

The program has been successful in containing high threat invasive plants by reducing their abundance to manageable levels. With the reduction in invasive plant abundance, control costs have been reduced by five-fold.

An example of a project where 100% eradication was not possible, but which was successful in containment that requires only one day of limited annual follow-up is the removal of *Ludwigia peploides* from an impoundment on the Peconic River on Long Island. The Peconic Estuary Program and 350 partner volunteers worked for a total of 1,600 hours in 2006—2008 and hand-pulled more than 126 cubic yards of the plant. *Ludwigia peploides* abundance was reduced to <1% of its former extent. Complete eradication is not possible because a few plants grow under riparian shrubs beyond the reach of people in boats. *Ludwigia peploides* may have been introduced through aquarium dumping or an escape from a nursery. However its survival and rapid growth was possible due to warm, slow moving, and nutrient-rich water in the dammed river impoundment. Removal of the dam and nutrient inputs from septic tank leachate is unlikely. If these “causes” could be removed eradication might be possible.

3.17.3 Suppression

The goal of suppression is to reduce an invasive plant population in size, abundance, and/or reproductive output (i.e., density, cover, seed production) below the threshold needed to maintain a species or ecological process (Hulme, 2006). Suppression should only be undertaken if there is a clear conservation outcome that can be attained with an effective use of resources.

The timeframe of a suppression project may vary depending on the invasive plant and desired conservation outcome. For example, an invasive plant may be suppressed in a restoration effort for a few years in order for planted desired species to establish and become competitive. Suppression may also be justifiable if a new, effective control method is likely to become available in the near future, and in the interim competition pressure on desired species needs to be reduced so that they may persist. Alternatively, an invasive plant may be suppressed over a longer timeframe to maintain a rare species. Since no project is likely to have sufficient resources in perpetuity eventual cessation of suppression is inevitable. Thus careful consideration of the value of suppression is needed before undertaking a suppression effort that may have to be implemented for a very long time.

Invasive plant suppression by chemical or mechanical means, or by using prescribed fire or grazing, is most likely to be effective only at a local scale. Long-term suppression at a larger scale is likely feasible only with the use of an effective, well-tested, host-specific biological control agent. Suppression at a large-scale for a long time without biocontrol is unrealistic, as it would require massive resource inputs over the long-term. An example of an effective suppression program is the use of biological control agents to reduce purple loosestrife density to levels low enough for native plant species to increase and persist.

3.17.4 Learning to live with Invasive Species we cannot control

In many instances, invasive plants are too widespread to be feasibly controlled, except in selected situations where the impact is significant and the control costs acceptable.
Despite our best efforts, the management of a biological invaders may not be successful in all situations where it is attempted. So what can be done when faced with a species that cannot be adequately controlled in valued conservation areas? John Randall (2009) advises these four general approaches:

1. Provide native species with refugees from the species identified as invaders or otherwise mitigate their harmful effects (e.g. protecting isolated sites or deer enclosures).
2. Manage/restore ecosystem processes that favour natives (e.g. fire, hydrology).
3. Identify individuals/populations of native species with increased abilities to compete with or persist alongside the invasive species and use propagules in restoration efforts.
4. Change the conservation goal from restoration of a pre-existing community to the 'rehabilitation' of a portion of that community or even to a 'new' mixed community of native and non-native species with desirable ecosystem functions and properties possible.

3.18 Contingency Planning and Coordination

Contingency planning to be successful must involve the actors responsible for the ultimate response to the emergency. This will make the task of implementation and disaster management more efficient and effective. If the people and organizations involved in contingency planning have established systems and mechanisms to ensure clarity of roles and responsibilities and of communication and in- formation flow, then they will be better able to work together, in a logical way, towards the common objective. Their concerted efforts will also strengthen coordination of the group in actual emergency response, a result that will save lives.
Achieving successful coordination requires concerted effort and an attitude that values and appreciates its benefits. Good coordination will result in maximum impact for a given level of resources, eliminate gaps and overlaps in services, assign appropriate division of responsibilities, and achieve uniform treatment and standards of protection and services for all the beneficiaries.

3.19 Barriers to Coordination

There are, however, barriers to coordination in interagency contingency planning. Organizations may resist becoming involved in an interagency contingency planning process. They may not have adequate resources such as time, people, budget for travel expenses to contribute to the effort. In some cases, they may fear that such involvement will use their already scarce resources while receiving little or nothing in return.
Coordination may prove difficult especially if participating agencies have a history of poor relations with each other. Participating agencies and individuals may also have different

expectations about which population should be provided with which services. At times this can be an advantage to the planning process since it provides a more comprehensive view of the situation. Certainly, breaking down these barriers so people and groups can work together towards a common objective requires leadership skills and resources. Recognizing and identifying barriers to inter-agency contingency planning is the first step to overcoming them. Barriers in Coordination could be:

- competition for resources;
- threat to autonomy;
- too many organizations;
- lack of trust;
- differing expectations; and
- poor leadership.

Trainer notes: Possible exercise.
Ask participants to brainstorm on what sort of *contingency plan procedures has been developed in Cameroon, if there is any written contingency plan available for future IAS threats.*
Participants could focus on non-native species, impacts and pathways or on legal and institutional issues also using the exercises done in the previous modules, e.g. identification of their main invasive species or pathways of concern (refer to the species listed on the Module 2)

An Example of Contingency Plan in Cameroon is the Foot and Mouth Disease (FMD) Strategic Plan provided in Annex 8. The FMD Strategy is justified as dealing with the most contagious disease of mammals which has a great potential for causing severe economic loss in susceptible cloven-hoofed animals such as cattle, pigs and small ruminants. It is aligned to the global strategy for the control of FMD and its prescribed PCP. Based on identified risk factors and their analysis, the main objective of the plan is to reduce the impact of FMD in the country and sustainably mitigate all identified risk factors so as to attain PCP stage 3 after 5 years. In a stepped approach, the Plan has defined PCP and PVS stage one and two activities to be carried out along with targeted vaccination during a span of five years.

In Phase one which covers the first two years of the strategy, the focus will be on improving the understanding of the epidemiology of FMD in the country and implementing a risk-based approach to reduce the impact of FMD. Based on identified priority risk factors, measures to be undertaken during this phase include diverse management plans for:

- Organising and Structuring livestock farmers.
- Training on good livestock production practices.
- Related to livestock movement, trade and marketing practices
- related to veterinary sanitary inspection.
- Other PCP and PVS related activities

Phase two is the three years following phase 1 and has as objective to implement risk based control measures to reduce the impact of FMD in one or more livestock sectors and/or in one or more zones. Standard procedures for control during this 3 year phase includes measures for:

- Participation of producers and stakeholders;
- Raising biosecurity public awareness;
- Vaccination monitoring systems
- Establishing a zoning approach with a national animal identification system.
- Operational programs for funding

The third Phase of the control strategy will be carried out for five years after phase 2 and has as objective the progressive reduction in outbreak incidence followed by elimination of FMDV circulation in domestic animals in at least one zone of the country. Measures to be taken include:

- Prompt response mechanisms (emergency plan, upgraded surveillance, implementation of emergency response measures, including culling);
- Intensive targeted vaccination;
- Up-dating and implementing the legal framework
- Developing public/private partnerships; and

Placed under the overall responsibility of the Minister of Livestock, Fisheries and Animal Industries, the FMD Strategy proposes the set up, by an Order of the Prime Minister, of a National Consultative Committee that will comprise representatives of stakeholders and implementation partners to control FMD. The Strategy concludes with presenting an average initial 5 year budget

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MODULE 4A

FORMULATION OF GENERIC EMERGENCY RESPONSE EXERCISES FOR THE INITIAL AND EMERGENCY RESPONSE.

"When we act is a sign that you had thought of it before: the action is like the green of certain plants that rises just above the ground, but try to pull it and you will see their deep roots.
(Alberto Moravia)

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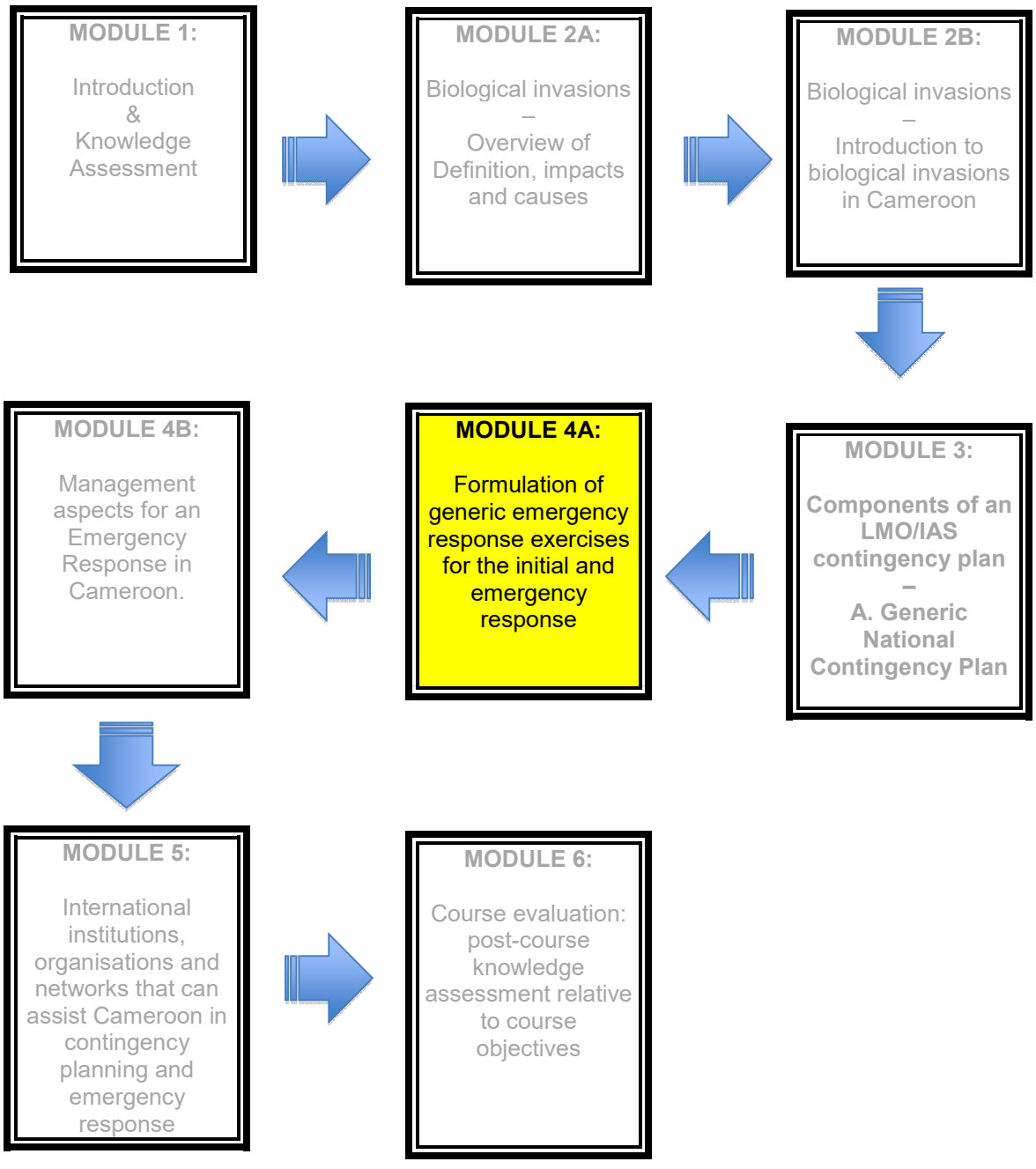

MODULE 1:
Introduction & Knowledge Assessment
MODULE 2A:
Biological invasions – Overview of Definition, impacts and causes
MODULE 2B:
Biological invasions – Introduction to biological invasions in Cameroon
MODULE 3:
Components of an LMO/IAS contingency plan – A. Generic National Contingency Plan
MODULE 4A:
Formulation of generic emergency response exercises for the initial and emergency response
MODULE 4B:
Management aspects for an Emergency Response in Cameroon.
MODULE 5:
International institutions, organisations and networks that can assist Cameroon in contingency planning and emergency response
MODULE 6:
Course evaluation: post-course knowledge assessment relative to course objectives

MODULE 4A: FORMULATION OF GENERIC EMERGENCY RESPONSE EXERCISES FOR THE INITIAL AND EMERGENCY RESPONSE.

By the end of this module participants should be:
- *More aware on measures for an Emergency Response;*
- *Be aware of some of the management responsibilities undertaken.*
- *Identify the key component of a response to a suspected biological invasion;*

4.1 Guide to the Emergency Response Plan

The Emergency Response Plan outlined in this document has been designed as a guide to help identify the key component of a response to a suspected invasion from an exotic species (LMO plant or animal invaders), plus the management structure that would best support the successful implementation of a response.
The document is designed to be a guide to plan a response to a specific pest and to provide the framework for training personnel in an Emergency Response. It is also designed to be a working document during a response to help personnel respond quickly and in an organised way in which personnel with various responsibilities know what it is they are supposing to be doing.

The appropriate pages from the **Management Responsibilities** section of the document can be handed to personnel in management positions to act as a guide in the tasks that they need to implement. Like wise the appropriate sections from the **Initial Response** and the Emergency Response can be handed to personnel in technical and operational positions, such as the Technical Advisor, the Response Manager and the Field Team Leaders.

- The INITIAL RESPONSE

Collecting information on the pest, determining how widespread it is and deciding whether to implement an Emergency Response or not. This is the initial step to an emergency response as shown in figure 4.1

- The EMERGENCY RESPONSE

Implementing the Emergency Response including measures to contain spread and eradicate the pest, plus deciding when it is appropriate to “stand-down” the Emergency Response.
The Emergency Response Plan is actuated once the Technical Advisor confirms that the suspected pest warrants a response. The plan is constructed around the two key stages of a response to the introduction of a suspected exotic pest (in this case the Cameroonian door knockers pests) and includes an overall management structure that would support the implementation of the steps required at each stage.

4.2. Initial Response

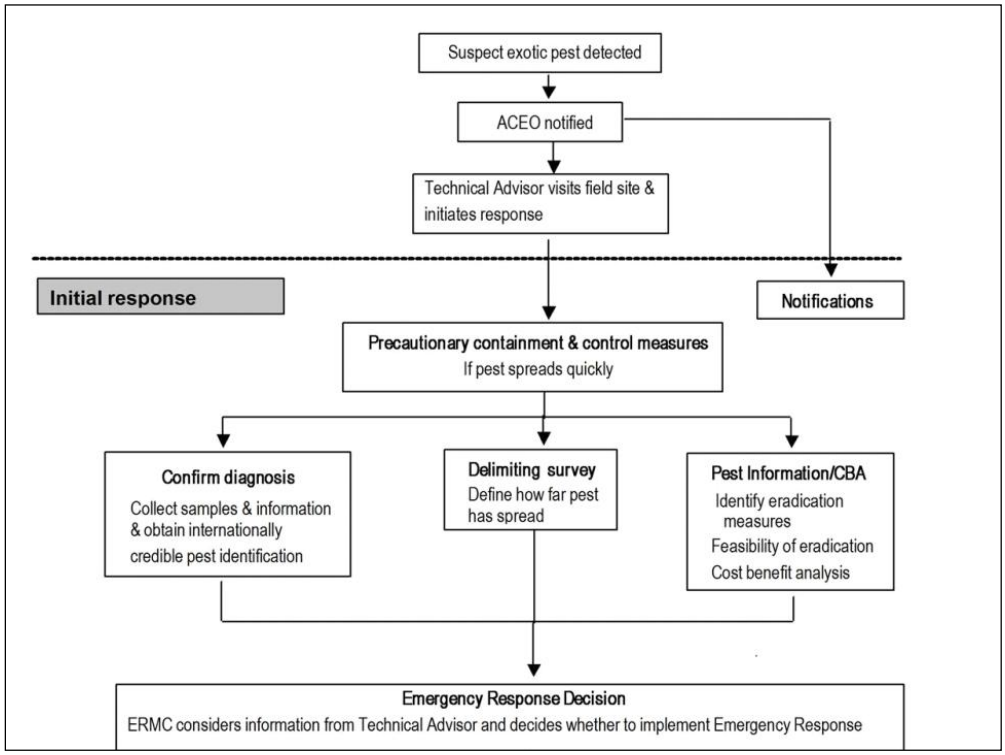


Figure 4.1: Schematic representation of the Initial step of the Emergency Response Plan.

4.2.1 Notifications Required Upon Detection of a Biological invasion

When a Field Officer suspects an exotic pest the following chain of peoples must be notified as a part of the Initial Response:

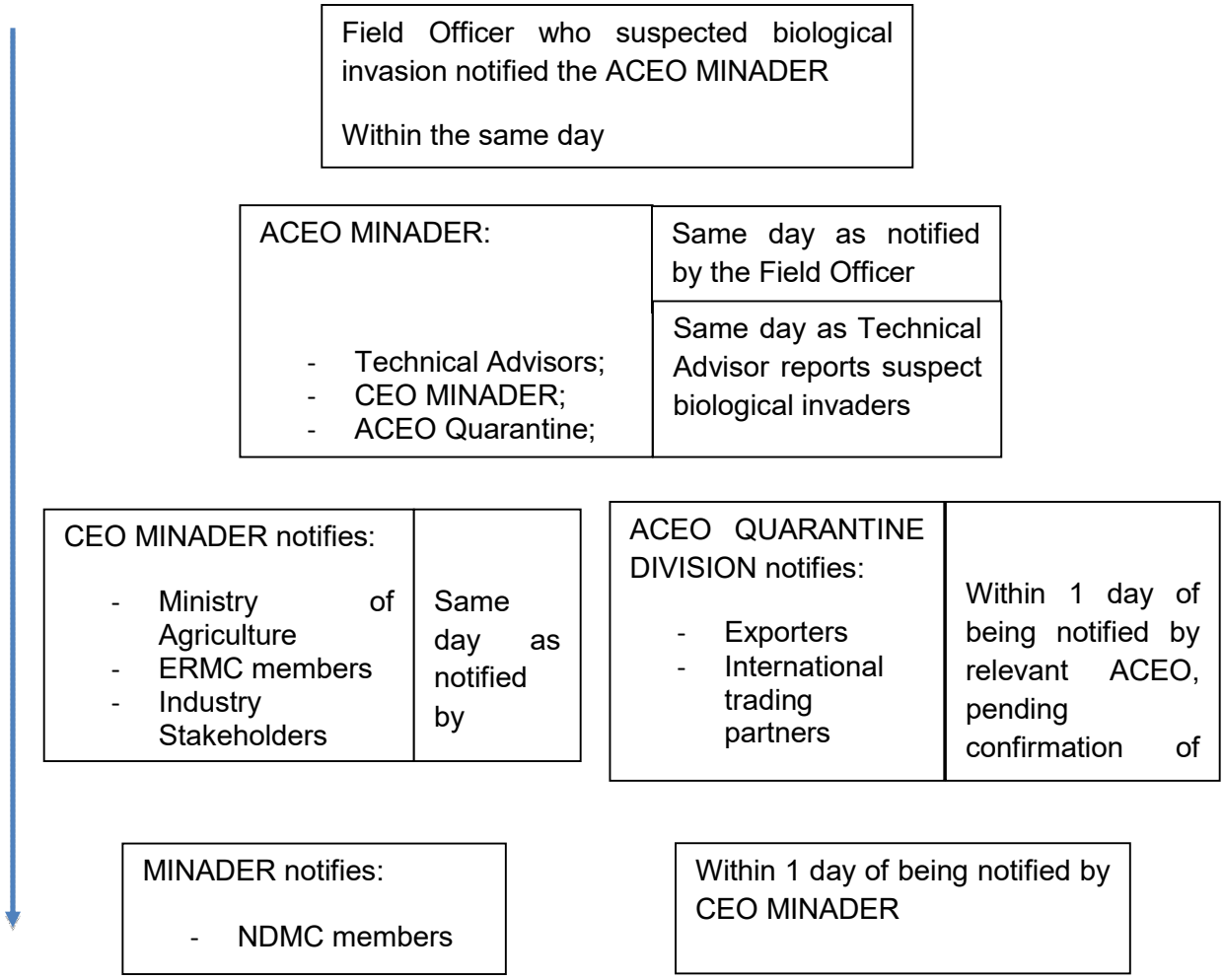


Figure 4.2: Initial Emergency Response scheme

4.2.2 Precautionary Containment and Control Measures

If the suspected biological invaders has the potential to spread rapidly, it will be necessary to put some initial precautionary measures in place to limit the spread while information is being gathered to decide whether to mount an ER or not.

These may be carried out in conjunction with collecting samples to confirm the identification of the pest and the delimiting survey.

Objective

To restrict the spread of a biological invasion before the ER is declared, if the suspected pest is capable of spreading rapidly.

Implementation

Stop spread from the initial site using measures such as:

- Preventing the movement of host material out from the infested site;
- Restricting the movement of people and vehicles into and out of the site; and

- Destroying and disposing of infested host material at he infested site.
- Protect larger geographic areas which appear to be uninfested; for example, putting a barrier between the two islands, using measures such as:
- Banning or restricting the movement of host material (or conveyors of infection) from the infested to the uninfested places by having an inspection point at the entry.

It is essential that advice is sought from an appropriately trained Technical Advisor before beginning any initial field precautionary measures, to avoid inadvertent spread of the biological invaders.
These activities must conform to the legislation. This will require using personnel who have existing legal authority to undertake the measures before an ER has been declared; for example, Quarantine Officers or Police depending on the powers required.
To achieve cooperation from the community, it is essential that a local community awareness programme involving local extension staff accompanies these activities.
If restrictions on the movement of potentially infested materials from an infested to an uninfested site were to be implemented this would need to be preceded by a public awareness campaign including signage at the wharf, (or harbours) and on the ferry and involving the mass media.

Confirm Identification/Diagnosis
The Technical Advisor visits the site of detection of the suspected pest to investigate whether the report justifies further investigation. The Technical Advisor decides whether to continue with the initial response or to advice that no response is needed. If there is any doubt regarding the identity of the pest, the initial response should proceed.
If the response is to continue, the Technical Advisor collects information from the site as follows:
Information from Detected Site:
Plants
- What the pest looks like;
- What damage or symptoms it causes;
- On what crop(s) the pest is found;
- When and where it was first noticed;
- How the pest may have reached the area;
- The size of the infested area; and
- Surveillance system in place in the area.

Animals
- Clinical signs of disease (what the sick animal look like);
- Description of gross lesions found from post–mortem examination;
- When were sick animal first noticed;
- How many animals have become sick;
- Details of the sick animals;
- Age (young, immature, adult);
- Sex (male, female); and
- Other differences;

- How many animals have died and over what period;
- Details of the dead animals:
- Age (young, immature, adult);
- Sex (male, female);
- Other differences;
- Whether any people have felt sick (zoonoses); and
- If possible, get numbers of animals that were noticed to be sick on each day or each week (depending on the time frame) from the time the first sick animals were noticed.

The Technical Advisor investigates:

- What host plants/animals have been bought to the location;
- What other potentially infested materials have been brought in to the location; and
- Whether anyone living at or visiting the location has returned from overseas recently.

This will give an initial indication on the particular pest that is causing the reported problem a possible source of the problem.

4.2.3 Tracing Possible Sources of the Biological invasion

If it is possible to trace the source of the pest, the information must be conveyed to the relevant ACEO (Crops, Forestry, Livestock) and to the ACEO Quarantine and measures put in place to address the risk of further introductions via the same pathway.

Collection of Samples

The Technical Advisor collects samples or from the detection site for identification or diagnosis of the pest (see annex 2). The following aspects must be considered:

Hygiene

Depending on the biological invaders, it may be necessary for all personnel involved in collection of samples to wear protecting clothing, including rubber boots, overalls and gloves.

Biosecurity precautions must be put in place to avoid accidental introduction into other areas.

For example, in the case of the fruit flies, all potential infested fruit removed from the infested area must be securely contained, for example in 20 lt. buckets with secure lids, perforated and securely sealed with gauze mesh. Trap catches should be killed before being removed from the infested site. Potentially infested host fruits should not be moved from one site to another unless it is clear that the fly is already established there. In the case of soil borne plant pathogens to prevent movement of soil and plant material from the infested area must be put in place as follows:

- Any vehicles and equipment leaving the infested area must first be thoroughly washed to remove all traces of soil and plant material;
- Boots and shoes of any person leaving the infested area must be thoroughly cleaned of soil and disinfected (using a foot bath with sodium hypochlorite or other suitable disinfectant);

- Any person who has come into contact with potentially infested plants or soil must wash their hands before leaving the infested area;
- Any equipment which has come into contact with plants or soil (e.g. Cutting tools) should preferably not be moved out from the infested area, or if it is, must be thoroughly disinfected beforehand;
- No host plant material should leave the infested area, unless as samples for the purpose of disease diagnosis. All samples of infested plant material taken for diagnosis must be placed in leak-proof containers to the place of examination, and destroyed or kept under security after examination; and
- If plants are to be sent overseas, they should be placed in the containers in which they will be shipped at the site of sample collection to minimize the risk of spread of infection.

If the biological invasion is suspected of being highly contagious then ***strict hygiene measures*** must be implemented as follows:

- The minimum number of people required to collect samples should be involved to reduce the risk of these individual spreading the pest further;
- Vehicles must not enter the premises or general area where the suspected infestation is located;
- Boots must be disposed of in a special container that is kept solely for disposal of clothing and equipment used on infested premises or when handing infested specimens;
- All samples must be placed in leak-proof containers so that infection isn't introduced into other areas; and
- If samples must to be sent overseas, they should be placed in the containers in which they will be shipped at the site of sample collection to minimise the risk of spread infection.

<u>Details for sampling</u>

Instructions for sampling and handling a plant pest must be provided.

<u>Photographs</u>

Where possible photographs of the pest and signs of symptoms should be taken with a digital camera. Likewise, photographs should be taken of sick animals and gross pathological signs from affected animals during post-mortem examination. If a digital camera is not available, photographs should be taken with a regular camera, the film processed immediately and the photographs scanned if they need to be emailed to support a diagnosis being made at a laboratory.

<u>Identification of Biological invaders</u>

- The Technical Advisor undertakes the initial identification;
- The Technical Advisor may need to refer samples to an internationally recognised institute for confirmation in order that the result can withstand scientific or legal challenge; and
- Contact details of international exerts for plant pest identification.

Handling and dispatching samples

The Technical Advisor:

- Contacts the identifying institution immediately by the fastest means of communication;
- Seeks advice on import permits, packaging, shipping and any other additional requirement ;
- Clarifies the mode of payment for identification charges;
- Forward his/her phone and fax numbers and email address to the institution;
- Asks to be informed when the specimen arrives;
- Asks the institution to fax the results of the identification, specifying if this identification would be a new record for a country, information on the pest's distribution in the region, ecology and control, and to send a hard copy of the fax;
- Immediately prepares the specimen(s) in accordance with the requirements of the identifying institution;
- Unless covered by another institution, the costs of the identification and shipping charges are covered by the Ministry of Agriculture. The Technical Advisor needs to inform the Financial Officer of this institution accordingly;
- The Technical Advisor sends the sample by courier service to save time the fastest way is preferred) and the ship must be traceable;
- The Technical Advisor informs the identifying institution that the sample is on its way and forwards the details of shipping arrangements; and
- The Technical Advisor directs all invoices to the Financial Officer.

To decide how far the pest has spread in order to decide the appropriate level of response.

Implementation

- Conduct the survey in and around the area where the incursion was reported;
- If necessary collect samples for identification/diagnosis (make sure to avoid spreading pest further);
- Items that may needed include:
    - Information on the pest, including pictures;

4.2.4 Delimiting survey

- Emergency response plan, including current quarantine law;
- A GPS;
- A map of the area;
- Notebooks, pens, markers;
- Equipment to collect samples or specimens or to examine hosts for symptoms of the pest (e.g. Traps, containers, paper bags, pocket knife, hand lens, specimen bottles, plastic bags in various sizes, 70% alcohol solution, torch, gloves, camera);
- First aid kit; and
- Bag to carry the equipment.

- If possible use GPS to record the geographic coordinates of the sites that are visited during the survey;
- Map the location of the infested sites and the uninfested sites that were visited, so that the boundary of the infested area can be determined;
- Keep records with the following information from each site that was visited:
    - Date & time visited;
    - Site identification number as recorded in the GPS;
    - Coordinates from the GPS (if available);
    - Property owner or occupier;
    - Address of the property;
    - Pests details (not present, present);
    - Were fruit or samples collected (yes, no);
    - If yes, what samples were collected?; and
    - Who was in the survey team at this site?

- Make a note of local staff and key people in the community who would need to be part of further actions recording name, titles, telephone and fax numbers of local contacts; and
- It is essential to make sure that any live pest removed from the site of infestation to the laboratory do not escape during transit to the laboratory for examination. For example, in the case of the exotic fruit flies, host fruit collected from the infestation site for rearing or larvae must be placed in secure containers such as plastic buckets with gauze mesh firmly fixed to the perforated lids.

- *Early detection of a biological invaders should be based on a system of regular surveys;*
- *Surveys can be general, site specific or species specific; and*
- *Targeted surveillance for specific species as well as "looking for the unknown" are required.*
- *A list of species to survey for should include species that are potentially invasive and for which a pathway is likely to exist (into your are of concern).*

The Technical Advisor compiles a dossier of information to assist the ERMC in deciding the appropriate level of response. The Technical Advisor may need to contact the appropriate national, regional or international experts to obtain the information and may request support to meet all the information requirements, if required:

4.2.5 Biological invaders Information

The dossier includes the followings information:

- Ecology of the invaders (speed and mode of dispersal, hosts, etc.);
- Means of identifying/diagnosing the pest/disease (information such as diagnosis keys, pictures of the pest and its sign or symptoms, isolation methods, diagnostic tests), and
- Available control measures & likelihood of successful application.

Options may include:

Plants

- Trapping, lures or other physical control methods;
- Host destruction – possibly by burning or burying;
- Disinfestation of equipment and facilities; and
- Chemical or biological pesticide treatment.

Animals

- Vaccination;
- Test and quarantine;
- Test and slaughter; and
- Disinfection of the equipment and facilities.

The Technical Advisor determines those measures most like to be successful. The Technical Advisor identifies sources, availability and costs of materials needed for the various control options e.g. traps and baits, insecticide, vaccine, test kits, disinfectant.

- How far the pest already spread

Information obtained from the delimiting survey.

- The feasibility of eradicate the pest

Combine the following information to assess the feasibility of eradicating the pest:

- How far the disease has already spread; and
- An assessment of the effectiveness of control measures in preventing further spread and eradicating the existing infection.

- Likely impact of the pest on the industry, the economy, and the environment

In conjunction with the ACEO Policy and Planning, the Technical Advisor assesses the effect of the pest on:

- Production;
- Food supply;
- Trade;
- Human health;
- Environment; and
- Quality of the life.

Estimate the cost of these impacts for use in a cost-benefit analysis.

- Cost-Benefit Analysis

The ACEO Policy and Planning makes an assessment of the costs versus benefits of the eradication based on the available information, to assist the ERMC in deciding the appropriate level of response.

- Legal Provisions

With the assistance of the Ministry of Agriculture Legal Advisor, the Technical Advisor investigates legal provisions for the control/eradication responses.

- Response Decision to be made by the ERMC

The ERMC considers the information provided by the Technical Advisor, (information from the pest dossier and the delimiting survey), the ACEO Policy and Planning (cost-benefit analysis) and Legal Officer, and decides on the appropriate level of response.

- Response options

- No further action

If the organism is not likely to cause any significant economic, environmental or social impact, no further actions is necessary.

- Long Term management

If the organism will cause a significant economic, environment or social impact, but cannot be contained or is already too widespread, the pest is considered established. In this case a long-term management approach is required. The Quarantine Division may need to consider treatments or restriction of exports due the presence of the pest.

- Eradication

If the organism will cause social, financial or environmental loss and can be eradicated at a cost lower than the expected cost of doing nothing, the Technical Advisor recommends an ER be initiated to contain and eradicate the pest.

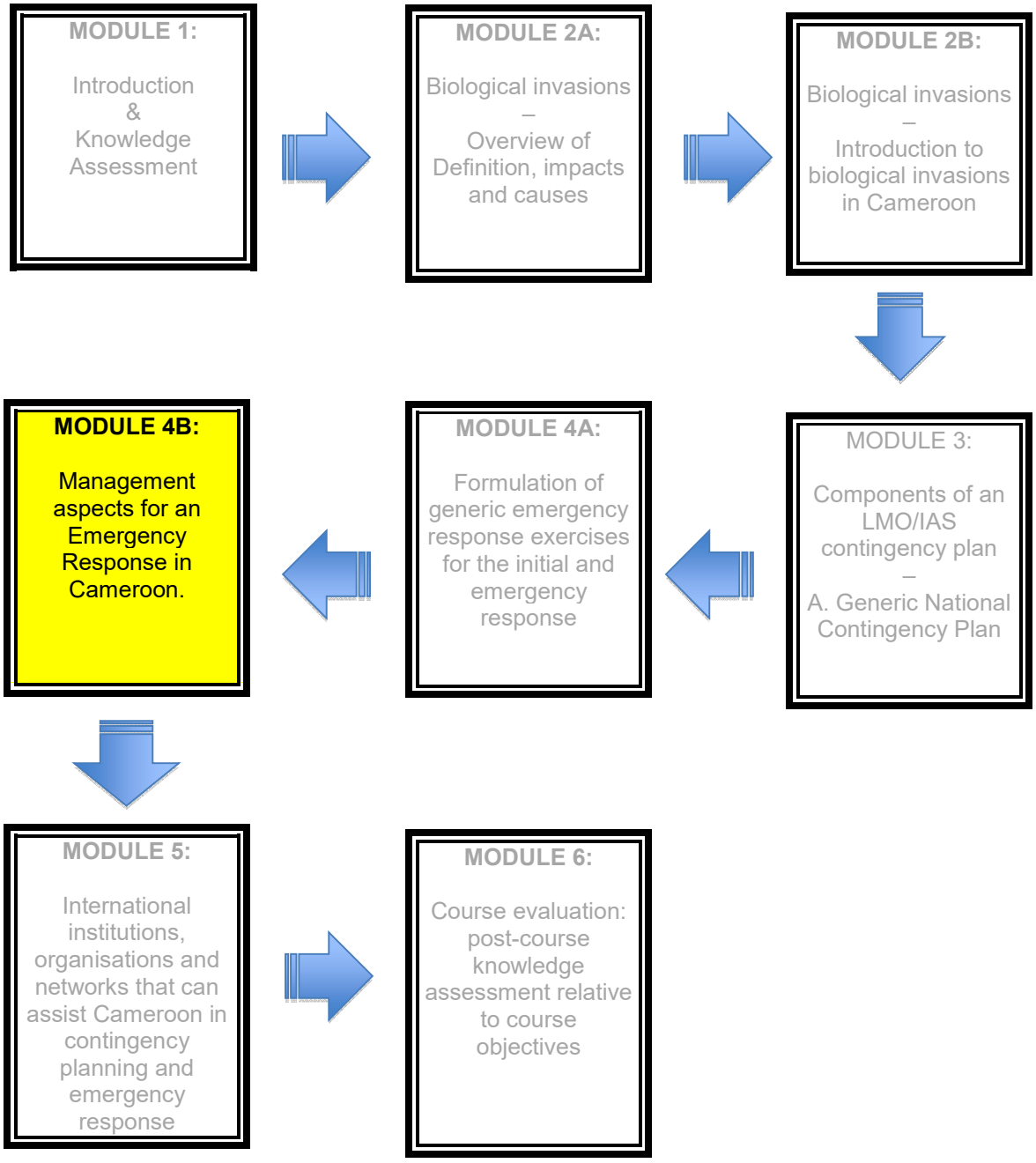
If the ERMC favours attending eradication, the CEO MINADER is responsible for requesting the Ministry of the Agriculture to declare an Infected Area and, if appropriate, to declare an Emergency. After this the operational aspects of the ER are put into action.

- The ERMC appoints the appropriate managers to fill key management function as indicated in the management structure;
- The CEO MINADER may need to invoke appropriate previsions of the biosecurity legislation as legal justification for future action;
- The ERMC need to inform Minister if, and under what conditions compensation is to be paid. As alternative to compensation, the ERMC may consider food support, the promotion of non-host crops or stock replacement;
- The technical advisor develops the financial action plan in consultation with the response manager. The CEO policy and planning and the financial officer develop the budget for the ER for approval by the CEO MINADER
- The CEO MINADER checks if the required founds are available from local resources and inform ministry of agriculture accordingly. The minister arranges for these funds to be made available;
- If necessary CEO MINADER, via the MINADT request the allocation of personnel from national institution such as police, army, public works and NGOs. The inclusion of army and police personnel is important when the operation. Require the quick mobilisation of large number of people. Assistance by public works become important when machinery is needed;
- The CEO MINADER ensures that the required regulations, founds and human resources are in place until the operations run; and
- The ministry of agriculture informs all stakeholders and sets a date for the start of the operation as soon as possible.

MODULE 4B

MANAGEMENT ASPECTS FOR AN EMERGENCY RESPONSE IN CAMEROON

Trainer's Edition


MODULE 1:
Introduction & Knowledge Assessment
MODULE 2A:
Biological invasions – Overview of Definition, impacts and causes
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MODULE 3:
Components of an LMO/IAS contingency plan – A. Generic National Contingency Plan
MODULE 4A:
Formulation of generic emergency response exercises for the initial and emergency response
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Management aspects for an Emergency Response in Cameroon.
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Course evaluation: post-course knowledge assessment relative to course objectives

MODULE 4B: MANAGEMENT ASPECTS FOR AN EMERGENCY RESPONSE IN CAMEROON.

By the end of this module you should be able to:
- *Understand the process of Emergency Response (ER);*
- *Understand the role of Emergency Response;*
- *Understand who to notify in a ER process; and*
- *Know the components of ER and associated issues*

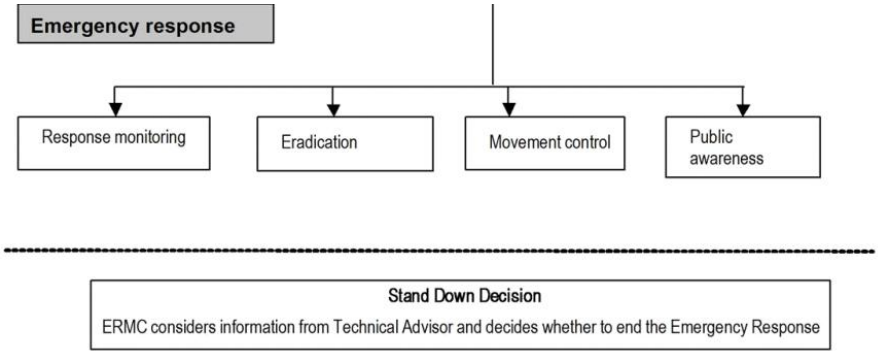


Figure 4.3: Schematic representation of the second step of the Emergency Response Plan.

4.3Emergency Response Action

Implementing the Emergency Response including measures to contain spread and eradicate the pest, plus deciding when it is appropriate to “stand-down” the Emergency Response.
The Emergency Response Plan begins once the Technical Advisor confirms that the suspected pest warrants a response. The plan is constructed around the two key stages of a response to the introduction of a suspected exotic pest (in this case the Cameroonian door knockers pests) and includes an overall management structure that would support the implementation of the steps required at each stage.

4.3.1 Operational Control Centre (OCC)

The location of the Operational Control Centre will depend on the location of the initial detection; If the detection is on Yaoundé the OCC will be established at an appropriate site on Yaoundé.
The following activities will be conducted from the OCC:
- management of response monitoring, containment and eradication activities;
- mapping;
- record keeping; and
- examination of samples, specimens, trap catches etc.

The OCC may need to include both office space and laboratory space and appropriate measures need to be put in place to ensure the pest or pathogen cannot escape. For example

for insect pests it may be necessary to screen windows and doors and to restrict access to laboratory staff and selected field team members.
The Field Controller, field team leaders and the field team members will be based at the OCC.

4.3.2 Response Monitoring

Objectives

- To monitor the area defined in the delimiting survey and detect new incursions and spread into new areas.
- To assess the effectiveness of the eradication effort.
- To confirm freedom of infestation of previously infested sites.

4.3.3 The Monitoring Plan

The Monitoring Plan should include the followings:

- Methods to determine if the site is infested or not;

These may include:

  - Trapping;
  - Collection of host plant material and examination in laboratory;
  - Collection of samples or specimens for testing, e.g. Blood samples from animals; and
  - Collection of information on whether any signs of the pest have been seen, plus details (as in section on confirm diagnosis).

- List of plants, animals, plant/animal products, or other articles that could be hosts or carry the biological invaders;
- List of sites to be visited. These will be based on:
  - Tracing contacts from known infested site i.e. Determine if any possibly infested material was moved from the infested site before controls were put in place, and investigate the site(s) to which that infested material was moved; and
  - Sites to which the pest could have spread through natural movement (e.g. Wind, flight, water, etc.).
- Other high-risk site to be visited such as:
  - Fruit and vegetable market;
  - Locations where horst material is being destroyed, if this is outside the infested area; and
  - The base from which field personnel involved in implementing the ER are operating (and where they are staying);
- A monitoring schedule with frequency of re-visits to uninfested properties, depending on the life cycle or incubation period of the biological invaders;
- Instructions for the monitoring teams on how to:
  - Set traps and/or collect and examine hosts plants or animals and/or collect samples or specimens;

- Treat or destroy infested host plants or animals or plant/animal products or other articles (if necessary);
- Record data;
- Collect and preserve specimens for identification by a local specialist (probably the technical advisor) and contact details of the specialist; and
- Conduct laboratory procedures such as examination of trap catches, larval rearing etc.

- Further action if suspicious specimens are found. Options are cleaning, treatment, containment, or destruction, followed by immediate notification of the field controller;
- List of equipment and record forms required (including safety equipment and first aid)
- Instructions for mapping sites visited and infested areas; and
- Audit plan to check that the monitoring program is being conducted as instructed.

Implementation

- Follow the procedures set out in the monitoring plan;
- Ensure legislation supports monitoring measures i.e. Officers have been given appropriate authority to entre properties and collect samples;
    - for example the Team Leader may need to provide names of team members to the CEO MINADER, who will gazette them as Authorised Officers for the duration of the ER;
- Ensure the local public awareness has been put in place in the infested area to en-list the co-operation of owners of possibly infested host material, growers' associations, traders, local extension officers and local authorities;
- Brief, train and equip the monitoring team;
- Ensure there are sufficient teams or individuals and sufficient equipment so that monitoring personnel can be restricted to certain areas if necessary to limit the possibility of spreading the biological invaders:
    - For example, in the case of some infectious animal diseases, the personnel doing surveillance outside this area until a specified period of time has been passed and/or they have followed strict hygiene such as disinfecting boots and clothing and equipment;
- Ensure that they are sufficient teams or individuals allocated to the laboratory functions if required, as set out in the monitoring plan.

4.3.4 Eradication

Objective

To have operation in place to eliminate the biological invasion from the infested area.

Preparation

The Technical Advisor determines the best technical options to inspect, treat or destroy infested products. Options include:

- Traps, lures or other physical control methods;
- Host destruction – possibly by burning or burying or slaughter of animals;
- Processing or consumption of infested crop;
- Disinfestation of equipment and facilities;
- Chemical or biological pesticide treatment;
- Vaccination;
- Fumigation;
- Soil sterilisation;
- Leaving land fallow;
- The use of pest resistant cultivars; and
- Restriction or subsequent cropping or animal husbandry.

4.3.5 The eradication plan

The eradication plan addresses the following points:

- Definition of the infested area;
- Specification of which plants, animals, plant/animal products, or articles need to be treated, destroyed or disinfested;
- Instruction on how to treat, disinfest or destroy plants, animals, plant/animal products or other articles;
- List of required equipment (preferably local available) including protective clothing, vehicles, safety and first aid, datasheets, map pens, GPS, etc. Stockpiles of pesticides that can be used and replaced may be available to the organisations involved. Consideration should be given at an early stage to the registration of any pesticides that are not already registered;
- Availability and use of firearms to destroy animals;
- Maintenance and processing of record sheets and assignments of responsibility for this task;
- Procedures for the release of plants, plant/animal products, or other articles from the quarantine area after clearance by appointed officers;
- Specify how much and under what conditions compensation needs to be paid to affected farmers when plants, plant/animal products needs to be destroyed;
- Identify and contact growers of the affected crop or animal (and growers association, if any) in the quarantine area;
- Specify the period of time without finds the pest and its damage that has to elapse before pest can be declared eradicated depending on the biology of the pest, quality detection methods, climate and efficacy of treatment. It may be necessary to discuss this point with trading partners and relevant technical advisor(s); and
- Site of OCC.

Implementation

- Follow the procedures set out in the Eradication Plan;
- Ensure legislation supports eradication measures i.e. Officers have been given the appropriate authority to enter properties and control the pest, including if necessary, destruction of plants, animals and plant/animal products:
    - For example the Team Leader may need to provide names of team members to the CEO MINDER, who will gazette them as Authorised Officers for the duration of the ER;
- Ensure the local public awareness has been put in place in the infested area to enlist the co-operation of owners of possibly infested host material, growers' associations, traders, local extension officers and local authorities;
- Brief, train and equip the monitoring team;
- Ensure there are sufficient teams or individuals and sufficient equipment so that monitoring personnel can be restricted to certain areas if necessary to limit the possibility of spreading the biological invasion:
    - For example, in the case of some infectious animal diseases, the personnel doing surveillance outside this area until a specified period of time has been passed and/or they have followed strict hygiene such as disinfecting boots and clothing and equipment; and
- Ensure that they are sufficient teams or individuals allocated to the functions if required, as set out in the Eradication Plan.

4.3.6 Movement Control

Objectives

- To stop the local spread i.e. movement of infested material out of the immediate infected area.
- To keep larger uninfested geographic areas free of infestation.

Preventing local spread out of the infested area

Definition of the infected area

The Technical Advisor needs to prepare the criteria that define an infected area. This will include the following:

- Known infested sites that were identified through the delimiting survey and subset monitoring;
- A larger area around known infested sites, with the size of the area depending on the method(s) of local spread of the pest:
    - For example, if it is a wind-bone pest, the area will be large enough to allow for spread via this mechanism and may be in the direction of the prevailing wind;
- In other cases it may allow the distance that the particular pest will fly; and
- In the case of an animal disease that is spread by contact between animals. It will depends on the likely to have come into contact with known infected animals – this will depend if they are fenced or free ranging.

Declaration of an infected area

- The area that is declared an infected area initially will be determined through the delimiting survey;
- The infected area will be marked on a map;
- The area should be marked on the ground as much as possible using signboards and/or typo of paint or marker posts. This is important to reinforce the restrictions for the people living and working in the area; and
- The area will be legally declared by public declaration.

Movement restrictions

- The technical advisor produce a list of materials that can potentially carry the invaders out of the infected area. The particular objects will vary with the biological invaders. They will include:
    - Host species such as fruit, plans, animals;
    - Equipment used for control/eradication;
    - People (residents, visitors, staff implementing surveillance and control measures)
    - Vehicles; and
    - Food – prepared from infested host material e.g. Meat;
- The technical advisor advice appropriate movement restrictions to prevent the pest being carried out from the infested area.

This may include:

- Host material movement:
    - Ensure that no host material is moved from the area. All people leaving the infested area should have their bag inspected to ensure they are not carrying any potentially infested material;
    - Farmers are advised that they cannot take host material to the market; and
    - Meat from animal in infested locations. The technical advisor needs to determine if it is safe for the people to heat the meat of infected animals. If it is this may be allowed, but must be cooked and consumed in the infected area, to avoid the risk of spreading infection. Meat from uninfected animals that have been slaughtered within the infected area may be allowed to be consumed within the infected area provided it has been cooked according to certain specification (where necessary);
- People movement:
    - Banning the movements of visitors into the area, except authorised personnel who are involved in the ER;
    - Relocating any large gatherings to an infested area;
    - Ensuring that the ER personnel use strict hygiene measures as they enter and leave the infested area (i.e. Boots, clothes and equipment are clean when they arrive and that boots are cleaned, and boots and overalls are removed and put in

plastic bags as they leave the infected area. Hands are washed. Equipment is washed and disinfected;
- Limiting the movement of residents out of the area. This may involve a complete ban on movement for high-risk personnel, such those who are directly contacting the infested animals or plants e.g. Feeding animals, working in the gardens (whit the exception of emergencies); and
- It may involve ensuring that lower risk residents who leave the area wash their feet/shoes in footbaths, and are questioned to identify if they have been in contact with potentially infested host material.

➢ Vehicle movement:
- If it is possible for the pest to be spread on vehicles e.g. Contaminated tyres or snails getting into or on the body of the car, the access of vehicles should be prohibited or severely restricted to movements that are essential for implementing the ER (maybe to collect host material for disposal, or maybe to prepare disposal sites). In this case strict hygiene measures should be applied to the vehicles e.g. Cleaning, spaying, disinfecting tyres, etc.;
- It may be appropriate to restrict the movement of vehicles within the infected area e.g. They may enter the area but they may not enter an infected site;
- If vehicles are potential risk, the technical advisor needs to consider how to manage an infested site that has a well-used road running through it, in particular the main areas (buses, trucks, cars, etc.) What is the risk and how should be minimized; and
- If possible, redirect traffic to an alternative route.

<u>High-risk areas</u>
- There may be areas where infestation has not been detected but which are high-risk because of other reasons; for example:
  - Fruit and vegetable markets;
  - Locations where host material is being destroyed, if this is outside the infested area; and
  - The OCC;
- These areas should be targeted for surveillance.

<u>Preventing introduction of the biological invaders into a free zone</u>

The geographic areas of the country which are not yet infested and which it is feasible to protect need to be identified. If Infestation is limited to a small location and the biological invaders does not spread easily, it may also be feasible to protect other parts of the Country on which the infestation has occurred by means of movement restrictions.

Trainer notes: Prevention – it's the "long hops" that matter

All cross border movements of commodities and persons pose species invasion risks. It has to be recognised, however, that risks posed by movements over Cameroon's land borders are relatively small. In most cases these national boundaries do not coincide with geographical barriers and the ecosystems on one side of the border are essentially the same as those on the other side. Species are free to move naturally over national boundaries (e.g. animal migrations and bird dispersal of seeds) and have done so for millennia. Even in recent times the allocation of land to various countries has changed. Even if resources permitted the system would not work for all land border crossings as the risk of non compliance is very high. The leakiness of many land border crossings would allow people to cross at unofficial entry points along the border in order to avoid biosecurity procedures. A sensible option for the management of invasive species pathway and vectors, therefore is to focus on international ports and airports. However, a risk based "prevention is better than cure" approach does not, however, mean that established invasions should be ignored.

Public Awareness Plan

The Publicity Officer in consultation with the Technical Advisor and the Response Manager organises a publicity programme to support the ER. Due to the sensitive nature of some infestation, media releases and other awareness measures must be subject to appropriate authorisation from the appropriate Minister.

This will include:

- Providing information to the media such as radio, television and newspaper on:
  - Objective of the operation;
  - Benefits in terms of crops/herds saved versus cost and difficulties for affected farmers and general public;
  - Estimated changes of success versus estimated chance of failure;
  - Details of the pest and of how it spreads;
  - The immediate impact of the pest, such as restrictions on trade, extra inspections associated with international travel;
  - What measures are being implemented to contain and eradicate the biological invader; and
  - What the public can do to support these.
- Discussing the proposed action with the local authorities, and utilising the extension service to inform the owners of possibly infested plants, animals, plant/animal products, or other material of proposed action;
- Using communication channels for providing information to the public, such as:
  - Church, ministers;
  - Schools;
  - Youth groups; and
  - Etc.
- Managing the international media if present (press releases and interviews). The international media should be managed in such a way that they do not get in the way of implementing the ER. Preferably, they should be restricted to in a restricted area and provided with information and photographs by the publicity officer;

- Ideally appoint a person with appropriate skills to establish a web site that provides information to the international public on the ER, including details of:
    - Details of the biological invasion;
    - The measures that are being implemented;
    - Progress on containment and eradication;
    - Photographs of the pest and/or the infested host; and
    - Maps showing the distribution of the pest in Cameroon and progress with the ER
- Preparing support material for the ER, such as:
    - Posters;
    - Leaflets; and
    - Signboards.
- Provide on-going response information for the general public. It may be possible to set up a hot-line to answer public enquiries.

Trainers notes: Example - South Africa – public groups become part of the process
The Working for Water Programme has been very active in encouraging public participation in its efforts to manage invasive alien plants. One thrust of this effort is the Weedbuster campaign. This culminates in the annual Weedbuster week, when a series of awareness raising and hands-on activities are organised throughout the country. The campaign also continues throughout the year. It involves schools and other groups among the general public including landowners. Activities undertaken include 'hack days', invasive species awareness talks, training on invasive species identification and production of awareness raising information for different groups. A Weedbuster hotline has recently been opened where the public can report sightings of invasive species, get help with identification and receive information on any relevant topic. Through this campaign it is hoped that the South African public will become a key resource in the fight against the impacts of invasive species.

Budget aspects
The Publicity Officer would prepare a budget for the proposed activities and provide this to the Financial Officer.

Stand-down procedures
The stand-down comes into effect when:

- An eradication is successfully completed; and
- Containment or eradication is unsuccessful and the programme is stopped.

Actions
The stand-down is implemented under either of the following conditions:

- The eradication is successfully completed, (in the case of a successful eradication it may be essential for an outside expert body to audit or verify the success of eradication as per eradication guidelines set at the beginning of the campaign. This verification report can be annexed to the final campaign report or would be made available to the stakeholders once the verification process is completed); and
- Eradication or containment is unsuccessful and the programme is stopped.

Report

The CEO MINADER will instruct the Field Controller, Technical Advisor (s) and Response Manager to prepare a report on the whole operation within a week after the field operation ceases for the ERMC to consider a stand-down of the ER operations. The report will include:

- Overview;
- Operational procedures;
- Decision made;
- Results;
- Costs;
- Problems encountered; and
- Recommendations;

The CEO Policy and Planning will ensure that the issue of compensation has been fully addressed and compensation paid to those entitled to it.

The CEO MINADER will discuss the report with the authors and finalise the report before submitting it to the ERMC. This report will be submitted to the Minister of Agriculture after the deliberation and approval by the ERMC

The Principal legal officer will prepare necessary legal instruments (on behalf of the Chairperson of ERMC) to revoke the existing emergency regulation. The Minister affects this through the national gazette and public notice in the newspaper and other mass media.

Notification of Stand-down

The CEO as chairperson ERMC shall inform the funding agency and other stakeholders on the stand-down. The CEO will authorise the ACEO Quarantine to inform trading partners and other relevant international (regional) institutions of the stand-down.

The CEO as chairperson of ERMC briefs the media about the Emergency Response operation outlining:

- Objective of the operations;
- Costs and benefits; and
- Further action (eradication verification, long term management options, no further actions, etc. …).

ACEO of the relevant advisory section informs the local authorities.

The Publicity Officer arranges for the public release of information about the ending of the ER.

Copies of the final report are distributed to all stakeholders, funding agencies.

Disbandment of Response Team(s)

The Response Manager arranges for seconded officers and volunteers to return to their respective institutions and all outstanding entitlement to be settled. The Response Manager and Field controller convene a meeting with their staff, labourers to debrief, review their work and thank them for their efforts.

The Response Manager in consultation with the Field Controller and Administration Office make arrangements for return and disposal of specifically acquired equipment during the time of operation. The Field Controller returns all field records sheets to the relevant ACEO for filling and future reference. The Financial Controller settles all payments and accounts.

The relevant ACEO reviews and updates certain sections of the ER plan based on the experience gained from the ER.

Avoiding the same problem in the future

After the stand-down, the relevant ACEO reviews the outcome of tracing procedures as presented in the final report, and put measures in place to prevent similar problem occurring again. this could involve instituting measures to address the entry pathway and/or setting up a programme of long-term surveillance and monitoring.

Activity 4.1

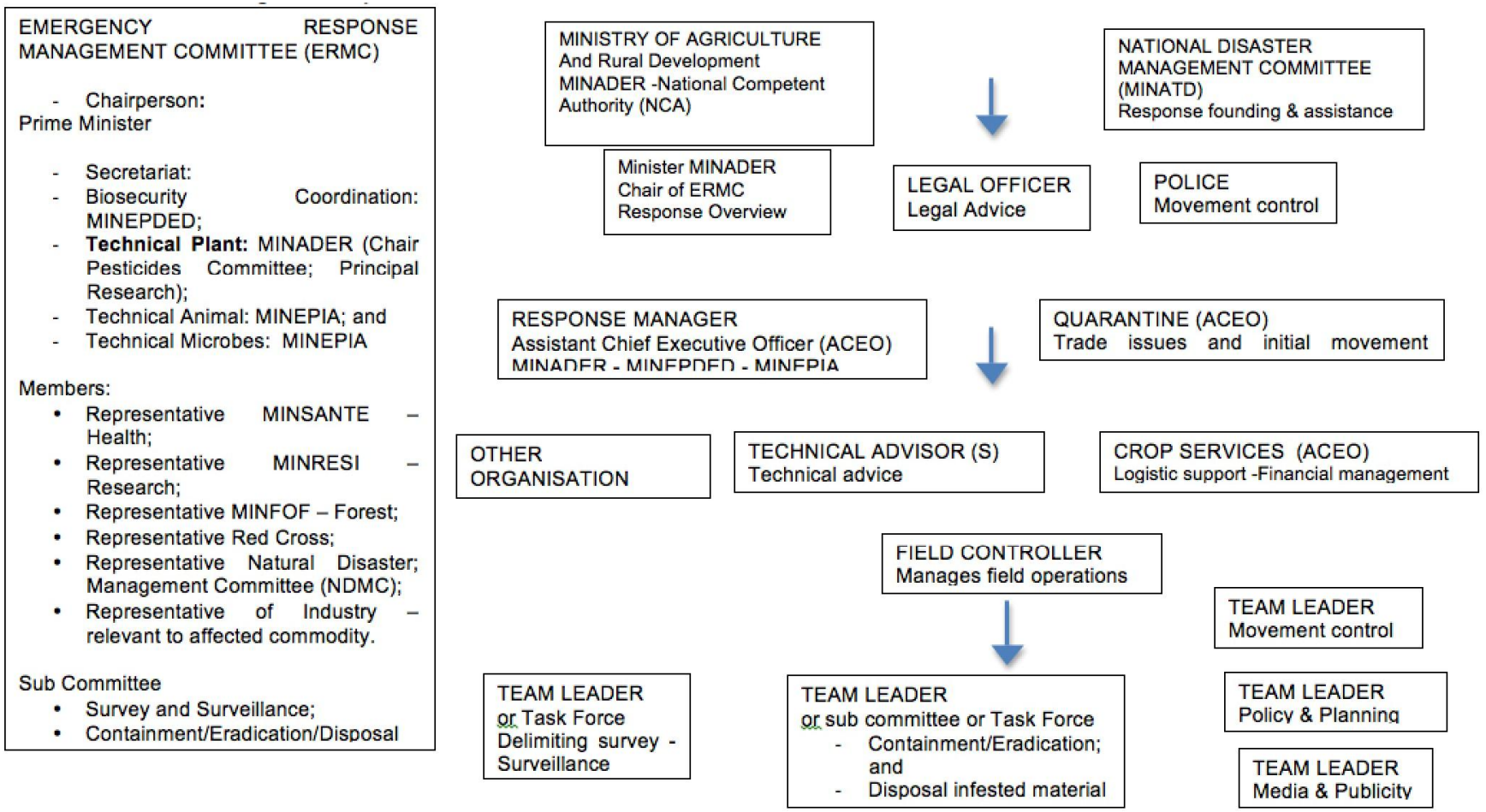
Have participants talk about the situation in their country. Are they aware of any recent incursions that sparked public or media interest? What was the species involved, what were the risks? How was it handled? What was the result?

- Prevention of introduction is the first line of defence against biological invasion and always the preferred option;
- Early Detection and Rapid Response (ED/RR), preventing establishment and/or spread, is a second line of defence;
- The chances to eradicate are highest soon after arrival of a new alien species, before it has had a chance to establish or spread much; and
- This will minimise ecological or economic impacts as well as be less costly than acting later.

Example of control, quarantine and surveillance programme is provided in annex 3: Field Instructions For Countries Starting A Fruit Fly Quarantine Surveillance Programme.

4.4 Management Aspects

Figure 4.4: Management Structure for an Emergency Response for biological invasions.



Activity 4.2: be part of the process!!!

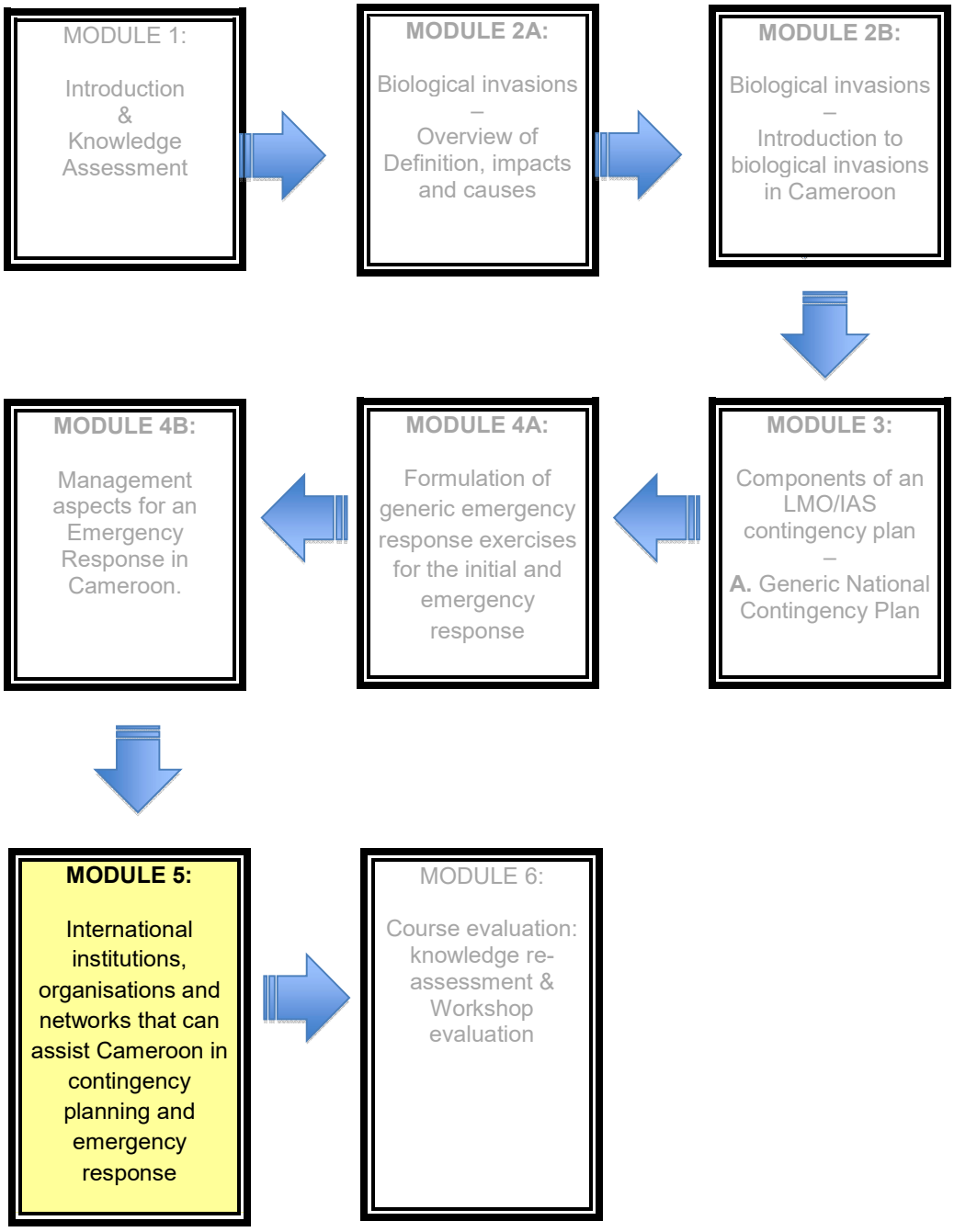
Following the management structure (above) of an emergency response, please create two working groups and simulate a hierarchical approach to an emergency response for:

- *plant invaders; and*
- *animal invaders (zoonosis).*

MODULE 5

INTERNATIONAL INSTITUTIONS, ORGANISATIONS AND NETWORKS THAT CAN ASSIST CAMEROON IN CONTINGENCY PLANNING AND EMERGENCY RESPONSE

Trainer's Edition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MODULE 5 INTERNATIONAL INSTITUTIONS, ORGANISATIONS AND NETWORKS THAT CAN ASSIST CAMEROON IN CONTINGENCY PLANNING AND EMERGENCY RESPONSE

By the end of this module participants should be familiar with the following:

- *The need and scope of International Agreements;*
- *Key international instruments /programs that provide the global approach to contingency planning and emergency response and can inform and guide national process;*
- *Key elements and approaches in developing and implementing National Strategic Frameworks for IAS Management and*
- *Existing National Legal, Policy and Institutional Options that shape the current framework for contingency planning and emergency responses to biological invasions.*

5.1. International instruments, initiatives and programmes on IAS/LMOs

5.1.1 The need for an International Approach

The need for an international approach to deal with the growing problem of invasive species stems from the global nature of the phenomenon. The causes and impacts of biological invasions are often international by definition. Through trade and transport pathways, countries both send and receive non-native species. Species may also be translocated within countries to areas or islands where they are not currently present and become invasive in this new location. For these reasons, unilateral action by a few States can never be enough to prevent unwanted introductions. Cooperation is essential at all jurisdictional levels. Two examples of the need for cooperation across national boundaries are the value of information on invasive species gathered in other countries and the potential for regional spread of invasive species.

Need to share information internationally. Similar invasive species problems are repeatedly faced in different parts of the world. Sharing information and expertise internationally on the ecology, impacts and management of such invasive species is a priority. In addition, knowledge of past invasiveness elsewhere is a key component of early warning [1] and is important in assessing potential risks from newer potential introductions.

For instance, water hyacinth (*Eichhornia crassipes*) is a problem in many tropical freshwater bodies worldwide, which includes waterways as far apart as in Florida (USA), the Wouri and Nyong Basins (Cameroon), Kafue (Zambia), Lake Victoria (Kenya) and Bhopal (India), as well as many others [2, 3].

Regional spread. Invasive species do not respect national borders. Species introduced into one nation can often easily spread to neighbouring nations, either without further human agents (if there are no biogeographical barriers) or by secondary unintentional introductions (e.g. transport). In order to be effective in preventing the spread of invasive species, initiatives to address the prevention, eradication or control an invasive species must also be able to cut across political boundaries.

The strategic framework for a country cannot be developed in a vacuum in relation to what other countries are doing. There are International Conventions that need to be taken into account, in the National implementation of the Invasive Species Strategic Framework. Cooperation with neighbouring countries or more widely in the Region will usually increase the effectiveness and

efficiency of invasive species management. In addition, International Programmes on invasive species are able to provide assistance.

This module provides a brief overview of international instruments relevant to invasive species and outlines:

- The rationale for international action on invasive species;
- The scope of existing treaties and guidelines that address invasive species in the context of biodiversity; aquatic ecosystems; plant, animal and human health; transport; and international trade; and
- Constraints in existing frameworks and recent policy developments.

Activity 5.1
GROUP EXERCISE
Categorize International Legal Instruments: write answers on the flip chart.

Activity 5.2
INDIVIDUAL EXERCISE:
Provide List of known Multilateral Agreements on IAS/LMO relevant to your sector of activities: Write on a Post it and Submit

5.1.2 Overview of International Instruments relevant to Invasive Species / LMOs

Nearly fifty internationally agreed legal instruments or guidelines deal with some aspect of the introduction, control, and eradication of invasive species. These instruments set out the policy or technical norms that should form the baseline for national legal frameworks. They fall into three broad categories:

- The longest-established agreements focus on controlling the introduction and spread of pests and diseases to protect human, animal and plant health through the establishment of quarantine systems. A series of quarantine agreements now mandate and govern sanitary (human health), zoosanitary (animal health), and phytosanitary (plant health) measures to control introductions for such purposes;
- Biodiversity-related treaties are concerned with invasive species for their possible impacts on native species and ecosystems. Some focus specifically on marine and/or inland water ecosystems; and
- Most recently, technical guidelines and codes of conduct aim to minimise risks associated with a limited number of transport and trade-related pathways.

Existing instruments have been developed by different multilateral bodies at different times with different objectives, for implementation by different national agencies and sectorial stakeholders. This affects how they refer to invasive species, down to the terms, definitions, and procedures used. Most national systems reflect these sectorial differences: there are overlaps as well as gaps in how invasive species are addressed. There also often is little contact between invasive species specialists in different departments and agencies.

Non-native species are introduced through trade intentionally (imported products) or unintentionally (e.g. as by-products, parasites and pathogens of traded products, hitchhikers and stowaways in vessels, vehicles, or containers that deliver products or services). National measures to minimise unwanted introductions - quarantine and border controls on live species, commodities, packaging and other vectors - therefore have a direct interface with the multilateral trading system and need to be consistent with applicable rules and disciplines adopted within the WTO framework. □

Multilateral environmental agreements do not directly address international trade aspects of non-native species control, except CITES - to a limited extent. The non-binding FAO Code of Conduct for Responsible Fisheries recommends that States develop international agreements for trade in live specimens where there is a risk of environmental damage *inter alia* in importing States. □In contrast, the IPPC, OIE, and Codex Alimentarius have a formal relationship with the multilateral trading system, following the conclusion in 1995 of the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (WTO-SPS Agreement). The SPS Agreement provides: □

- That a WTO Member may adopt national measures to protect human, animal, or plant health/life from risks arising from the entry, establishment or spread of pests, diseases, or disease-causing organisms and to "prevent or limit other damage" within its territory from these causes;□
- For the use of international standards as a basis for national protection measures that affect trade. The aim is ensure that national measures have a scientific basis and are not used as unjustified barriers to international trade. The Agreement recognises standards set by three organisations: IPPC (pests of plants and plant health); OIE (pests and diseases of animals and zoonoses); and Codex Alimentarius Commission (food safety and human health); and□
- For key principles (reflected in the revised 1997 IPPC Agreement) that include consistency in the application of appropriate levels of protection, least trade restrictive alternatives, acceptance of equivalent but different SPS measures and transparency through advance notification of measures. □

Consistent with these principles:

- Countries may take action when necessary to protect plant/animal health by □preventing Introduction or carrying out eradication/containment; □
- Such action should be based on the appropriate level of protection for that country; □
- Risk analysis is to be used in the development of measures; □
- Countries should base national measures on international standards where available. □Where no international standard exists or a higher protection level is sought, the State concerned must justify a national measure through scientifically-based risk assessment; and □
- Emergency (or provisional) measures are permissible without such analysis, when situations require urgent action or there is insufficient information on which to base action. However, such measures must be reviewed for their scientific justification and modified as appropriate. □

The International Plant Protection Convention (IPPC) □

The International Plant Protection Convention (IPPC) provides a framework for international cooperation to prevent the introduction of pests of plants and plant products and to promote

appropriate measures for their control. It deals with the spread of pests between countries and phytosanitary measures within a country (see the International Phytosanitary Portal (IPP) at http://www.ippc.int for further information). It is not explicitly a trade or environmental treaty but is directly relevant to invasive species issues that fall within its scope. □

The IPPC defines "pests" as *"any species, strain or biotype, animal life or any pathogenic agent injurious or potentially injurious to plants or plant products"* e.g. fungi, bacteria, phytoplasmas, viruses and invasive plants. Official IPPC definitions can be found in the International Standard for Phytosanitary Terms (ISPM) # 5 *Glossary of Phytosanitary Terms*, which is revised annually [4].

Until the 1990s, the IPPC mainly focused on phytosanitary certification with an almost exclusive agricultural focus. The IPPC mandate has always included the protection of native plants [5] but in practice the convention has often been implemented more narrowly to guard against human and economic diseases and pests. However, since 1999 the IPPC has clarified its role with regards to invasive species that are plant pests. This includes a revision to clarify how environmental impacts are included under the term "economic harm" and a current revision relating to bio control (http://www.ippc.int/IPP/En/default.htm). □

Another item of particular relevance to invasive species is the revised standard for Pest Risk Analysis for Quarantine Pests (ISPM 11 Rev1) [6] (http://www.ippc.int/IPP/En/default.htm). Pest Risk Analysis (PRA) underlies Import Health Standards or other import restrictions. The Revised ISPM 11 spells out clearly that such analysis may include:

- Invasiveness of the commodity itself (e.g. the garden plant that is proposed for import can be a potential invasive species); □
- Secondary effects of plant pests on other taxa; □
- Effect on plants via effect on other taxa; and□
- Effects on native plants (i.e. not just cultivated plants). □

It is expected that in future more countries will increasingly apply their established phytosanitary systems (including PRA) more widely in order to protect the environment and biological diversity from the risks posed by plant pests. While this is overdue, it will also result in significant challenges. By including environmental impacts the Pest Risk Assessment will need to deal with a wider scope of impacts, such as pathogens affecting wild plants, for example. Moreover, impacts on native biodiversity and ecosystem functioning often show a higher level of complexity than impacts in the agricultural context. National Plant Protection Organisations (NPPOs) will need to be given adequate resources to effectively fulfil this □expanded mandate. The IPPC provides for national mechanisms that are well suited to prevention, early detection, and control of invasive species.

The IPPC publishes a series of International Sanitary and Phytosanitary Standards (ISPMs) which are highly relevant to invasive species management. ISPMs are the standards, guidelines and recommendations recognised as the basis for phytosanitary measures applied by Members of the World Trade Organization under the Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement). At the time of writing (July 2012) there were 36 ISPMs.

Each IPPC Party is required to:

- Establish a National Plant Protection Organisation (NPPO); □

- Adopt legislative, technical and administrative measures to prevent introduction/spread of pests;
- Establish a single official contact point to facilitate the exchange of official information;
- Undertake pest risk analysis, in the absence of an ISPM, to provide technical justification for a national phytosanitary measure;
- Carry out surveillance of growing plants, including both areas under cultivation (e.g. fields, plantations, nurseries, gardens, greenhouses and laboratories) and wild flora, and of plants and plant products in storage or in transportation, particularly with the object of reporting the occurrence, outbreak and spread of pests, and of controlling those pests;
- Provide for the protection of endangered areas and the designation, maintenance and
- Surveillance of pest free areas and areas of low pest prevalence;
- Establish export certification systems to ensure that exported products comply with the import requirements of trading partners;
- Establish inspection procedures and treatments (when appropriate), and
- Establish an official process for the implementation of the ISPMs.

Implementation is facilitated by nine regional plant protection organisations (RPPOs). The RPPO for Africa is the Inter-African Phytosanitary Council which is based in Yaoundé, Cameroon.

RPPOs are beginning to develop regional phytosanitary standards to facilitate regional harmonisation of trade-related measures consistent with the WTO-SPS Agreement.

Office International des Epizooties (OIE)

Animal health issues are addressed by the Office International des Epizooties (OIE), which develops standards and guidance on pests and diseases of animals (but not on animals themselves as pests). The International Animal Health Code for Mammals, Birds, and Bees and the International Aquatic Animal Health Code set out standards on import risk analysis and risk management measures for specific diseases and are updated annually. The OIE has an ad hoc working group on risk analysis for aquatic animal diseases and a long- established Working Group on Wildlife: this addresses wildlife management and reintroduction issues that have an animal disease dimension, but has not yet covered related habitat and ecosystem issues.

The World Health Organisation (WHO)

Human health can be affected by non-native species providing hosts for diseases. One example is the west Nile virus, apparently introduced to New York (USA) via an imported non-native bird and then transmitted to local mosquitoes. Because the virus can decimate bird populations and affect other wildlife and humans, it is a serious concern. The World Health Organisation (WHO) has developed International Health Regulations to prevent the international spread of infectious diseases to humans, which are currently being updated due to changes in disease epidemiology and the increase in international traffic. Codex Alimentarius (a joint FAO/WHO initiative) deals with food safety and is responsible for international standard setting in this regard.

The Convention on Biological Diversity (CBD)

The Convention on Biological Diversity (CBD) is the only global instrument to provide a comprehensive basis for measures to protect all components of biodiversity against those non-native species that are invasive.

Article 8(h) requires Parties:
"As far as possible and as appropriate, (to) prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species."

Other CBD provisions, that should be taken into account when implementing invasive species measures relate to strategic and cross-sectorial planning, regulation, and management of potentially damaging processes and activities, involvement of local populations and the private sector, incentives, environmental impact assessment, transboundary notification, and emergency planning.

CBD institutions have prioritised invasive species issues in recent policy-making. In 1998, recognising the problems invasive species pose to indigenous and local communities and their negative effects on local and national economies, the Conference of the Parties (COP) designated alien species as a cross-cutting issue to be taken into account in each thematic work program and identified geographically and evolutionarily isolated ecosystems, including islands, as needing special attention because of their vulnerability to biological invasion.

In 2002, after extensive preliminary work, the sixth meeting of the COP adopted Decision VI/23 on *Alien species that threaten ecosystems, habitats and specie*s. This decision:

- Reaffirms the importance of national and regional invasive species strategies and sets out detailed □
- Recommends content of national strategies and action plans; □
- Urges closer international and regional cooperation and specific measures for □capacity building, assessment, information and tools; □
- Urges Parties, other governments, and relevant organisations to promote and □implement the *Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats or Species* annexed to the decision. □

At COP 7 (2004), it was decided that "specific gaps in the international regulatory frameworks at global, regional and national levels persist, notably in relation to species that are invasive, but do not qualify as plant pests under the regulations of international agreements", with regard to the following pathways: □

a. The use of non-native organisms in aquaculture and the restocking of marine and inland water systems for commercial and recreational fisheries taking into account contributions of national codes, and voluntary international efforts such as Codes of Practice on the Introductions and Transfers of Marine Organisms developed by the International Council for the Exploration of the Seas and the FAO Code of Conduct on Responsible Fisheries; □

b. Unintentional or opportunistic introductions (e.g., "hitchhiker organisms"), including through hull-fouling, packaging material, import consignments, vehicular transport and other means;□

c. Unintentional introductions of invasive alien species through international assistance and humanitarian programmes, tourism, military, scientific research, cultural and other activities; □

d. Intentional introductions of alien species for non-food purposes, including certain aspects of horticulture and trade in pets and aquarium species;□

e. Intentional introduction of alien species, as biocontrol agents for control or eradication of invasive alien species, pests or weeds;

f. Transnational and national ex situ breeding projects with alien species as sources for intentional or unintentional introduction;□

g. Intentional introduction of invasive alien species through international assistance programmes, including conservation and development projects and other activities;

h. Intentional introduction of potentially invasive alien species through international incentives schemes; and□

i. Introduction of alien species through aquaculture escapes, bait and pet releases, water transfer schemes.

The work on invasive alien species under the Convention was reviewed in-depth at COP 9 in 2008.

The Cartagena Protocol on Biosafety (CBP)

The Cartagena Protocol on Biosafety (CBP) or to give it its full name "The Cartagena Protocol to the Convention on Biological Diversity" grew from CBD Article 8g: *Establish or maintain means to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity, taking in to account the risks to human health*.

The CBP aims to create an enabling environment for the environmentally sound application of biotechnology, making it possible to derive maximum benefit from the potential that biotechnology has to offer, while minimising the possible risks to the environment and to human health.

The Biosafety Protocol requires Parties to make decisions on import of LMOs for intentional introduction into the environment in accordance with scientifically sound risk assessments. These assessments aim at identifying and evaluating the potential adverse effects of LMOs. The Protocol sets out principles and methodologies on how to conduct a risk assessment. The Protocol also requires Parties to adopt measures and strategies for preventing adverse effects and for managing and controlling risks identified by risk assessments.

The Ramsar Convention

Invasive species in coastal and inland wetlands was addressed by the Conference of the Parties to the Ramsar Convention on Wetlands in November 2002. Resolution VIII/18 (Invasive Species and Wetlands) urges Ramsar Parties to:

- Address the problems posed by invasive species in wetland ecosystems in a decisive and holistic manner, making use, as appropriate, of the tools and guidance developed by various

institutions and processes, including any relevant guidelines or guiding principles adopted under other conventions; □

- Undertake risk assessments of alien species which may pose a threat to the ecological character of wetlands, taking into account the potential changes to ecosystems from the effects of global climate change, and applying the guidance available in Ramsar's *Risk Assessment Framework* (Resolution VII.10); □
- Identify the presence of invasive species in Ramsar sites and other wetlands in their territory, the threats they pose to the ecological character of these wetlands, including the risk of invasions by such species not yet present within each site and the actions underway or planned for their prevention, eradication or control. □
- Cooperate fully in the prevention, early warning in transboundary wetlands, eradication and control of invasive species, applying the *Guidelines for international cooperation under the Ramsar Convention* (Ramsar Handbook 9); □
- In their development and implementation of national strategies and responses to invasive species, to recognise that terrestrial invasions by alien species can threaten and affect the ecological character of wetlands including through the lowering of water tables and alteration of water flow patterns, and to ensure that appropriate measures to prevent or control such invasions are in place; □
- Examine carefully the potential environmental impacts due to invasive species; □
- Work closely with their counterpart national focal points for the CBD the UN □Convention to Combat Desertification, the UNESCO Man and the Biosphere Programme (MAB), the International Maritime Organisation (IMO), and others in the development and implementation of national policies, strategies and management responses to threats from invasive species; □
- Ensure that prevention, eradication and control of such species are fully incorporated in national legislation and national wetland and biodiversity policies, strategies and action plans, applying the Ramsar *Guidelines for reviewing laws and institutions to promote the conservation and wise use of wetlands* (Ramsar Handbook 3) and *Guidelines for developing and implementing National Wetland Policies* (Ramsar Handbook 2);

The International Maritime Organisation (IMO) □

The International Maritime Organisation (IMO), through its Maritime Environmental Protection Committee (MEPC), has focused on prevention efforts to minimise invasive species introductions via ships ' ballast water. It supports the development of a mandatory legal regime to avoid unilateral responses by individual states in such an international industry, but began by adopting voluntary *Guidelines for the control and management of ships' ballast water to minimise the transfer of harmful aquatic organisms and pathogens* to assist governments, ships' masters, operators and owners, and port authorities to establish common procedures to minimise the risk of introducing harmful aquatic organisms and pathogens from ship's ballast water and associated sediments. The MEPC has also approved a technical circular on design measures for ballast water and sediment options in new ships (MEPC 47th session, London, 4-8 March 2002). The IMO Council convened a Diplomatic Conference in early 2004 to finalise the draft IMO *International Convention for the Control and Management of Ships' Ballast Water and Sediment*s. □There are no internationally agreed prevention measures for hull fouling as an invasive species vector, although CBD Decision VI/23 §7 called on the IMO to develop mechanisms to minimise this as a matter of urgency. The IMO International Convention on the Control of Harmful Anti-Fouling Systems on Ships (2001) provides for the global phase-out of tri-butyl- tin (TBT) in paints, but this ban is designed to reduce chemical

pollution of the marine environment and could even lead to a significant increase in the number of introductions of invasive fouling species, such as ascidians. □

Activity 5.3
INDIVIDUAL EXERCISE:
Revisit the list you initially provided in your Individual Exercise in 5.1
Now provide a list of Multilateral Agreements for LMOs/IAS that was left out and provide additional Agreements.

International Instruments 3: Technical Guidelines and Codes of Conduct □

There are many invasive species-related technical guidelines issued by a variety of organisations. An example is given below. □

Technical Guidance for Fisheries and Aquaculture □
Aquaculture and mariculture operations present a known risk of unwanted introductions (escapes, parasites, and disease). Some technical guidance has been adopted to establish principles and standards and provide best practice guidance for this rapidly growing industry. Through the Food and Agriculture Organisation (FAO), the Code of Conduct for Responsible □

Fisheries was adopted in 1995. The Code provides guidelines for the responsible introduction, production and management of fish species under managed conditions. It urges States to adopt measures to prevent or minimise harmful effects of introducing non-native species or genetically altered stocks used for aquaculture into waters. The 1994 Code of Practice on the Introductions and Transfers of Marine Organisms was issued by the International Council for the Exploration of the Sea and the FAO's European Inland Fisheries Advisory Commission. It establishes procedures and practices to diminish the risk from intentional and unintentional introductions of non-native marine species into marine and freshwater ecosystems.

5.1.3 International programmes and initiatives

INVASIVE SPECIES AND SUSTAINABLE DEVELOPMENT PROGRAMMES
Invasive species issues are often seen as agricultural or biodiversity issues. They are also very significant livelihood issues, and invasive species have a significant impact on sustainable development.

The Barbados Programme of Action states "the introduction of certain non-indigenous species" as one of the four most significant causes of the loss of biodiversity in SIDS. (Section IX para 41) and specifically identifies the need to "support strategies to protect Small Island Developing States from the introduction of non-indigenous species" (Section IX para 45, C. (vi)).

The Plan of Implementation of the World Summit on Sustainable Development (WSSD) calls for countries to "Strengthen national, regional and international efforts to control invasive alien species, which are one of the main causes of biodiversity loss, and encourage the development of effective work programme on invasive alien species at all levels" (Paragraph 42(i))

GLOBAL INVASIVE SPECIES PROGRAMME (GISP)

Mission*:*

GISP's mission is to conserve biodiversity and sustain human livelihoods by minimising the spread and impact of invasive alien species".

Objectives

- to promote implementation of Article 8 (h) of the Convention on Biological Diversity
- to improve the scientific basis for decision-making
- to examine and strengthen legal and institutional frameworks
- to reduce economic impacts
- to develop capacity for the management of invasive species
- to promote awareness of invasive species issues at all levels
- to promote access to information on invasive species.

GISP entered a period of dormancy in 2011due to funding constraints.

COOPERATIVE INITIATIVE ON INVASIVE SPECIES ON ISLANDS (CII)

While islands have been particularly affected by invasive species, they also present special opportunities for fighting back and for rolling back the tide of biological invasion. For instance, even where invasive mammals have been established on islands for over a century, successful eradications and ecosystem recovery have been achieved. Over the last 30 years there has been an exponential increase in the size of islands from which invasive mammals have been eradicated. Important progress has also been made in eradicating or containing other invasive species including plants and invertebrates.

Recent cooperative efforts show that even where there are major differences in climate, politics, language and ecology, the experience of one island country can be very valuable in undertaking projects on other islands.

The aim of the CII is to facilitate cooperation and build capacity to manage invasive species on islands. This will have immensely positive results for biodiversity conservation, ecosystem restoration and sustainable livelihoods. The scope of cooperation and capacity building includes the full suite of management activities: prevention, eradication and control. The scale will include local, national and Regional levels.

(For more information: http://www.issg.org/islandinvasive species.html - Islandinvasive species*)*

Goals of the CII include:

- Promoting awareness of invasive species impacts and support for their management;
- Facilitating training and skills sharing programmes;
- Facilitating and supporting "Demonstration Projects" where awareness and support can be enhanced, or new techniques and skills developed;
- Sharing existing technical information and knowledge;
- Promoting and facilitating the application of Best Practices in invasive species management;
- Promoting partnerships;
- Promoting research and adaptive management aimed at reducing uncertainty;
- Advocating the establishment of emergency resources to quickly respond to new incursions.

In order to achieve these goals, objectives are focused on providing targeted training opportunities – especially at “Demonstration Projects”, applying a "Learning-by-Doing" approach and empowering local communities to deal effectively with their invasive species problems. □

The Cooperative Initiative on Invasive Alien Species on Islands was launched in April 2002 at the COP6 of the Convention on Biological Diversity. It followed calls from Small Island Developing States for cooperative action to address the impacts of invasive species on islands.

Established under the umbrella of the Global Invasive Species Programme (GISP), the establishment was a joint initiative involving the New Zealand Government and the Invasive Species Specialist Group (ISSG) of the Species Survival Commission of IUCN - the World Conservation Union. Seed funding has allowed the appointment of a small coordinating team, (based at the ISSG office, University of Auckland, New Zealand). One of the roles of the coordinating team is to provide those that are looking for advice, assistance, etc., with contacts for agencies, organisations, people and projects that have the required expertise. □

Examples of existing activities that have been built on and enhanced by the CII: □

- Dissemination of technical and management information on invasive species to a □wide range of practitioners via the Global Invasive Species Database (ISSG); □
- Publication of proceedings of the Eradications Conference (ISSG); and □
- Provision of technical advice and support, including peer review, to planned projects □(provided by ISSG’s expert members, DoC, etc.). □

Examples of new activities since the CII launch in 2002 include:

- Promoting and coordinating the preparation of a Pacific Prevention Plan for Red □Imported Fire Ants; □
- Promoting and facilitating a feasibility study for eradicating invasive cane toads and □rats from Viwa Island (Fiji) in order to alleviate threats to an endangered ground frog; □
- Coordinating the initiation of a feasibility study for eradicating invasive mammals and managing weeds for biodiversity gains in Cocos Island (World Heritage Site), Costa Rica; □
- Coordinating inputs to, and participating in, a feasibility study of controlling a suite of invasive mammals on Mont Panié, New Caledonia; □and
- Providing a focal point for supporting connections between experts in the Galapagos, NZ and Chile in relation to non-native species on the Juan Fernandez Islands. □

The CII is a global initiative. The initial focus has been on the Pacific, because of the availability of funding for that region. However, the CII is already performing a global networking function and becoming actively involved in projects in most regions. It can also provide support to regional cooperative initiatives being proposed for the Indian Ocean, the Caribbean and Mediterranean and help to pass the experience in those regions to other countries. The CII are actively seeking funding support for activities in all regions, and particularly to support the creation of linkages between regions and the sharing of information globally. □

International Cooperation between peers □

An important aspect of international cooperation is the support that you can get from “peers” – people in a situation similar to yours, elsewhere in the world, that have tried to deal with situations similar to the one you are dealing with. □Such non “anarchic” and bottoms up support

can be found for instance on the listserv Aliens- L (see *www.issg.org* on how to subscribe), where questions can be posed, experiences shared, and where people can be contacted who are dealing with similar problems ("peers helping peers"). It is dedicated to invasive species issues, especially practical management. It is email based – and hence available to people with bad Internet connections (email is easier than web access). Aliens–L is focused on invasive species that have a biodiversity impact and is global in scope. It is housed by IUCN.

"PESTNET" is a moderated listserv. Its goal is plant protection in the Pacific Island countries and Southeast Asia. It carries queries and information on pests, diseases and weeds and their control. It has alerts on new incursions and helps with species identification. To subscribe: contact *pestnet-subscribe@yahoogroups.com*

5.2. Developing and implementing a National Strategic Framework for LMOs/IAS Management

5.2.1. Introduction to the Concept of a National Strategic Framework for LMO/IAS Management

In previous modules, the impacts of invasive species have been discussed, as well as many options to fight back, like prevention, eradication or control, public awareness building, etc. Throughout the modules, it has been pointed out how aspects of management are often interrelated with other issues. For instance, an eradication plan's success may depend on public awareness as much as on the technical feasibility of the methodology proposed. Moreover, if an agency wishes to carry out management projects, it must have a mandate allowing it and facilitating it to do so, and this is likely dependent on legislation or other regulations being in existence. Existing laws on their own will not be able to reduce invasive species impacts unless they are effectively implemented and such implementation will be difficult without the public or other stakeholders understanding the need for them. In other words, management, public awareness, stakeholder support, institutional mandates, legal aspects etc. cannot be developed or maintained in a vacuum – they influence each other and support each other.

In order to deal with invasive species, a National Strategic Framework will need to be established.

Each country will have to decide how it wants to approach the development of a strategic framework - what is the most appropriate way in the context of its circumstances. While there is not a single recipe that will be successful in all cases generally speaking such strategic framework will need to include a national invasive species strategy ("the plan"), implementation of that strategy ("carrying out the plan"), institutional and structural arrangements ("whose job is it? Who decides? How will agencies work together?") and legal / regulatory aspects ("what are the rights and obligations?"). These are the "building blocks" of a National Strategic Framework.

The four major aspects have areas that overlap with each other – they influence each other and support each other (Figure 5.1).

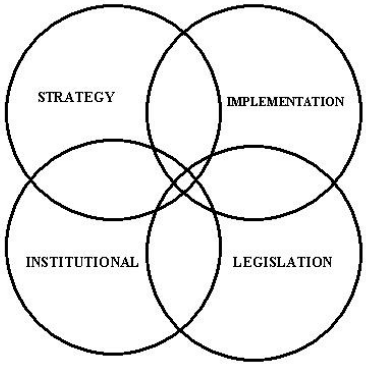

Figure 5.1: Aspects of a National Strategic Framework

The second part of the Module will deal with the National Strategic Framework and cover the following sections:

- Developing and implementing a National Strategy; □
- Leadership, Coordination and Cooperation; □
- Legal, Policy and Institutional Framework; □
- Implementation Approaches □When operationalising the strategy it is useful to think in terms of three functional levels: □
  1. Strategic = High level direction/decision-making. □
  2. Tactical = Processes and plans to meet strategic goals. □
  3. Operational = Day to day decisions: Procedures at the workface.

□

These levels represent a continuum from the highly centralised (e.g. Central Government approval of an invasive species strategy) to the very flexible (e.g. the day to day decision- making process for an eradication operation at the field level). It is important to have agreed and working structures at all three levels in order to effectively implement the National Strategy.

This section outlines the "Building Blocks" of a National Invasive Species Strategic Framework (sometimes known as a biosecurity strategic framework). These are:

- The National Strategy; □
- Leadership, Coordination and Cooperation; □
- Legal, Policy and Institutional Frameworks; □
- Implementation Approaches;

□

A strategy is valuable but it cannot stand alone. Without the other building blocks its implementation is likely to be problematic. The strategy provides the high level ("strategic") overview but does not address operational (day to day) issues nor issues at a tactical level (the processes and plans to meet strategic goals)

A National Strategy to address the problem of invasive species (or biosecurity strategy) provides an overall national framework for activities by all stakeholders, governmental as well as non-governmental. It underlines the national commitment to action. Effective invasive species management involves many stakeholders operating in an interrelated and cooperative manner. The National Strategy outlines general policy and practices for all relevant parties and clearly articulates

each stakeholder's obligations and responsibilities. One of the most important aspects of a national framework is to achieve leadership and coordination of the national efforts, and to achieve cooperation between different agencies and to ensure appropriate participation of all stakeholders (including non-governmental) – this should therefore be an important component of the National Strategy itself.

5.2.2. Developing and implementing a National Invasive Species Strategy

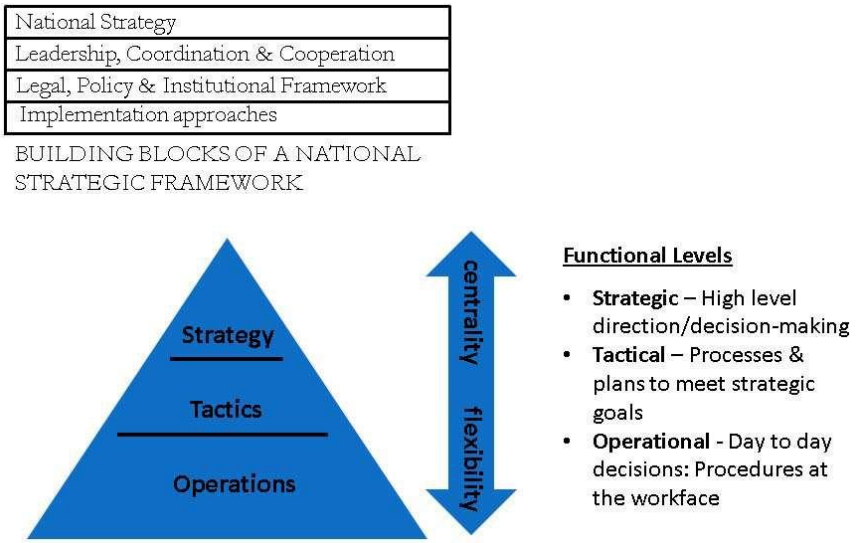

Figure 5.2: Building Blocks of a National Strategic Framework to address the strategic, tactical and operational dimensions of invasive species management.

Trainer notes: Be familiar with the main references, and have the key ones available at the training sessions. A good exercise would be to ask participants to talk about how much contact and communication they have with colleagues in other agencies or from other stakeholder groups

In this module, we will focus on the development of a strategy at the national level because it is such a critical step in managing biological invasions. However, the concept can be applied, with some adaptation, at different scales as well e.g. Regional (e.g. South Pacific, European, Mediterranean, Central African, Caribbean...), or sub-national (e.g. State of Hawai'i, Island of Maui).

Some examples will also be drawn from national strategic efforts that only deal with a subset of the invasive species mandate – e.g. ballast water. However, the aim of this module is to highlight the use of an overarching national strategy, ideally covering all aspects of invasive species.

For the development of a national strategy, usually the starting point is to carry out an assessment of the current situation (situation analysis). This will give a better idea of what it is you are trying to deal with in real life. Such assessment should include an assessment of the "biological" situation as well as the legal and include questions like: what non-native species are there already? What protected areas or endangered species are at risk? What primary production is at risk? It may also be useful at that stage to do a "stocktake" of what legal and institutional arrangements are already in place and what stakeholders are involved in the invasive species issue and in what capacity are they involved.

Two other common components of the development of a national strategy are the designation of a "task force" and a "lead agency".

The ***Task Force*** is a mechanism within which all the key stakeholders representing different sectors, fields of interest and competencies are brought together at the earliest possible time and are actively involved in the development of the National Strategy. The ***Task Force*** normally acts in an advisory capacity only. At a later stage, it may continue in an advisory role in the implementation of the National Strategy – or it may be replaced or reconstituted by a more permanent entity with an advisory role.
The ***Lead Agency*** is the agency with principal responsibility for the operation and managing of the National Strategy on an ongoing basis. The ***Lead Agency*** normally operates at the national level and interacts, as appropriate, at the regional and international level. While that agency will most typically perform some of the tasks involved in implementing the National Strategy, it does not usually carry out all of them; part of the National Strategy aim is to decide on the best lead agency – it could be an existing agency whose responsibility is increased, or it could be a new entity created for the purpose. Sometimes a coordinating entity is preferred rather than a lead agency.

The ***National Strategy*** itself describes the overall objective and scope, national policies, practices and operational arrangements. It should be consistent with relevant international requirements. It can advise on the specific arrangements, but the critical function of a national strategy is to identify key agencies and organisations responsible for its implementation and the actions required of each of them – including how coordination and cooperation between agencies (and other entities) will be achieved and maintained.

Operational and Tactical Arrangements are the processes and procedures for implementing the National Strategy and managing it on an ongoing basis, including the operation of specific actions and recommendations identified in the Strategy. The Strategy will identify "high level action requirements" (e.g. a system of surveillance must be developed) whereas tactical management deals with more specific processes and plans to implement the strategy (e.g. carry out a survey in Port). Operational arrangements describe the day-to-day management of invasive species (e.g. set bait for eradication project on island C at this time). See Figure 5.2. However, given that the implementation of the National Strategy, as well as the implementation at the tactical and operational levels, must all be carried out under the umbrella of the overall National Strategy and/or Strategic Framework, we will deal with them together.

Preliminary Assessment (Situation Analysis)
Usually an important first step is to gather the information that will allow a case to be made for national commitment to action. A preliminary assessment can be made based on existing information (literature, databases, etc.). Some key information to be provided in this preliminary assessment could include:

- Inventory of existing invasive species in the country, and their known or potential impacts □
- Information from elsewhere that will help in the consideration of potential impacts of non-native species present in your country □
- Threats to environment, ecosystem functions, primary production, trade, health (see Module 2) □
- Human and social aspects □
- Situation with regards to particularly vulnerable ecosystems, endangered species. □
- Situation with regards to indigenous people(s) □

- Identification of major pathways for potential future introductions of non-native □species (especially those known to be invasive elsewhere under similar □conditions) □
- Economic analysis (as possible) □

West African Recommendations to more effectively tackle invasive species problems

The delegates of the West African workshop on Invasive Alien Species recommended the following steps be taken to more effectively address the problem of IAS in the region:

1. Establishment of national steering committees and focal points
The committees should be formed immediately ensuring representation from relevant existing committees and all relevant ministries and stakeholder groups. The national focal point should coordinate the steering committee, and could serve as liaison to a regional body formed to address IAS in West Africa.

2. Establishment of a regional coordinating mechanism
A regional co-ordinating mechanism should be established under existing regional bodies. CAB International is requested to facilitate the process and provide interim regional co-ordination.

3. Development of a regional strategy and action plan
A draft regional document should be prepared by a technical team taking into account national strategies and action plans, for subsequent validation and adoption. The strategy should include links, where appropriate, with relevant international and regional instruments, bodies and organizations.

4. Promotion of awareness at national and regional levels
Policy makers and other stakeholders should be made aware of the threat posed by IAS, and of the associated economic and environmental impacts. Media and languages appropriate to the different stakeholder groups should be utilized.

5. Building/strengthening of national and regional capacity
Particular needs include: training and technology transfer; exchange of IAS experts in the sub-region; strengthening research capacity; and setting up centres of excellence based on existing capacity.

6. Development of a regional legal framework
The framework should promote regional harmonization of policy, legislation and regulations on IAS, taking into account existing legal frameworks. The framework should create an enabling environment for the application and enforcement of regulations, and for building consensus on IAS management issues.

7. Improvement of the knowledge base
Biological, ecological and socio-economic research should be undertaken on prevention and management of IAS. Emphasis should be given to baseline studies and IAS inventories, risk assessment, use of indigenous technical knowledge, and assessment of the impact of IAS and management strategies.

8. Enhancement of regional communication and information dissemination

The regional co-ordination mechanism should serve as a clearing house for information and expertise on IAS, to promote regional communication and collaboration. Emphasis should be given to early warning systems and promotion of community participation.

9. Mobilisation of increased financial resources
In response to the growing threat posed by IAS, increased funding for prevention and management is requested from governments, the private sector and development partners[2].

Constraints in Zambia's policies and plans that relate to invasive plant management.
Under the preparatory phase of the GEF Removing Barriers to Invasive Plant Management in Africa project the four pilot countries identified constraints in the enabling policy environment as it relates to invasive plant management. The following is a summary of the main constraints identified for those plans and policies that impact upon invasive plant management in Zambia

NATIONAL POLICIES CONSTRAINTS

- No national policy on invasive species □
- IAS not listed as a national issue □
- Fragmented legal framework □
- Poor provision for stakeholder participation □
- Lack of stakeholder involvement and emphasis on command and control approach

CONSTRAINTS IN MAINSTREAM REGULATIONS OF RELEVANCE TO INVASIVE SPECIES - Investment Act, Water Policy, etc. □

- Legislation out-dated □
- No environmental focus and provision on biodiversity conservation within mainstream legislation □
- No provision to mitigate and restore following development □

CONSTRAINTS IN POLICIES OF WHICH REFER TO INVASIVE SPECIES (AS NOXIOUS WEEDS, PESTS, ETC.) – Noxious Weeds Act, Plant Pests and Diseases Act, etc. □

- Invasive species rarely explicitly mentioned or defined □
- Inconsistency in terminology □
- No criteria for declaration of weeds □
- List of weeds is not comprehensive □
- No specific provision for EIAs for species introductions □
- Provisions for control often localised □
- Outdated legislation □
- No provision for invasive species risk assessment □
- No provision for unintentional introductions □
- Weed control legislation focuses on terrestrial ecosystems □
- Regulations on control and eradication on private and local authority land but not on state land □
- No criteria stated for exemption from weed control regulations □
- No measures for mitigation of impacts of invasive species □

CONSTRAINTS IN POLICIES OF RELEVANCE TO BIODIVERSITY CONSERVATION

- IAS not listed as threat to wetlands □

- No provisions for control of invasive species in Game Management Areas and other wildlife estates other than the □National Park □
- No provision for restoration of native vegetation □
- No distinction between native and non-native species in forestry regulations

CONSTRAINTS IN POLICY IMPLEMENTATION

- Legislation subject to abuse □
- No clear criteria for exemptions to certain legislation □
- Poor funding for implementation and no specific funds for prevention, management and control of invasive alien □species □
- No cost recovery schemes so a reliance on Treasury funding □
- Lack of equipment, infrastructure and logistical support □
- Inadequate monitoring systems □
- Lack of qualified and specialised staff □
- Inadequate staffing numbers □
- No incentive measures for landowners to comply with regulations □
- Difficulties in implementing policies on customary land, which is often prone to encroachment and disputes □
- Lack of involvement of stakeholders in resource management issues □

National Assessment of Invasives: the U.S. Office of Technology Assessment Report

In 1990, the US Congress was worried about non-native zebra mussels in the Great Lakes. It turned to the Office of Technology Assessment (OTA), one of its research agencies, to determine whether zebra mussel was just the tip of the invasion iceberg. Specifically, Congress asked OTA to determine the economic and environmental impacts of all the nation's invaders; how effective federal policies were; what role state laws played; and the relationship between invaders and genetically modified organisms. In 1993, OTA published the results of its research: *Harmful Non-Indigenous Species in the United States*, a 400-page report [7]

When the report was published, the United States had, for the first time, a national assessment that provided information regardless of taxonomic group, economic sector, and government agency. A number of its features have proven especially significant: estimates of the total number of non- indigenous species in the U.S.; their probable economic costs; a list of foreign species first detected between 1980-1993; a compilation of the responsibilities of the 20 or so relevant federal agencies; and not just detailed summaries of state fish and wildlife laws but also managers' assessments of their adequacy.

The study was neither cheap (estimated cost $700,000) nor quick - which helped ensure its thoroughness. It laid the foundation on which subsequent, more detailed, work has built. Many call it "the Bible" on U.S. invaders.

It may also be useful, at this time, to take stock on the institutional and legal arrangements that are in place.

- What agencies at national, provincial, regional council level, island level have aspects of invasive species management in their mandate? □
- What stakeholders have an interest in the invasive species issue? □

Constraints: It is often a good idea to identify constraints at this stage, i.e. what are currently some of the main impediments that stand in the way of effective and efficient management of invasive species in your country (or Region)? National workshops or other consultation where all

stakeholders can participate will usually be able to provide a list of constraints and some initial ideas on how they could be addressed. This will be useful in the actual development of the strategy.

Constraints faced by European countries

The European Strategy on Invasive Alien Species mentions as "challenges and opportunities" the following constraints, faced by many European countries:

- low public awareness and opposition to government intervention;
- shortage and inaccessibility of scientific information (for species identification, risk analysis, detection and mitigation techniques etc.);
- absence of clear and agreed priorities for action;
- ease of introduction and movement (e.g. through the post), inadequate inspection and quarantine;
- inadequate monitoring capacity;
- lack of effective emergency response measures;
- outdated or inadequate legislation;
- poor coordination between government agencies, countries and other stakeholders.

The Strategy states that it aims to address these constraints. The Strategy recognises that Parties' existing legal obligations may constrain or influence the measures which can be taken, particularly with regard to regulation of trade-related activities[8].

In order to develop a National Strategy you need to know what the starting situation is. A useful start is with an assessment of:

- What non-native species and invasive species there are?
- What potential invasive species are likely to arrive through what pathways?
- What are the threats to primary production, biodiversity and health?
- What agencies / entities are dealing with what aspects of invasive species?
- What laws regulations, policies exist?
- What constraints have stakeholders identified?

Trainer notes: Possible exercise:
Participants may be able to brainstorm on what sort of things they would need to assess in the country (or region). They could focus on non-native species, impacts and pathways or on legal and institutional issues.
Ideally this would only require a quick re-visiting of exercises done in previous modules, e.g. identification of their main invasive species or pathways of concern (Module 2), or identification of agencies and other players with mandates relevant to invasive species in Cameroon.

Task Force to Formulate National Strategy

Once it has been decided that a national response will be formulated to the issue of biological invasions, it is necessary to decide how best to do this. There are three main options, namely: designate an agency or individual to carry out the task, hire a consultant or specialist to provide advice, or set up a task force, committee, or other group.
Most countries to date have adopted the Task Force approach. It is understood that this option has been most widely adopted because it is a more inclusive and cooperative process, bringing together the many key stakeholders in the issue and utilising their combined expertise to devise a national

strategy that best suits the country.
The following needs to be kept in mind when deciding on task force membership:
It is essential that all key stakeholders in government, industry and civil society are actively involved in the issue and the development of the National Strategy. This allows them to understand the issues fully, consider how they will be affected and how they will be able to participate. They should also be able to understand the obligations they will have under the National Strategy. Involvement in the development of the Strategy creates a sense of ownership, and thus assists in gaining their commitment to its implementation.
It is recommended that Task Force membership should comprise the following:

1. The Lead Agency if already identified □
2. Representatives from the equivalent of the:
   - Plant Protection / Animal Health Protection □
   - Environmental administration. □
   - Fisheries/marine resources administration. □
   - Health/quarantine administration. □
   - Local government. □
   - Industry, primary producers (e.g. forestry association) □
   - Science community/academia. □
   - Environmental and other non-governmental organisation(s), as appropriate. □
   - Indigenous people(s) (as appropriate) □

Participation in the Task Force should be an evolving process and ensure continuity of involvement of all interested stakeholders.

The Task Force process is completed once the National Strategy is finalised (and agreed by the national government). However, it is normal to have in place an on-going advisory group after the National Strategy is operational – often named "National Invasive Species Council" (or similar).

This group may be very similar to the original Task Force in composition (see also below).
The Task Force is usually established at the time that the national government decides that it wishes to act upon the threat of invasive species. It will most frequently be established before any agency is designated as the Lead Agency or Competent Authority; indeed, recommending which is the most appropriate agency for this task is one of its principal responsibilities in developing the National Strategy.

Useful steps for the Task Force to take:
1) Carry out (or organise it to be carried out by someone on their behalf, e.g. a consultant) a preliminary assessment of the current situation and, based on this -

- determine key stakeholders and ensure their active involvement in the Task Force. □
- determine existing operational arrangements (e.g. how invasive species are handled □at present, by whom, etc.). □
- determine existing legislative provisions that may be relevant and make □recommendations for revisions as necessary. □

2) Determine the Task Force's method of operation, timetable, work programme, reporting obligations, etc. □
3) Analyse all relevant information and taking account of all gathered data and opinions, determine suitable policies, practices, operational procedures and responsibilities, especially who should be the Lead Agency, implementation arrangements and a review/evaluation plan. □

4) Circulate the draft National Strategy widely to all interested parties for consultation □
5) After consultation, taking into account the comments received, the draft can be fine-tuned. □At this point then, the Task Force has completed its most significant task, and has completed preparation of the draft National Strategy, which would normally be submitted to the National Government for consideration/ approval. □

The development/formulation of the National Strategy is usually done by a Task Force (or National Invasive Species Committee)□It is critical that all relevant stakeholders are represented on the taskforce, including from government, industry/sectors and civil society, and that a draft Strategy is circulated widely for consultation this allows

- *maximum input of expertise* □
- *maximum ownership of the resulting National Strategy* □
- *maximum support for implementation* □

Example

Formation of a National IAS Committee in Mauritius

At the GISP Southern African Regional Workshop (Lusaka, Zambia June 2002) it was recommended that each country present established a National IAS Committee or Working Group to address IAS issues in the countries represented. The first Committee meeting was convened in 2003 and agreed upon the following terms of reference.

The Committee has been established to advise individual sectors of the Republic of Mauritius on issues relating to IAS. Its mandate is to:

- Inform stakeholders, including the general public, on IAS-related matters □
- Take stock of IAS identified in Mauritius and measures to control same. □
- Take stock of legislation to control entry of IAS □
- Advise on gaps in IAS management in Mauritius □
- Suggest measures whereby these gaps may be addressed. □
- Support activities of the relevant sectors with respect to IAS (e.g., training) □

The Committee will meet at least four times per year to discuss matters relating to an agreed annual workplan as well as any other relevant matters. □In addition the following Sub-committees will be convened when necessary to work on specialist components of the annual workplan: □

- Agriculture □
- Biodiversity (Marine and terrestrial) □
- Education and Awareness □

Health □Other subcommittees may be created as and when required.

Lead Agency or Coordinating Agency

One of the key roles of a National Strategy is to determine what the best Lead Agency will be. There are many closely inter-related issues that need to be considered in determining and designating the Lead Agency, the key ones being:

- The current department/agency configurations and responsibilities within the national

Government. There is no single agency that is automatically best suited to be the Lead Agency – it will depend on the situation. □

- Several countries have decided to designate an existing agency as the Lead Agency. However, newly creating an entity is an alternative option. □
- The constitutional structure in each country (e.g. is there a federal structure that needs to be reflected or is the legal system centralised?). □
- The legal/regulatory aspects. (The key issue here is that the necessary legislative powers to implement and operate the National Strategy must be available.) □
- The capability and resources of existing agencies□

If an existing agency is given increased responsibilities to become a lead agency, it is critical □that resources available to this agency (e.g. budget) reflect this. □

The *Lead Agency* is the agency with principal responsibility for operationalising and managing the National Strategy on an on-going basis. While that agency will most typically perform some of the tasks involved in implementing the National Strategy, it does not usually carry out all of them – it works best in a system of cooperation with other national or local government agencies and consultation with other stakeholders. □Some countries have chosen to establish a coordinating entity rather than a lead agency. □Regardless of whether a National Strategy has been developed (yet) or not, leadership and coordination are critical components of an overall National Strategic framework. The concept of a Lead Agency is therefore discussed further in Section 5.3.2. □

Trainer notes:□It would be interesting at this stage to check with the audience -

- Do participants know who their counterparts are in other relevant agencies? □
- Did they know them before the training course or did they meet here? □
- Can they be encouraged to meet as individuals? Even if there is not much □institutionalised or formalised cooperation between their respective agencies. □

Example

New Zealand Lead Agency for Biosecurity Strategy

In August 2003 the New Zealand Government adopted the Biosecurity Strategy. As part of the implementation of this new National Strategy, it was decided that the Ministry of Agriculture and Forestry would now have responsibility for the overall leadership of the whole of the biosecurity system, not just the biosecurity concerns relating to the primary production system, as had been previously the case.

This decision meant that MAF had to carefully review how it would fulfil that overall leadership role.

In addition, New Zealand's key agencies with IAS responsibilities are involved in developing structures and procedures to strengthen their cooperation.

National Invasive Species Strategy Format

The National Strategy is a leadership statement and 'blueprint' for dealing with invasive species Issues.

The National Strategy is normally designed and compiled by the Task Force but some of the work for this may of course be delegated to an agency (most likely the Lead Agency) or a consultant. Regardless of the approach taken, it is important that there is wide stakeholder participation in the development of the National Strategy. Where countries have developed such National Strategy it has often been called "National Invasive Species Strategy" or "Biosecurity Strategy".

Example

Example of Coordination approach – National Invasive Species Council, USA

In the USA, The National Invasive Species Council (Council) is an inter-Departmental council that helps to coordinate and ensure complementary, cost-efficient and effective Federal activities regarding invasive species. The Council was established February 3, 1999 by Executive Order 13112. Council Members include the Secretaries of the Interior, Agriculture, Commerce, State, Defence, Treasury, Transportation, Health and Human Services, as well as the Administrators of the Environmental Protection Agency and the US Agency for International Development. The Council co-chairs are the Secretaries of the Interior, Agriculture and Commerce.

In January 2001, The Council released the National Invasive Species Management Plan (the Plan). The Council is now moving forward to set up Task Teams and Subcommittees to implement the action items of the Plan.

The Council actively works with the Invasive Species Advisory Committee (ISAC). The ISAC was established to advise the federal government on the issue of invasive species and to act as representatives of the many stakeholders[9]

Widespread stakeholder involvement in the development of a National Strategy is critical.
This should include governmental agencies, industry and other non governmental and community input.

A National invasive species Strategy is not meant to provide detailed action plans (e.g. it would not deal with the need to eradicate rats from island X), but it is meant to move the country closer towards dealing with invasive species in an overall framework. Such activities identified will be of a "high level" nature, (e.g. "legislation does not presently cover risk assessment for freshwater species – it is recommended that this be addressed by 2014").

While the content of each National Strategy will be somewhat different, in order to take account of the individual countries' circumstances, there are a number of essential issues that should be included.

Vision, goals / objectives

> "*Dealing with invasive species issues requires a collective vision, decided by core [...] stakeholders. This vision must underlie long- term strategies undertaken at regional, national and local levels.*"
> Conclusion from participants at invasive species session at the 2002 Pacific Region Global Biodiversity Forum (Rarotonga, Cook Islands)[10]

A first step should have been to establish a vision for the National Strategy, as well as an overall objective. In other words, what is the ultimate outcome that you are aiming for? It will be important that this is well understood and supported by stakeholders, so that they will be likely to support the actions, regulations and laws that are required and are likely to want to comply and assist.

Scope
The strategy must set out clearly what it is trying to cover.

- What species, or types of species are included, and pathways are included (e.g. does it cover terrestrial AND marine?
- Does it cover invasive species mandates of CBD as well as those covered by, for instance, IPPC, OIE? What geographical area is included?
- Does it cover LMOs as well as non-LMOs?
- What sorts of habitats are included? (e.g. terrestrial? freshwater? marine?).

Any strategy will, therefore, have to be clear about what it is trying to cover – and what it is not covering (yet). For example, the existing Regional SPREP invasive species strategy[11] does not cover marine invasive species, at this stage, whereas the New Zealand Biosecurity strategy[12] extended the lead agency's coordination responsibilities to cover the whole biosecurity system (primary sector, biodiversity,marine, terrestrial). Ideally, a national strategic framework should be applicable to all taxa and all pathways and habitat type, and all national mandates that stem from International Instruments relevant to invasive species. However, in reality, the overall picture may have to be built up over time and the scope of what you can develop will be determined by the national situation and priorities. In any case, a national strategy is not written once and forever. Regular reviewing and, if required, updating or amending should be an integral part of any National Strategy

Scope of the European IAS Strategy:

"Terrestrial, freshwater and marine environments under the sovereignty or jurisdiction of Bern Convention Parties. It also provides guidance for activities carried out in areas beyond national jurisdiction (e.g. shipping);

Alien species (as defined by the Conference of the Parties to the Convention on Biological Diversity) in all taxonomic groups, including viruses, prions, bacteria, feral animals of domestic species (cats, dogs, goats, etc.) and alien biological control agents. It does not apply to genetically modified organisms"[8].

Context
The development of a national strategy needs to take into account both national and international frameworks. For instance, international instruments might convey rights to protect national biodiversity, primary sector etc. from impacts from invasive species. Likewise, international instruments do create obligations that must be fulfilled. (This will be especially relevant where invasive species management intersects with trade).

Existing sectoral procedures or strategies should be taken into account. Problems caused by invasive species cross borders of agency mandates (e.g. health, agriculture, environment, fisheries, forestry) and where there are national plans for these, there should be integration with planning on invasive species issues. (See also below: cooperation between agencies.)

The invasive species strategy must also be integrated with other national commitments, e.g. to sustainable development and biodiversity conservation. invasive species prevention and management issues are a cross cutting issue, and the invasive species issues will have significant relevance not only for biodiversity strategies but also for sustainable development and poverty

alleviation.

National strategies like those for biodiversity conservation or poverty alleviation need to have linkages to invasive species strategies.

Components / Content of National Strategy

The Task Force in charge of developing a national invasive species strategy for will usually best start with an assessment (see above). Based on the information and data gathered, they will be able to analyse the current situation including the existing constraints, and identify gaps to be filled, or existing systems to be modified, expanded, or maintained.

A national invasive species strategy is not meant to provide detailed action plans (e.g. it would not deal with the need to eradicate rats from island x), but it is meant to move the country closer towards dealing with invasive species in an overall framework. Such activities identified will be of a "high level" nature, e.g. "legislation does not presently cover risk assessment for freshwater species – this should be addressed by 2014".

Procedures, systems and actions should address all aspects of invasive species management, including prevention, early detection and rapid response, eradication, control, mitigation, awareness, research, etc. Specific national circumstances must be accommodated but, in general, the following components for a national invasive species strategy should be considered[5-13].

- Status and trends of invasive species in the country: identification of priorities □
- Main sectors (e.g. type of industry) pathways, vectors and particular risks, □
- Identify government departments / agencies at all levels (e.g. including regional) that □have a mandate relating to invasive species, and their roles and responsibilities under the strategy □
- Procedure/system for cooperation within and between relevant agencies (and sectors and institutions as appropriate) □
- Procedures/system for stakeholder participation □
- Relevant legislation and regulations as well as proposals for addressing gaps that □were identified in the review stage □
- Outline of criteria for risk analysis, management planning and mitigation □
- Requirements related to monitoring, □
- Requirements / systems for training and capacity building □
- Where appropriate, specific measures or policies for isolated and biodiversity-rich □ecosystems (e.g. islands and archipelagos, protected areas) □
- Requirements for recovery of species/ecosystems affected by invasive species □and ways to promote use of native species □
- Requirements for public awareness efforts □
- Research requirements □
- Funding issues □
- Priority list of actions, timelines and lead partners for implementation, with realistic □targets to be achieved □

The Government Response (Great Britain) to the review of non-native species policy

In 2001, in recognition of concerns that the arrangements for handling issues relating to non- native species were insufficient, the Department for Environment, Food and Rural Affairs (DEFRA) commissioned a review of non-native species policy. A range of organisations were represented in

the working group carrying out this review – its report was published in March 2003.
The Government prepared a response to address the issues raised in this report. This government response then went through wide consultation at the end of 2003 and early 2004 in order to seek contributions on the further development of a strategy. The response consultation document – equivalent to a first draft of National Strategy - can be found on the web at: http://www.defra.gov.uk/wildlife-countryside/resprog/findings/non-native/index.htm
Scope: "non-native species whose introduction and/or spread threatens biological diversity. This is interpreted broadly to include threats to the entire ecosystem, including human interests (e.g. including threats to human health and financial damage)".

Note:
Components include -

Organisational Structure
Key recommendation 1: The Government should designate or create a single lead co-ordinating organisation to undertake the role of co-ordinating and ensuring consistency of application of non-native species policies across Government.

Prevention measures
Key Recommendation 2: Develop comprehensive risk assessment procedures to assess the risk posed by non-native species and identifying and prioritising areas for other prevention action.

Key recommendation 3: Develop codes of conduct to help prevent introductions for all relevant sectors in a participative fashion involving all relevant stakeholders.

Key Recommendation 4: Develop a targeted education and awareness strategy involving all relevant sectors

Key recommendation 5: revise and update existing legislation to improve handling of invasive non-native species issues

Monitoring and detection measures *Key recommendation 6*: Establish adequate monitoring and surveillance arrangements for non- native species in Great Britain

Management and control measures *Key recommendation 7:* Policies should be established with respect to management and control of invasive non-native species currently present or newly arrived in the wild, and operational capacity be developed to implement these policies.

Stakeholder Engagement *Key Recommendation 8:* Stakeholders should be fully consulted and engaged in development of invasive non-native species policies and action through a mechanism such as a consultative forum. In order to facilitate consultation, questions are added, e.g. under Recommendation 1 about the lead co-ordinating organisation, it asks for comments on particular potential entities[14] also at:
http://www.defra.gov.uk/wildlife-countryside/resprog/findings/non-native/index.htm

The components in the US National Invasive Species Strategy are reflected in the chapters of its strategy document:

Introduction

Survey of Federal Roles and Responsibilities[9]

An Action Plan for the Nation□
- A. Leadership and Coordination
- B. Prevention□
- C. Early Detection and Rapid Response
- D. Control and Management□
- E. Restoration□
- F. International Cooperation□
- G. Research□
- H. Information Management□
- I. Education and Public Awareness□
- J. Conclusion

Also at:
http://www.invasivespecies.gov/council/main.shtml

Implementation Arrangements

The implementation, of a national framework for addressing invasive species issues will need to deal with implementation of the National Invasive Species Strategy and other high level strategic planning as well as with on-going day to day activities (e.g. carry out yearly survey for newly introduced potential invasive species in protected area X, carry out inspection of luggage and passengers at international airport, set traps and bait as part of eradication programme for rats on island Y, etc.). Some of these have been addressed in several modules already, for instance:

- The information base for decision-making.
- The establishment and operating of invasive species management programmes.
- Undertaking comprehensive education, awareness and training programmes. □
- Fostering of international links and cooperation. (Covered in the first part of this □module). □

Note:□

Requirements for information sharing, research and funding, for instance, must also be covered.
This module focuses on implementing some of the higher-level strategic actions:
- The integration of invasive species management within national and sub-national □priorities. □
- The requirements for leadership and coordination of national efforts. □
- The cooperation of agencies and stakeholders, and the need to involve stakeholders □widely. □
- Requirements of legal and institutional frameworks.

Flexibility:

As part of the implementation, further assessments and reviews may be carried out, and more detailed national plans may usefully be developed for a subset of the invasive species response. While they will have strategic elements, they will usually have more detailed tactical components. Examples would be a Departmental Plan for ecological weed control in Protected Areas, or a contingency plan for foot and mouth disease. Some national plans may be somewhere in between a national strategy, covering all invasive species issues, and a more narrowly focused tactical plan, such as the Australian Weed Plan and the Australian Ballast Water Plan. This illustrates that there is not one exact way to go about building a national framework but that different national circumstances should, and can be, dealt with differently.

Implementation of a National Strategic Framework will consist of implementing high-level recommendations for action (e.g. from National Strategy) as well as the planning and carrying out of day to day activities to address invasive species issues.

5.2.2 Leadership, Coordination and Cooperation

Leadership and/or coordination: Lead Agency or Invasive Species Council
In most countries, responsibility for invasive species control is shared between various sectors. There is often no coordinating framework to link the high number of administrations and agencies with relevant powers/duties or to ensure consistent implementation.

Appropriate institutional arrangements will depend on the regulatory structure. As part of the development of a National Strategy, the identification of a lead agency or other coordinating entity is of key importance. The lead agency might be the nature conservation authority, agriculture department, public health authority or a specially established body.

The main obligation and responsibility for the implementation and ongoing management of the National Strategy and other components of the national framework usually falls on a lead agency in a system of cooperation with other national or local government agencies and consultation with other stakeholders. In addition, other agencies will retain certain generic responsibilities, such as customs authorities responsible for application and enforcement of border controls.

In countries where a mix of sectoral rules remains in place, responsibility for invasive species management will be shared between the relevant sectoral institutions and agencies.

For this to work effectively, a coordination mechanism should be put in place to ensure consistent practice. In the United States, a federal Invasive Species Council has been established for this purpose.

The designation of a lead agency and the development of procedures for coordination can take some time, and usually this is best done in the context of developing an overall framework (including a national strategy). The first step, therefore, is to establish a multi- stakeholder task force (or committee), which can develop a national strategy as well as a system for national coordination.

Interagency Cooperation
It has been highlighted before that an effective strategic framework will need to include a mechanism for close and effective cooperation and coordination between agencies (e.g. ministries or departments of agriculture, forestry, environment, protected areas, human health, etc.). Clarity of mandates and clarity of decision making are required. Competition for funding should be avoided, and decision-making systems should be in place to resolve potential conflicts of interest. Information flow between agencies should be increased and, where necessary, improved. This will avoid situations where one agency may use a species (e.g. for erosion control) while another then needs to spend taxpayer’s money to control the same species as an ecological weed.

Setting up and maintaining interagency co-operation can be a challenge, and it may take some time and effort to change ingrained attitudes of "turf" (for instance "we never used to need to get agency

X's approval – why should we now?"). This requires a special effort, and initially will depend a lot on good will and understanding of a common goal.

Interagency cooperation is essential at several levels, and for several different types of invasive species issues. For example, at the "strategic" level, interagency cooperation will be a critical component of implementing a National Strategy. However, at the tactical and operational levels, many types of interagency cooperation are also required. A national "weed strategy" will require cooperation between environmental and agricultural agencies, at a minimum. A contingency plan to respond to newly introduced mosquitoes that can carry human diseases will need cooperation between health, environmental and agricultural agencies, etc. Where relevant, interagency cooperation at state or provincial level should also be considered[15].

Wide stakeholder involvement

Stakeholder advisory role in developing the National Strategy

Stakeholder involvement in the implementation of a national strategy and in other components of a national framework is very important. In many countries, this has been organised by constituting an advisory body that has wide representation from stakeholders. Such body should include representation from relevant government agencies, as well as from industry and from environmental and other non-governmental and community representatives. For this reason, the original "Task Force" that prepared a national strategy is quite often re-constituted into an ongoing advisory body. This is a good avenue to ensure continued stakeholder involvement and to ensure that a breadth of expertise is available to provide advice during the implementation phase.

Stakeholder involvement in the implementation of invasive species management

In addition to stakeholder representation on an advisory body, stakeholder consultation and stakeholder involvement should be a key approach in addressing invasive species. This has been mentioned in several other modules already, but cannot be stressed enough. Stakeholder involvement could, for example, take the form of:

- Consultation in risk analysis □
- Participation in surveillance □
- Development of voluntary guidelines or codes of conducts relating to their sector □
- Community led restoration programmes □
- Community led eradication or control programmes □
- Awareness raising and education □

Internet-based Management of Conservation Issues

Invasive Species Advisory Committee (ISAC) (USA)

The purpose of the Invasive Species Advisory Committee (ISAC) is to advise the Invasive Species Council (Council), as authorised by Executive Order 13112, on a broad array of issues related to preventing the introduction of invasive species and providing for their control, as well as minimizing the economic, ecological, and human health impacts that invasive species cause. The ISAC will maintain an intensive and regular dialogue with stakeholders to explore these issues. The Secretary of the Interior will serve as the administrative lead for member selection and administrative support for the Committee.

ISAC, including the Chairperson, Vice-Chairperson, Secretary, and DFO, will consist of no more than 32 voting members. Members of ISAC will be knowledgeable in and represent one or more of the following communities of interest:

- Weed Science □
- Fisheries Science □
- Rangeland Management □
- Forest Science □
- Entomology □
- Nematology □
- Plant Pathology □
- Veterinary Medicine □
- Farming or Agricultural Practices (broad range) □
- Biodiversity Issues □
- Applicable Laws and Regulations Relevant to Invasive Species Policy □
- Invasion Biology □
- Plant / Animal Genetics □
- Population, Community or Ecosystem Ecology □
- Conservation Biology □
- Environmental Economics □
- Restoration of Invaded Ecosystems □
- Risk Assessment □
- Biological Control of Invasive Species □
- Public Health / Epidemiology □
- Industry Activities, Structure and International Trade □
- Environmental Education □
- Ecosystem Monitoring □

Natural Resource Database Design and Integration
□

5.2.3 Legal, Policy and Institutional Framework

In the national context, law is used to implement policy objectives and determine principles, standards and procedures to achieve them. It sets rules for the conduct of human activities and allocates rights and responsibilities amongst the actors concerned. It may be designed not only to prohibit or restrict actions but also to promote desired goals through provision of economic and other incentives. It is important to understand how legal and Institutional systems underpin the mandate to act to address invasive species – without such underlying framework, you may not be able to address invasive species effectively (e.g. government agency may be in a situation where they have a mandate to carry out risk assessments for plant species, but not other potentially invasive taxa, or emergency response may be ineffective because personnel cannot get access to certain properties, etc.)

Another important function of national legislation is to establish the institutional mechanisms needed to develop appropriate implementing regulations, including standards and criteria as appropriate, ensure compliance, monitor success and failure, and promote policies for improved implementation and any necessary legislative changes. Institutions are therefore key to overseeing implementation and compliance, as well as to generate needed reforms.

In general, until recently, national legal measures have tended to evolve in a reactive and piecemeal way as new problems and pathways have become apparent.
An important part of the development of an overall framework to effectively deal with biological invasions is the review of existing legal and institutional situation, and to develop whatever is required to fill gaps and increase effectiveness and efficiency.

Common weaknesses of existing national law and institutions

National law has developed by sectors over a long timescale. In most countries, invasive species-related provisions are distributed across nature conservation, agro-forestry, fisheries, water resources, and quarantine legislation, and in recent instruments dealing with the control of genetically modified organisms. Relevant provisions may also be found in hunting, fishing and wildlife regulations that address the introduction or release of specie for purposes of restocking. The reasons for this sectoral tradition are usually historical or administrative rather than scientific or technical.

Common problems with national legislation relating to invasive species

Fragmented legal and institutional frameworks

- Absence of a strategic approach to the problem, with alien-related issues ignored or under-represented in national environmental or biodiversity planning processes;
- Fragmentation of, and inconsistencies between, existing provisions
- Absence of institutional coordination / cooperation between government agencies etc...

Weaknesses related to coverage and terminology

- Gaps in taxonomy: frameworks do not specify whether they go beyond the species or sub-species level.
- Gaps in scope of regulatory frameworks: common omissions relate to alien plants, fish, micro-organisms and to marine and coastal ecosystems;
- Narrow or inconsistent objectives, often linked to protecting economic interests rather than native biodiversity in its own right;
- Non-existent or inconsistent definitions of key terms.

Problems related to compliance, enforcement and remedies

- Absence of legal measures to address pathways for unintentional introductions;
- Risk assessment and permit procedures cumbersome and costly;
- Absence of legally-backed requirements for monitoring;
- Powers and duties for eradication, containment and control weak or non-existent; crisis management approach towards invasions;
- Conventional criminal and civil law procedures are difficult to apply in the biological invasions context – resulting in difficulties of enforcement[5].

Key Requirements for National Legal frameworks

In moving beyond a piece-meal approach to non-native species control, decision-makers need to consider carefully the purpose and scope of the policies and laws they adopt.

Explicit objectives are necessary to provide a conceptual framework to develop the legislation itself, guide implementation, set priorities and build awareness. Objectives of the legal framework will be the same as those for the overall invasive species national framework.

For in-depth coverage of legal and institutional requirements, see Reference [16]. Some key concepts are given below that are especially relevant in the development and implementation of an overall national framework for dealing with invasive species.

Definitions and use of terminology

Ideally, definitions should be used consistently in all relevant sectorial instruments but this is often not realistic. Terminology, in the international context as well as the national context, developed independently in different sectors. In view of this, and of the different mandates of the different

sectors, it is no surprise that definitions and terminology vary widely between countries and even between sectors within one country (e.g. agriculture and conservation). Those implementing the national instruments should be aware of these differences. Legislation should clearly define its terminology.

5.2.4 Implementation Approaches

Moving towards Regional and Trans-boundary Cooperation and Strategies

At the international level, the obligation of States to cooperate with one another derives from the very essence of general international law. In the field of environmental law, international cooperation is also fundamental for environmental reasons: firstly because ecosystems and natural resources may straddle national boundaries and second, because threats to ecosystems and natural resources often cannot be addressed and regulated by States individually.

Invasive species issues illustrate these points well. Invasive species may move beyond the boundaries of the State where they were introduced, making bilateral or regional cooperation particularly important. Such cooperation can take many forms and shapes:

- Formalised Regional Strategy (e.g. European invasive species Strategy, SPREP invasive species strategy) □
- Regional Action Plan (e.g. development of Pacific Ant Prevention Plan) □
- Transboundary Cooperation □

Example □Examples of Regional Strategies: □

(1) *South Pacific Regional Environment Programme: Invasive Species Strategy for the Pacific Island Region* □An Invasive Species Programme was initiated by the South Pacific Regional Environment Programme: (SPREP). One of the objectives of this programme was to develop a strategy for invasive species for use by all countries and relevant agencies in the region. The aim of the Regional Strategy is to promote the efforts of Pacific Island countries in protecting and maintaining the rich and fragile natural heritage of the Pacific Islands from the impacts of invasive species through cooperative efforts[11].

(2) *Council of Europe European Strategy on IAS* □The Bern Convention (1979) provides regional framework for implementing the UN Convention on Biological Diversity. A European Strategy on IAS was developed and recently adopted (December 2003) to promote comprehensive and cross sectorial approach to all aspects of IAS, with a focus on transboundary cooperation within Europe [8].

Supporting Restoration and Appreciation of Native Biodiversity

The management of biological invasions should be seen as part of a broader suite of policies and measures to conserve biodiversity. Measures to control 'negative' biodiversity (invasive species) should be combined with positive strategies for restoration of degraded ecosystems and, where appropriate, re-establishment of native species formerly present on national territory.

Where possible, consideration can be given to using incentive measures in management and restoration strategies. There are many precedents for using tools such as grants, subsidies, tax incentives, contractual management agreements, market-based instruments and cross- compliance mechanisms to support sustainable land management in environmentally sensitive areas or for other environmental management objectives[16].

In addition, consideration should be given to increase the community's appreciation of native species, for their biodiversity values as well as for their economic and cultural values.

Using and Encouraging Native Species as an Alternative

It has been stressed many times and by many experts that prevention is the key to addressing invasive species problems. An important aspect of prevention is to reduce the need to introduce more potentially invasive species, by using alternatives. The use of alternative non-native species (e.g. less likely to become invasive) or the promotion of the use of native species would be an important part of prevention.

Promotion of the use of native species could be considered for instance for

- Gardening □
- Erosion control □
- Developing aquaculture (e.g. use of. native fish where possible, in preference over □potentially invasive fish like tilapia), □
- Stocking of rivers and ponds with freshwater fish □
- Forestry □
- Aid and development assistance □

Controls on Domestic Movement of Species

Non-native species present on national territory may become invasive for the first time when moved (intentionally or unintentionally) to a new part of the same country. Legal frameworks should therefore provide a basis for regulating intentional domestic movements of non-native species and for assessing projects and activities that may create pathways for subsequent invasions (e.g. infrastructure development, inter-basin transfers of water). Domestic controls are also needed to help contain the spread of a non-native species that has established itself in one part of the country.

Internal domestic controls should be developed as a priority in certain contexts. Island Countries and Countries with islands need to minimise the risk of inter-island or mainland-to- island introduction of non-native species.

Internal domestic controls (within a country) for movement of species must be considered

Prioritisation

Resources are often insufficient to carry out all activities that you have decided should ideally take place. Prioritising therefore must be a part of any strategic planning.

In many circumstances, risk analysis will be a tool that can be used to identify priorities for action, e.g. when trying to decide where to focus border control, what species or pathways to cover in surveillance programmes, or what species to try and eradicate first if newly introduced species have been detected.

However, other aspects may also have to be taken into account when prioritising. Availability of resources can itself be a factor: with a certain budget you may be able to eradicate pest number 5 on your list - while pests number 1,2,3,4 of higher risk may simply not be possible with the available resources. Human dimensions of invasive species issues may also need to be taken into account. For instance, public opinion may not be ready yet to support the eradication of a particularly cute animal that actually is an invasive species, or of the removal of a “weed” that has some uses that are appreciated by the public. Another factor to keep in mind, especially if decision makers are not very aware yet of invasive species issues, is the great results that can be obtained by producing

"success stories", especially if decision makers and/or politicians can be associated with them. This means that sometimes, a project may be chosen that may only be medium or low priority if simply looked at from the point of view of the risk that the invasive species poses but that is a guaranteed quick success story.

Precaution

Precautionary measures are advocated, required or allowed by several international instruments, including the CBD, the Biosafety Protocol, the WTO SPS Agreement and FAO Code of Conduct on Responsible Fisheries. The preamble of the CBD states the precaution as: lack of full scientific certainty shall not be used as a reason to postpone measures to avoid or minimise a threat of significant reduction or loss of biodiversity.

Precaution is particularly relevant to invasive species issues because of the inherent scientific uncertainty and limitations on predictive capacity – this is especially acute when trying to predict impacts on biodiversity. The ecological complexity of possible effects on biodiversity (and its flow-on to ecosystem services etc.) is one of the challenges that must be faced by national strategic framework to deal with invasive species. It will often be a particular challenge for any lead agency that may have been given an extended mandate to cover biodiversity (ecological) impacts, but that traditionally had a mandate focussed more narrowly on impacts on primary production or other economic sectors.

5.3. National Strategic Framework: Summary

Activity 5.4
Participants should brainstorm on the main messages that they will "take home" from the module. What are their conclusions on what the key parts are for development of a national strategic framework? Use Figure 5.3
What would be the next step for Cameroon?

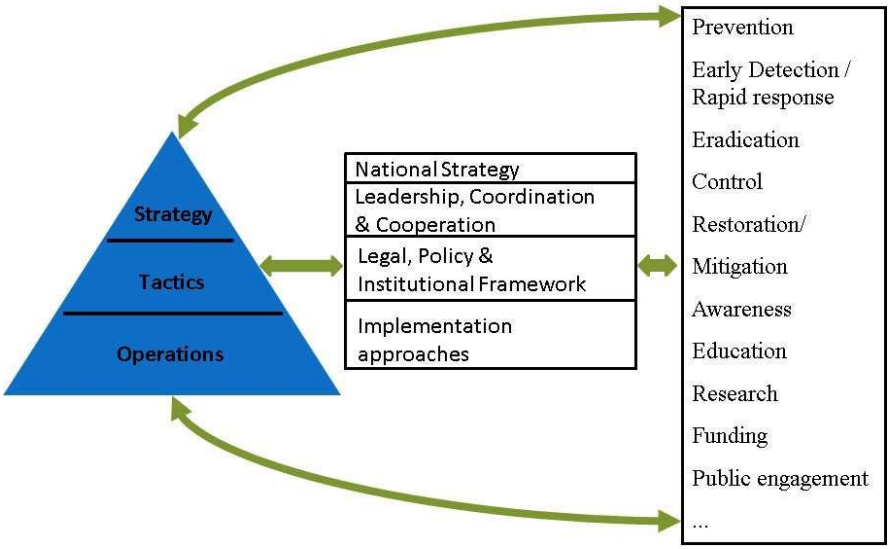

Figure 5.3: Overview of Strategic Framework: Aspects and building blocks at the strategic, tactical and operational levels

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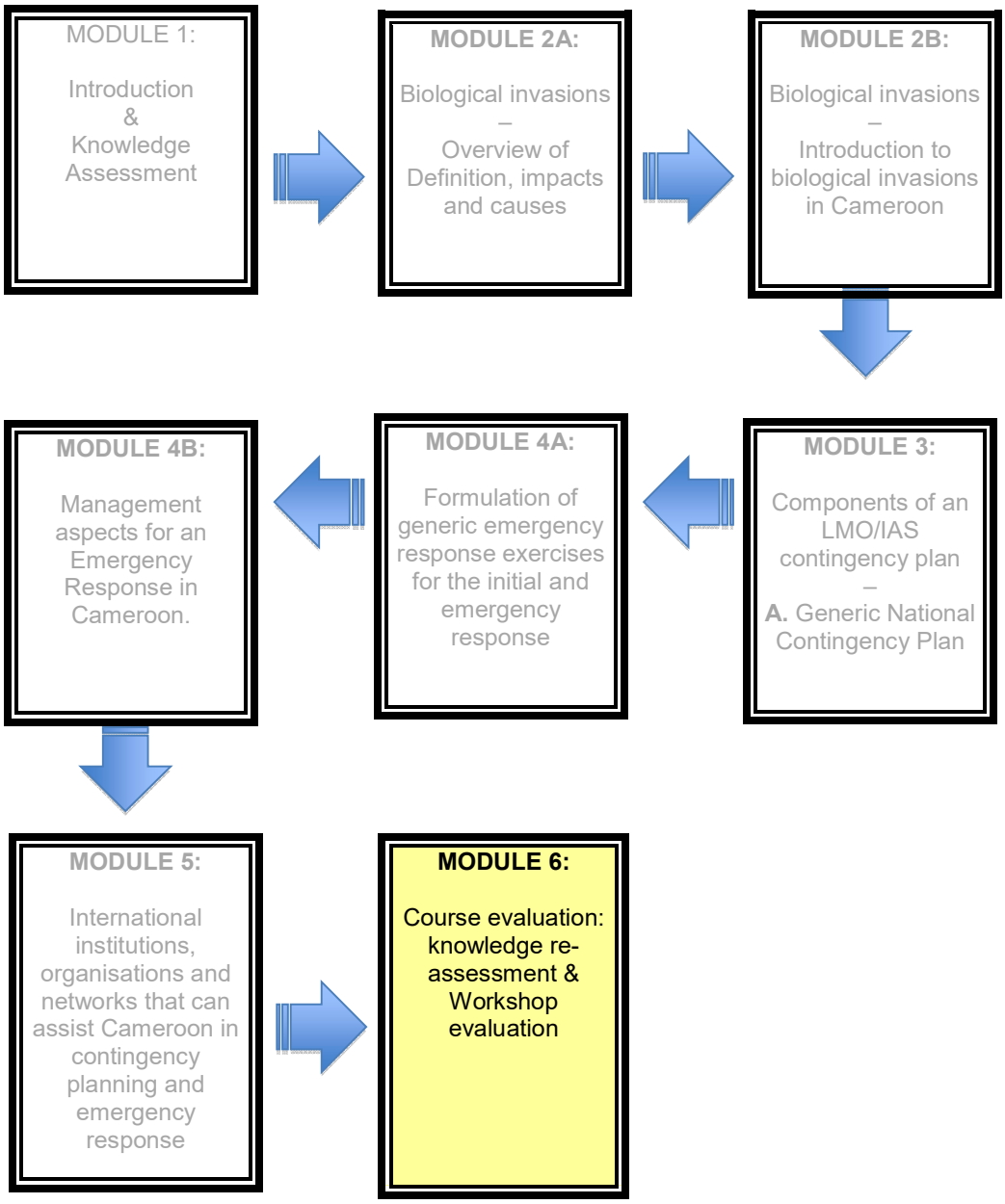
MODULE 6

KNOWLEDGE REASSESSMENT
&
WORKSHOP EVALUATION

Trainer's Edition


MODULE 1:
Introduction
&
Knowledge
Assessment
MODULE 2A:
Biological invasions
–
Overview of
Definition, impacts
and causes
MODULE 2B:
Biological invasions
–
Introduction to
biological invasions
in Cameroon
MODULE 3:
Components of an
LMO/IAS
contingency plan
–
A. Generic National
Contingency Plan
MODULE 4A:
Formulation of
generic emergency
response exercises
for the initial and
emergency
response
MODULE 4B:
Management
aspects for an
Emergency
Response in
Cameroon.
MODULE 5:
International
institutions,
organisations and
networks that can
assist Cameroon in
contingency
planning and
emergency
response
MODULE 6:
Course evaluation:
knowledge re-
assessment &
Workshop
evaluation

MODULE 6: KNOWLEDGE REASSESSMENT & WORKSHOP EVALUATION

By the end of this module participants should:

- *Determine through an assessment and be informed on the level of performance in the delivery and understanding as pre-defined in the learning outcomes for each module.*
- *Determine through a self assessment, the extent to which their pre-course expectations have been met.*

6.1 Introduction

The two days training of trainers workshop on Contingency Planning process and Emergency Response for biological invasions for Cameroon took place in Yaoundé in the CIDE Building, MINEPDED on Thursday 10th and 11th of November 2016. There were 36 participants from 28 institutions and the training was led by an international and national trainer, Dr. Giorgio Muscetta and Mrs. Prudence Tangham Galega. The list of participants is attached in Annex 4.

6.2 Workshop Objectives

The overall objective of the workshop was to train trainers to raise awareness on the options available for Contingency Planning process and Emergency Response for IAS and LMOs to facilitate their management.

This was broken down into the following specific objectives:

1. Understand how to formulate generic emergency response exercises for biological invasions in Cameroon;
2. Know the components of a contingency plan required for the management of an incipient biological invasion;
3. Understand rules of contingency planning and emergency response as part of an integrated, risk-based approach to the management of biological invasions;
4. Understand the specificity of different processes as required for different species and taxa (including LMOs);
5. Know about international institutions, organisations and networks that can assist Cameroon in contingency planning and emergency response procedures; and

The workshop consisted of six modules, 4 teaching modules and a pre- and post-course knowledge assessment designed to train trainers to raise awareness on the options available for detection, diagnostics and monitoring of IAS and LMOs to facilitate their management.

The training programme is attached as Annex 1.

6.3 Report Outline

This module therefore provides the following:

- a summary of the participants' workshop expectations and results of the pre-course knowledge assessment;
- Successful delivery of Workshop Objective;
- Feedback on the workshop as a whole, and on each specific module based on a post workshop evaluation, and
- Overall comments on the workshop.

6.4 Workshop Expectations

Twenty-eight participants wrote down their expectations of the workshop which are reproduced below:

- Improve my knowledge in the field of biological invasions in Cameroon;
- Improve my knowledge of the components of an IAS/LMO's Contingency Plan;
- Improve the ability to develop a Contingency Plan and formulate an Emergency Response for an imminent biological invasion in Cameroon; to be able to transmit the teaching;
- Clarify the idea about the origin of biological invasions (root causes, impacts, management responses and the part played by contingency planning and emergency response in an integrated, risk-based approach to the management of biological invasions;
- Improve the decision maker processes to implement an Emergency response plan for a specific biological invasion in Cameroon;
- To understand and have a clear idea about the causes, methods, institutions who help and who can be called upon to work with Cameroon and the specific functions of each agency;
- Master techniques for Contingency Planning and the various Emergency Response procedures;
- To broadly master the modules in order to transmit this knowledge to students;
- A useful and fruitful training – at least 100 persons;
- Able to recognise, suggest possible sources of biological invasions and prescribe precautions in terms of Emergency Response Plan;
- Be trained in the Contingency plans and Emergency response measures;
- To be able to identify, stop the spread and manage the prevention of invasive species; and
- At the end, I expect be capable to correctly respond in case of the activation of an Emergency response plan for a biological invasion in Cameroon.

Following this session, it was explained that in many cases, the participants' expectations were over-ambitious. Given the limited duration of the training, it would only be possible to give an overview of the topics and not to go into detail or work in a highly participatory manner. By way of managing expectations, the idea of the "10,000 hours rule" was introduced – i.e. that it requires 10,000 hours of purposeful practice to become an expert in any one domain. Following the training, a detailed training manual will be produced that will allow potential trainers to study the topics in more detail. However, even the manual can only be introductory in nature as the subject is vast and in many cases highly specialised training and practice is required to acquire the requisite expertise.

6.5 Feed Back and Post Workshop Evaluation

Thirty-six participants completed the workshop evaluation forms (Annex 5-6-7). The responses were highly encouraging with the total 283 of 350 responses in the highest category (84%), 67 of 350 responses in the middle category (16%) and only 2 responses (1%) in the lowest category. The total number of responses does not add up to 350 because not every participant responded to all questions.

Three working groups with participants have been created on the second day of the Workshop. The participants were invited to focus discussions on the following:

- Case studies on Emergency Response: Case 1 on Plant organisms – Case 2 Animal based – Case 3 on Virus based.

- What was the threat?
- Was there an initial response? And what?
- What was the response management structure?
- Are there other management authorities that should have been involved?
- Is there an Emergency Response Management Committee (ERMC)?

- What are the responsibilities of the ERMC?
- How was the funding done?

From discussions the participants identified the following as case studies:

- Case Study 1: Avian Flu;
- Case Study 2: Ebola;
- Case Study 3: African Swine Fever; and
- Case Study 4: Water hyacinth.

The participants were mostly happy with the quality of the teaching/facilitation and resources and agreed that the modules met their objectives. The main reservation was the lack of time with several participants proposing that the training should be extended to at least three days. Ideally, the training would be residential and held outside Yaoundé as this would help to minimise distractions. 28 out of the 36 participants who completed the workshop evaluation (75%) felt that they could go on to be national trainers.
Logistical arrangements were mostly felt to have been adequate. However, participants would have liked to have resources such as PowerPoint presentations and hand-outs in advance to save on note taking and to allow them to concentrate fully on the presentations. Another point raised was the appalling conditions of the toilet facilities. This latter issue needs to be addressed, as it is inexcusable.

6.6 Successful delivery of workshop objective

Objective: To train trainers to raise awareness on Contingency Plan process and Emergency Response for IAS and LMOs to facilitate their management.
Has this objective been successfully delivered?

Very successfully	27	Moderately successfully	5	Unsuccessfully	0

Comments:
☺ In general, I am very happy with this training;
☺ I have attained my objective of acquiring understanding in the fields of Contingency Plan and Emergency Response for biological invasions in Cameroon;
☺The work was well managed and focused on specific hazard impacts on biological invaders coming from animal, plants and virus invaders;
☺ The availability of course documents in hand during the course make participants more able to better understand the explanations;
☹ Too many modules for one day;
☹ The workshop should have lasted three days; and
☹ Obtain more accurate data and information about national networks, capacities, laboratories and capacity building concerning IAS and LMOs.

6.7 Delivery of individual workshop elements

1. Pre-course knowledge assessment

Successful	52	Moderately successful	20	Unsuccessful	0

Comments

☺ The questions were appropriate for the training. They helped to focus the attention during the presentations;
☺ Every document was available, leading to a good following, focusing;
☺ The concepts were understood; and
☹ Not all the competences acquired at the end featured in the assessment.

2. An overview of biological invasions globally and in Cameroon: root causes, impacts, management responses and the part played by contingency planning and emergency response in an integrated, risk-based approach to the management of biological invasions.

Successful	95	Moderately successful	30	Unsuccessful	0

Comments

☺ The presentation was clear;
☺ This is indispensable knowledge for the prevention of problems linked to biological invasions;
☺ All the three questions have been found to be answered;
😐 Sample size to be detected by statistical means; and
☹ The delivery was quite fast with little or no time to assimilate or reflect upon the information presented.

3. Components of an LMO/ IAS Contingency Plan.

Successful	98	Moderately successful	32	Unsuccessful	0

Comments

☺ This helps us to better protect our species; and
☺ The presentation plan was well performed leading to easy comprehension.

4. Formulation of generic emergency response exercises for the initial and emergency response.

Successful	34	Moderately successful	17	Unsuccessful	1

Comments

☺ This helps us to better understand all the management aspects for an Emergency Response; and
☺ Technical documents and specific case information available.

5. ***An overview of international institutions, organisations and networks that can assist Cameroon in contingency planning and emergency response on biological invasions.***

Successful	32	Moderately successful	17	Unsuccessful	0

Comments
☺ Very instructive;
☺ Useful information about institutions and web sites;
☺ A worldwide discovery of the institutions involved;
😐 We must in future look to improve our partnerships with research institutions in explicit fields and to fund studies; and
☹ Too much text on the slides.

6. ***Post-course knowledge assessment***

Successful	12	Moderately successful	8	Unsuccessful	0

Comments
☺ The subjects covered have been well understood;
☺ I am happy with this training;
☺ An improvement of knowledge from the beginning to the end of the session; and
☹ Few time to exchange with participants.

6.8 Overall comments on the workshop

What are the most important points you have learned from the workshop?
☺ I have enriched my specific understanding concerning on the importance of Contingency plan and Emergency Response measures for Cameroon;
☺ I have enriched my specific understanding concerning the importance to be prepared to formulate Contingency Plan and Emergency response procedures for IAS and LMO's in Cameroon;
☺ International institutions and networks offering their assistance in these fields;
☺ The overview of the roots, causes and pathways of biological invasions processes;
☺ The detection and identification of LMOs;
☺ Other methods of LMO/IAS prompt response;
☺ International and national institutions which can assist Cameroon with Contingency Plan and Emergency Response operations;
☺ The documentation on international institutions on the Internet;
☺ List of international networks, websites and databases on IAS and LMOs;
☺ Databases for invasive species;
☺ What Cameroon is doing to be risk free;
☺ Cameroon is prepared to face risk management;
☺ That processes of Contingency plan and emergency response of biological invaders uses lots of tools, and actors and training is needed; and
☺ I have understood the hazard posed by to be unfurnished of appropriate measures of Contingency plans and Emergency responses for IAS and LMOs invaders in Cameroon.

6.9 Discussion

The training was well received overall with enthusiastic participation and predominantly positive impressions and comments. Many participants had unrealistic expectations going into this workshop in terms of the skills they would gain from it. A very large majority of the participants felt that they could go on to become national trainers. This shows a great deal of enthusiasm and confidence but the results of the knowledge assessment would temper this conclusion with caution.
It would be irresponsible to offer all but a few of the participants positions as national trainers as only a handful scored marks that would make them suitable as for trainers. Other individuals will either need a great deal of extra study or further training if they are to become national trainers. The trainers selected will need to have a sound background in biology or it will require a multi-disciplinary team to cover all the necessary types of expertise – ecology, molecular biology, epidemiology, invasive species management and an understanding of the international and national policy and institutional environment.

6.10 Next steps

The next step is to complete the course manual from the training materials presented plus any additional input that is contributed by the participants. Once the manual is completed the next step would be:

- Provide national training meetings to ensure to be prepared in the event of a biological invasion;
- Support national awareness and preparedness activities and contingency planning efforts by presenting the Awareness and Preparedness for Emergencies at a Local Level programme; and,
- Develop a framework for a national environmental CP that is fully integrated with existing plans and efforts.

To organise national trainings it is recommended that only the top 4-5 individuals in the post-course knowledge assessments are used as national trainers. Others could be considered but they would need to study the manual and be subjected to a further test before they could be hired as a national trainer.
National trainings should be of two or ideally three days in length and should involve more group exercises. Practical field-based activities might be possible but this would demand an extra day at least. In addition, a visit to a laboratory would also be beneficial. This would require a further extra day.

ANNEXES

ANNEX 1: Outline Course Programme

Introduction to the contingency planning process and emergency response exercises for biological invasions in Cameroon.

Venue, [to be inserted]

Workshop team:
[to be inserted]

Workshop modules:

- **MODULE 1:** Overall Introduction and Knowledge Assessment.
- **MODULE 2:** An Overview of biological invasions globally and in Cameroon.
- **MODULE 3:** Components of an LMO/IAS contingency plan.
  3A. Generic National Contingency Plan.
  3B. Specific disease Contingency plan.
- **MODULE 4:** Formulation of generic emergency response exercises Management aspects for an Emergency Response in Cameroon.
  4A. The Initial Response & the Emergency Response.
  4B. Management aspects for an Emergency Response in Cameroon.
- **MODULE 5**: International institutions, organisations and networks that can assist Cameroon in contingency planning and emergency response.
- **MODULE 6**: Course evaluation: post-course knowledge assessment relative to course objectives.

PROPOSED VENUE: Centre d'Information et de Documentation sur l'Environnement - MINEPDED

PROGRAMME

TIME	Activity	RESPONSIBLE
	DAY 1: Thursday 10th NOVEMBER, 2016	
08:30-09:00	Registration	**Task Team and PCU**
SESSION 1: SETTING THE SCENE		
09:00-09:05	Welcome Remarks	**TASK TEAM Coordinator MINESUP Project Coordinator MINEPDED**
09:05-09:10	Official opening	**S.G MINEPDED**
09:10-09:25	Introductions	**All**
MODULE 1		
09:25-09:50	Module 1: *Introduction and Knowledge Assessment (Course Learning Objectives and Structure)*	**Consultants**
09:50-10:20	*Group Activity: Pre-Course Knowledge Assessment*	**All**
10:20-10:30	Facilitation Approach	**Consultants**
10:30-11.00	***HEALTH BREAK***	
MODULE 2 – 3		
10:00-12:30	**MODULE 2:** *Biological invasions globally and in Cameroon*	**Consultants**
12.30- 13.00	*Group Activity*	
13:00-14:00	***LUNCH***	
14:00-15:30	**MODULE 3:***Components of an LMO/IAS Contingency Plan*	**Consultants**
15:30-16:00	***HEALTH BREAK***	
16:00-16:45	*Group Activity*	**All**
16:45-17:00	Reflection on the day's proceedings	**Consultants**
17:00	**End of the Day 1**	

DAY 2: Friday, 11 NOVEMBER, 2016		
MODULE 4 - 5 – 6		
09:00-10:00	**MODULE 4A:** *Formulation of generic emergency response exercises for initial and emergency response*	**Consultants**
10:00-11:00	*Group Activity*	**All**
11:00-13:00	**MODULE 4B:** *Management aspects for an Emergency Response in Cameroon*	**Consultants**
13:00-14:00	***LUNCH***	
14:00-15:00	**MODULE 5:** *International institutions, organisations and networks that can assist Cameroon in contingency planning and emergency response*	**Consultants**
15:00-16:00	**MODULE 6:** *Course evaluation: post-course knowledge assessment relative to course objectives*	**All**
16.00-16.30	**Closing Statements**	**Head Task Team Coordinator PCU**
16.30	**End of Course**	

ANNEX 2: Sampling and shipment for identification

Care should be taken when packing disease specimens. When collecting, the specimen should not be kept in the heat, especially in direct sunlight. Plastic bags should be AVOIDED at all costs, as they cause the specimen to "sweat" and this encourages the growth of other organisms that may hide the real disease-causing organism. Try not to collect disease specimens that are wet. Ensure that, with each specimen, some diseased and some healthy tissue is included; the two should be packed separately. If you know whether the disease is fungal, bacterial or viral, the following instructions can be used:

DISEASES SPECIMENS

Fungal

Specimens can be collected and wrapped in newspaper. The sheets of newspaper can then be put into a paper envelope and placed in a cardboard box with polystyrene or other packaging material that will protect the specimen from damage.

Bacterial

Bacterial disease specimens often deteriorate rapidly, leaving the plant bacteriologist receiving the sample with an oozing mess. If the specimen dries out, the bacteria will die and it will not be possible to identify the disease. Ideally, specimens should reach the plant bacteriologist within 12 – 24 hours of collection to be of use.

Slope cultures in miniature vials of fungal and bacterial pathogens may be prepared and sent instead of fresh samples. This method has been shown to be very successful.

Viral

Filter papers or thick tissue paper should be soaked in 50% glycerol so they are totally wet but not dripping. The specimens should be placed between the papers and the whole sample placed in a plastic bag.

Nematodes

Specimens collected from plants suspected of attack by nematodes must include both roots and soil, packed separately in plastic bags. Nematodes can also be extracted and placed in 25% glycerol or 5% formaldehyde in miniature vials and sent for identification. Alternatively, nematode extracts may be embedded in glycerine and the cover slip sealed with nail polish on a slide and sent.

Unknown

Follow fungal specimen instructions. Collection details to include with specimen:

a) Common name and preferably scientific name of host plant(s);
b) affected part of plant;
c) country, state, locality;
d) map references and altitude (if possible);
e) collection date (very important if isolations from the tissue are to be attempted);
f) collector's name;
g) tentative identification by symptoms and morphology of organisms;

h) disease severity, e.g. number of plants affected (is it one plant on the edge of a field or is the whole area affected; this will help to identify the importance of the problem).
i) reference number.

Posting

- Specimens should be sent by the fastest and most reliable way.
- A covering letter stating the sender's name and address and what information is required must be included in the package and sent with the specimen.
- Pack the container with brown paper.
- A declaration form obtainable at Post Offices must be completed and stuck on the parcel containing the samples.
- Samples should be sent to their destination as soon as possible. Label the box clearly and state:
- "Perishable biological material. Keep material cool but DO NOT refrigerate - no commercial value;" "Fragile" or "Handle with care".

WEED SPECIMENS

Weed specimens must be pressed and dried, and accompanied by appropriate information. There are weeds that have similar characteristics and correct preparation of appropriate specimens will ensure that the identification received is accurate.

Collection**.** It is not often possible to identify a weed specimen from leaves alone, so other representative portions must be collected. What constitutes an adequate specimen varies with the type of weed concerned:

- ❑ Grasses and small herbaceous plants. Grasses and small herbaceous plants should be collected, complete with roots, basal leaves, stems and flowers and/or seed heads. Bulky plants may be divided and a portion sent, provided this portion includes the basal shoots and a complete flowering stem. Long stems can be folded back and forth before pressing. Plants that have underground runners, tubers, bulbs or stems should be sent with at least some of these portions still attached.
- ❑ Shrubs, trees and other larger herbaceous plants. Specimen of these plants should consist of a portion of branch or stem up to 30 cm long. Leaves, flowers and/or fruits (both flowers and fruit if possible) should be provided still attached to the stem.
- ❑ Vines. Appropriate vine samples include buds, fruit and mature leaves. A description of the vine is also necessary. A photograph of the vine showing the growth characteristics can be very useful if buds or fruits are scarce.
- ❑ Others. When collecting ferns, make sure the rhizome (root-like structure) is attached to the frond. With tree ferns, include the scales or hairs at the base of the frond stalk. These are essential for identification.

When plants have large flowers or leaves, it is important to describe the dimensions of the whole flower or leaf and collect the tips and base of each. Photographs should also be taken in the field.

Preparation of specimens. *Before being sent for identification, weed specimens should be pressed between sheets of newspapers and dried, if possible in a drying oven, under moderate pressure. During humid weather and when pressing succulent or water plants, the paper should be changed each day. In dry areas, there is less urgency to change papers although specimens should be checked daily. Fresh plant material should not be sent for identification in plastic bags without first*

wetting the newspaper with alcohol. Such specimens deteriorate quickly, become mouldy and make identification impossible. When sending fresh specimens pressed in newspaper, they should be sprinkled with 70% alcohol, with as much air removed as possible, and sealed with sticky tape to prevent evaporation. Specimens sent as dried specimens each in a sheet of newspaper, and packed flat between cardboard are preferred, because with certain plants, the alcohol can destroy some characteristics.

Always collect at least three specimens of the weed sample. Make sure they are labelled correctly. Information to accompany the sample should include:

- ❑ Collector's name, date of collection, country, province, personalised collection number,
- ❑ Location: longitude and latitude, distance and direction from the nearest town or property and local name of the site of collection.
- ❑ Habitat type: type of area, soil type and associated dominant vegetation.
- ❑ Plant description. It is useful to describe anything which cannot be seen from the pressed specimen such as the weed's growth habit (tree, grass, vine, herb) and approximate height, flower colour (flowers often fade or change colour when dried), growth description of the weed.

Posting. Specimens should be sent by the fastest and most reliable method. A covering letter stating the sender's name and address and what information is required must be included in the package and sent with the specimen. Pack the container with brown paper. Specimens should be sent to their destination as soon as possible and the recipient informed by telephone, fax or e-mail to expect the samples. Label the box clearly and write: "Perishable biological material. No commercial value. Handle with care."

ENSURE THAT YOU HAVE THE CORRECT IMPORT PERMITS AND CONTACTS IF YOU ARE SENDING THE SAMPLES OVERSEAS.

ANNEX 3: Field Instructions for countries starting a fruit fly quarantine surveillance programme

From: Property of FAO/AusAID/UNDP/SPC Project RAS/97/331 Regional Management of Fruit Flies in the Pacific. For use by staff allocated to fruit fly quarantine surveillance by government agencies with commitments to Project RAS/97/331.

Importance of Fruit Fly Quarantine Surveillance

Figure A3.1: Museum set specimen of adult *B. papayae* [© Centre for Agriculture and Biosciences International (CABI) Bioscience].

Most Pacific Island countries are free from serious fruit fly pests that can devastate fruits and fleshy vegetables grown for home consumption and for market. There is potential for many of these countries to develop significant export trade in these commodities and in order to do this, well managed fruit fly surveillance system is required to show that these pests are not present.

This system will also act as an early warning system, which may detect newly arrived species of fruit fly in time for them to be eradicated, with benefits for both local production and export. A fruit fly quarantine surveillance system consists of trapping and fruit collection in areas at risk from exotic fruit fly establishment.

Trapping

Fruit fly trapping consists of:

- Two modified Steiner traps placed at every site:
- One trap at each site baited with Cue Lure and the other trap baited with Methyl Eugenol. Each lure attracts different fruit flies;
- Routine collection of flies caught in traps at between 12 - 16 day intervals;
- Labelling and drying samples;
- If not available, forwarding samples to a person trained and approved to identify fruit flies
- Examining all flies in samples and checking for presence of exotic fruit flies; and
- Re-luring traps at three monthly intervals.

Fruit Collections

This work consists of:

- Collection of samples of fruit in areas at risk from exotic fruit fly establishment between 2 - 4 times a year;
- Incubation of these samples to rear out adult flies from any infested fruit; and
- Examination of these flies and checking for exotic species as above.

Description of Steiner Fruit Fly Trap

The Steiner trap is made from a one-litre plastic kitchen food container. It has a 3 cm hole drilled in the centre both the lid and base; lure applied to cotton wicks inside the traps slowly evaporates and is released through these holes, which are also the points of entry into the trap for flies attracted by the scent. The trap lies horizontally when hung from a wire fixed to one side of the pot. Inside the trap, lure together with malathion insecticide is applied to a cotton wick which hangs by a short length of wire from the top of the trap. The lure attracts flies, and insecticide kills them so they fall to the floor for collection. Malathion has very low toxicity to people, and quantities used in the traps are safe, particularly if direct contact with the wicks is avoided. Also placed inside the trap

Figure A3.2: Steiner Fruit Fly trap

If traps have not been established before, traps placed virtually anywhere with vegetation and fruiting trees will provide basic and valuable information about fruit flies that are present. First trap sites are likely to be located in the gardens of Government employees whose work is associated with fruit fly management in some way (eg. agricultural quarantine is a wire mesh floor which fits snugly with the sides. This prevents flies from soaking in any puddles of water that may collect in the bottom and thus helps to keep them dry. A line of 2 mm diameter holes is drilled along the bottom to allow any such rain water to drain away.

List of contents in quarantine surveillance kits

The following items are required for quarantine surveillance. Items marked with an asterisk are provided in kits forwarded to countries by project RAS/97/331.
Numbers of traps in kits are adjusted according to an estimate of the number of sites immediately appropriate for a country, with additions provided as spares. These estimates are based on land area, number of islands and population of people. Please store these materials securely until they are used.

GUIDE FOR ESTABLISHING TRAP SITES

Trapping strategy

/border protection or research) or who have some connection, such as work colleagues or friends.
In most countries that want to develop export trade in fruit and vegetables, it is desirable to establish baseline information on the fruit fly species present.
To do this, a network of traps needs to be deployed throughout the major land areas to cover main towns, villages and typical rain forest. Total numbers of trap sites may range from approximately five to ten in a small country to more than fifty in a larger place.

Between one to two years input should obtain data on the abundant lure responsive species that are

present, and separation and counts of the different species of fly present in each trap will indicate their relative abundance at different times of the year. Irrespective of above, it is important that progress towards establishing a permanent and sustainable network of traps for quarantine surveillance is made as quickly as possible. To achieve this, regularly serviced traps are required in places where there is risk of exotic fruit fly establishment. It is preferable to use an approved entomologist to help with long term establishment of a trap network, to assist with selecting the best locations for each site, and to provide training in sorting and identification of flies.

Trapping Items in kits		**Fruit Collection Items in kits**	
Steiner Traps: between 20 - 30 units	*	Paper bags: 100 bags	*
Gauze for floors	*	4 litre ice cream containers: 20 units	*
Cotton wicks (dental rolls)	*	2 litre ice cream containers: 20 units	*
Cue Lure 500 ml	*	500 ml flat plastic containers: 10 units	*
Methyl Eugenol 500 ml	*	Plastic “food take-away” pots: 10 units	*
Malathion 50% EC 250 ml	*	Fine gauze cloth	*
Pipettes	*	Sugar	
Wire for hangers	*	Toilet tissue roll	
Birdstop for application to hangers	*	Chicken wire	*
Trapping data sheet.	*	Permanent marker pens, black	*
Cardboard specimen boxes	*	Masking tape for labeling containers	*
Thymol	*	Cardboard specimen boxes	*
Soft nose forceps	*		
Permanent markers, red, blue, black	*		

Selecting Trap Sites

1. Establish principle objectives for sites (e.g. initial appraisal of fruit fly species present, or detailed determination of lure responsive species present and their relative abundance, or quarantine surveillance, or all of these).
2. Select appropriate localities for each trap site to meet needs of above objectives. If this is the first time traps have been placed, research farms, office gardens or properties belonging to staff will suffice given considerations provided in 3 - 5 below.
3. For quarantine surveillance, traps should be placed within 1 km of the following:
    - Tourist hotels and resorts
    - Rubbish dumps
    - Housing areas with international travellers and consumers of imported fruit (urban and suburban areas and some villages)
    - International wharves and airports
    - Yacht anchorages; and
    - Places where imported fruit is sold if this hasn't been subjected to adequate quarantine security protocols.
4. Within localities, select the best sites using local knowledge and field visits. Preferred sites are where there is an abundance of fruit, particularly:
    - Guava
    - Pacific almond
    - Mango
    - Papaya
    - Citrus
    - Rainforest
5. Places where there is a mixture of these fruit are excellent, particularly if banana, plantain, chilli, capsicum, eggplant, squash, gourd are also within 500 meters.
6. Select sites which will be easy and cheap to visit: as stated previously staff member's gardens or office grounds are often ideal, as are places that are visited frequently (eg church, school, friend's house).
7. Avoid places where people will interfere with and vandalise the traps.
8. Obtain permission from landholders, occupiers or village chiefs. Explain the purpose and importance of the traps and ask them to tell children and visitors not to play with them.
9. Place methyl eugenol and cue lure traps on the same site, preferably separated by a minimum of 5 metres.

Preparing wicks

- If wicks haven't been made up, take three lengths of 4 cm long dental roll and a 15 cm length of wire. Bundle the rolls together with the ends in line, and then bind them in the middle with the wire. Twist the ends of the wire together into a loop and use this to hang the wick inside the trap, using the two wires from the roof of the trap as a hook. Dental rolls may also be supplied in 12 cm lengths, in which case use a single one for each wick and bend it three ways, then bind as above.

Setting up traps

1. Check trap is complete and nothing is broken:
    - Lid and pot
    - Hanger and wire to loop around tree branch
    - Wick for lure, placed in wire hanger inside trap
    - Mesh floor.

2. Care is required with management of lures and their application to traps:
    - Trap surfaces, particularly the outside, must not be contaminated with any lure.
    - Avoid spillages inside traps and contact of charged wicks with sides, as this will reduce the risk of contamination and will increase their life in the field.
    - Malathion is a low toxicity insecticide, however, still avoid getting lure on hands, and wash immediately if contact occurs.
    - Lure must not be spilt on the ground.
    - Cross contamination of lures and traps must not occur.
3. Plan how cross contamination is to be prevented. Options in order of preference are:

With 2 people available

- Use one person to manage cue lure traps and the other for methyl eugenol traps.

With only 1 person available

- Service traps for one lure (e.g. cue lure) first, and then the others (e.g. methyl eugenol) after washing thoroughly, possibly on the same or the following day.
- Take soap and plenty of water into the field, and at each site wash hands thoroughly after servicing each trap.

4. Become familiar with lure containers and dispensers, and develop skills to handle these which prevent spillage and cross contamination:

    - Ensure the droppers are labelled or colour coded and don't mix them up (Fiji standard: blue = cue lure, red = methyl eugenol).
    - Place droppers in a holder when not in use to prevent stray drops of lure causing contamination.

5. Once the method of managing cross contamination has been selected, apply lure to wicks in the field at each trap site:
    - Remove trap lid.
    - Use the droppers to apply 2 ml of lure to the wick in each trap without any spillage on the ground or in the trap.
    - Once lure has been applied, do not let the wick touch trap sides.

Replace lid and hang trap in selected tree.

Trap Placement

1. Hang trap in tree using the wire hanger, preferably no less than 2 metres from the ground, minimum height 1.5 metres.
2. Loop wire hanger over branch, bend wire and twist to secure firmly.
3. Bend wire to form a hook, and hang trap from this to enable easy removal if required during servicing. Set up hooks so that wind cannot blow trap off.
4. Ensure the trap hangs freely and the only point of contact with the tree is via the wire hanger. Any other contact will provide access for ants.
5. Apply ant protectant (sticky or greasy paste) as supplied to wire hanger: this stops the ants and other scavengers from crawling down the wire.
6. Mark down days when the traps are to be visited on a wall planner (1998 planner appended) or in a diary. Mark in days when flies are collected (once every 12 - 16 days), and days when traps are to be re-lured (once every 12 weeks).

7. Update regularly!

Trap Clearance

1. At specified times, visit sites.
2. Prepare labels for samples specifying:
   - Clearance date;
   - Trap site (unique code or name) ;
   - Lure type; and
   - Collector's name.
3. Avoid contamination using systems detailed in "**Setting up Traps**" - i.e. use two people to clear traps, or clear cue lure and methyl eugenol traps at different times, or wash hands thoroughly after clearing each trap.
4. Empty flies from traps into cardboard specimen box without any spillage, select correct label, place inside with flies together with a pinch of thymol to prevent growth of fungi, and close lid securely.
5. Instead of labels, it is also acceptable to write the collection data on each specimen box. Either way, use biro or pencil and avoid water-based inks, and ensure this information is always provided for each sample.

Postage of Flies for identification.

1. Pack specimen boxes inside a cardboard carton, using crumpled paper as packaging to prevent crushing.
2. Wrap carton and post flies to:

Trap Maintenance

1. Every 12 weeks, maintain traps;
2. Check trap for damage, and repair/replace if broken:
   - Broken hangers: repair by replacing wire
   - Brittle traps with cracks: use again if still fly-tight, note problem and schedule in replacement
   - Brittle traps broken beyond re-use: discard and replace.
3. Discarded traps must be placed inside a plastic bag which is then tied off, removed and destroyed, otherwise they will interfere with operation of new traps. Burn the old traps or bury them at 0.5 metres deep.
4. Re-apply 2 ml of lure to wicks. Take specified precautions regarding contamination of surfaces and mixing lures (i.e. either use 2 people, relure at different times or wash hands thoroughly after each trap).
5. Re hang traps in trees in same location, and ensure they hang freely without touching leaves or branches.

Apply ant protectant as provided to wires.

Annex 4: List of ToT Participants.

CAMEROON BIOSECURITY PROJECT TRAINING WORKSHOP ON CONTINGENCY PLANNING PROCESS AND FORMULATION OF EMERGENCY RESPONSE EXERCISES FOR BIOLOGICAL INVASIONS IN CAMEROON (Activity C12)

Venue: CIDE – MINEPDED, Yaounde, **Date: From the 10th to 11th november 2016**

ATTENDANCE SHEET

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Annex 5: Pre-Course Knowledge and Attitude Survey

QUESTIONNAIRE
KNOWLEDGE ASSESSMENT RELATED TO CONTINGENCY PLANNING AND EMERGENCY RESPONSE FOR BIOLOGICAL INVASIONS IN CAMEROON.

PURPOSE
The purpose of this questionnaire is to assess the pre-course knowledge and understanding of the trainees about issues of relevance to the course on contingency planning and emergency response to manage biological invasions in Cameroon.

Your participation is voluntary and your data is anonymous and confidential.

A: FEW DETAILS ABOUT YOU

Name□:
Institution□/ Sector of Intervention:

Tick Stakeholder Group as appropriate:

Government	
Public Agency	
Academia	
Research	
NGOs	
Cooperative	
Private Sector	
Others	

If others, Specify:

Occupation:

Relevance of Biological Invasion to your occupation:

B. Knowledge and Awareness on Terms

Please indicate your knowledge of the terms listed below. Please choose a number from 1-3:

1. I have never heard of this term
2. I have heard of the term but I would find it difficult to define
3. I understand and can define the term

- Biosecurity_____
- Biological Invasion _____
- Invasive Alien Species _____
- Species Of Biological Concern____
- LMO _____
- GMO_____

- Pathways _____
- Vectors _____
- Contingency Plan _____
- Emergency Response _____
- Emergency Response Exercise ___

If you have answered 3 for any of these questions please explain what the term means in the boxes below. If the term is a set of initials (LMO & GMO) please explain the term, do not just tell us what the initials stand for.

Term	Provide Definition of Term	Do not write HERE
Biosecurity		
Biological Invasion		
Invasive Alien Species		
Species Of Biological Concern		
LMO		
GMO		
Pathways		
Vectors		
Contingency Plan		
Emergency Response		
Emergency Response Exercise		

C. Different types of impacts associated with biological invasions

Please Name the type of impacts of biological invasions which you are aware of.		Do not Write HERE

D. Expectations on a Training on Contingency Plan and Emergency Response Exercise

1. Have you previously participated in a Training on Contingency Plan and Emergency Response?

Yes	No

2. If Yes, Provide details on the Training Course and its content

3. What are your General expectations from this training workshop on CP & ER?
4. What are your Specific expectations from this training workshop on CP & ER? LIST at least 5 specific areas of interests in the table below.

AREAS OF INTERESTS	Do not write HERE	Do not write HERE

NAME:

Thanks for your cooperation

Annex 6: Contingency Planning Knowledge assessment form.

TRAINING OF TRAINERS ON CONTINGENCY PLAN AND EMERGENCY RESPONSE FOR BIOLOGICAL INVASIONS IN CAMEROON - PRE-COURSE KNOWLEDGE ASSESSMENT RELATIVE TO COURSE OBJECTIVES

1 True or False

1. Contingency planning is the same thing as operational emergency response planning. **T F**

2. Contingency planning, while important, does not actually improve preparedness for disasters. **T F**

3. Contingency planning is related to and overlaps with many of the strategies employed to improve preparedness. **T F**

4. The LMO/IAS model of contingency planning is designed as an interagency process suitable for any type of emergency or scenario to be planned for. **T F**

5. The LMO/IAS model includes active implementation of preparedness activities as well as planning activities. **T F**

Multiple choice. Mark ALL correct statements—more than one may apply.

2. The LMO/IAS definition of contingency planning includes which of these phrases:

A "Contingency planning is a management tool…"

B "…adequate and appropriate arrangements are made in advance to respond in a timely, effective and appropriate way …"

C "…to ensure that the rights of the disaster affected are respected."

D "…a tool to anticipate and solve problems that typically arise during a humanitarian response."

3. Which of the following statements illustrate the differences between Contingency planning and other types of planning?

A In contingency planning, you are sure of the magnitude of the event you are planning for.

B In contingency planning you are always working in a state of uncertainty.

C The planned for event may or may not happen.

D The planning is based on assumptions rather than emergency assessment data.

4. Which of these are considered disaster preparedness measures?

A Early warning mechanisms

B Coordination arrangements

C Contingency planning

D Capacity analysis and development

5. Which of the following activities support the Preparation of the LMO/IAS contingency planning model?

A Coordinate and prepare for the process.

B Define scenarios for planning.

C Ensure facilitation.

D Analyse hazards and risks.

6. Which of the following activities support Response Planning of the LMO/IAS contingency planning model – Response planning?

A Define objectives and strategies.

B Define management and coordination arrangements.

C Review, test and update the plan.

D Consolidate & review planning outputs.

Name of Participants:

Answers:

.A,B,D	10	.T	5
.A,C	9	.T	4
.A,B,C,D	8	.T	3
.B,C,D	7	.F	2
.A,B,D	6	.F	1

Annex 7: Workshop Evaluation Form - Post-Course Knowledge Assessment

TRAINING OF TRAINERS ON CONTINGENCY PLAN AND EMERGENCY RESPONSE FOR BIOLOGICAL INVASIONS IN CAMEROON (COMPONENT 3, ACTIVITY C12), 9-10 NOVEMBER 2016.

PARTICIPANT FEEDBACK

Check the relevant boxes and leave optional written feedback in the comments section

Successful delivery of workshop objective

SCALE

5. Excellent: Delivery/Application and understanding was highly successful.
4. Very Good: Delivery/Application and understanding was successful
3. Good: Delivery/Application and understanding was average
2. Fair: Delivery and understanding was inadequate
1. Not Fair enough: Little or no understanding and delivery was mediocre

MODULE 1: Introduction and knowledge assessment

Module Learning Objectives	5	4	3	2	1
Course Objectives and structure					
Pre-Course Knowledge Assessment					
Facilitation Approach.					
If you ticked 5, how can this be improved					

MODULE 2: Biological invasions globally and in Cameroon

Module Learning Objectives	5	4	3	2	1
Key terms					
Different types of impacts & the costs					
Examples of Biological Invaders					
Process of biological invasions					
Identification of Root causes of biological invasions.					
If you ticked 5, how can this be improved					

MODULE 3: Components of an IAS/LMO Contingency Plan

Module Learning Objectives	5	4	3	2	1
Process of Contingency Planning;					
When to begin and who to notify in a CP process					
Benefits and outcomes linked to a good CP activity					
The need for Contingency Planning					
Major components of Contingency Planning.					
If you ticked 5, how can this be improved					

MODULE 4: Formulation of generic Emergency Response exercises

Module Learning Objectives	5	4	3	2	1
More aware on measures to active an Emergency Response;					
Be aware of some of the management responsibilities undertaken.					
If you ticked 5, how can this be improved					

MODULE 5: Legal and Institutional Framework and Programmes that can assist Cameroon in Contingency Planning

Module Learning Objectives	5	4	3	2	1
Key international instruments /programs that can inform and guide national CP & ER process					
Existing National Legal, Policy and Institutional Framework					
If you ticked 5, how can this be improved					

Annex 8: Example of Contingency Plan In Cameroon

STRATEGIC PLAN FOR THE CONTROL OF FOOT AND MOUTH DISEASE (FMD) IN CAMEROON

Retrieved from:Mtf/Cmr/034/Stf Support Towards Improving The Control Of Transboundary Animal Diseases Of Trade Livestock - Strategic Plan For The Control Of Foot And Mouth Disease In Cameroon - February 2015 (http://www.standardsfacility.org/sites/default/files/STDF_PG_336_Strategic_Plan_FMD_Feb-15.pdf) Accessed 16 October 2016.

1. INTRODUCTION

Foot and mouth disease (FMD) is the most contagious disease of mammals and has a great potential for causing severe economic loss in susceptible cloven-hoofed animals such as cattle, pigs and small ruminants. There are seven serotypes of FMD virus (FMDV), namely, O, A, C, SAT 1, SAT 2, SAT 3 and Asia 1. In a bid to curb the nefarious effects of this disease on the Cameroonian economy, it was deemed necessary to elaborate a control strategy based on available data.

There had never been a systematic and comprehensive effort to assess the epidemiological parameters of the disease nationwide and its associated risk factors. Complementary and updated data was collected from susceptible livestock. Virus entry points and distribution pathways were assessed .All risk factors were systematically assessed and analysed for a technically and economically realistic and feasible control strategy to be conceived.

This involved an analysis of disease determinants and virus isolation and sequencing of 2400 bovine samples obtained from 480 herds/epidemiological units by a three stage sampling design based on the National Census Bureau's data base. A preliminary selection of sampling zones was done to select zones with at least 20 livestock producing families and 200 heads of cattle, followed by a random sampling of 5 herds per zone and a final random sampling of 5 animals per herd.

The sampling technique used for non-clinical animals was the probang. Samples from clinical cases were collected from vesicles and other lesions. These were used for virus isolation and sequencing. Questionnaires were administered for risk analysis.

Aligned to the global strategy for the control of FMD and its prescribed PCP, this strategy, which is presented on the OIE/FAO, recommended RBSP template for PCP stage 1 countries contains amongst other things:

- The FMD situation in the country;
- The impact of FMD on livestock and livelihood;
- Working hypothesis and risk hotspots;
- Organisation of veterinary services and prior control efforts;
- Gap analysis;
- The proposed FMD control strategy and operational plan; and
- The budget.

Its main objective is to reduce the impact of FMD in the country and sustainably mitigating all identified risk factors so as to attain PCP stage 3 after 5 years. To that effect all PCP and PVS stage one and two activities will be carried out along with targeted vaccination during the five year span. Samples of two types; epithelial tissue from clinical cases, and probangs from clinically healthy or recovered were collected in the 500 herds visited.

Figure A8.1: Probang collection in Badzama, East Region.

Figure A8.2: Sample collection and disinfection of probing cup before subsequent re-use

Figure A8.3: Blisters from ruptured vesicles and epithelial sample collection from tongue of cattle in Badzama, East Region.

2. THE CAMEROON FMD CONTROL STRATEGY

The FMD control strategy for Cameroon is based on identified risk factors and their analysis, and will address stages 1 to 3 of the PCP and the PVS, which constitute components 1 and 2 of the global strategy. In the preceding section, the epidemiology of FMD in Cameroon was presented as structured in the expected outcomes of stage 1 of the PCP. This was deliberately done so, in order to propose a strategy that would intrinsically imply commencement mid-PCP stage 1.

This strategy document aims at reducing the impact of FMD in the entire national territory but prescribes a step-by-step approach which begins with cattle all over the national territory.

2.1 PHASE 1

2.1a. Objectives

For the first two years of the strategy, the focus will be on improving the understanding of the epidemiology of FMD in the country and implementing a risk-based approach to reduce the impact of FMD.

2.1 b. Expected outcomes of phase 1

1. All husbandry systems, the livestock-marketing network and associated socio-economic drivers are well described and understood for FMD-susceptible species(value-chain analysis).
2. The distribution of FMD in the country is well described and understood and a 'working hypothesis' of how FMD virus circulates in the country has been developed.
3. Socio-economic impacts of FMD on different stakeholders have been estimated.
4. The most common circulating strains of FMDV have been identified.
5. There has been progress towards developing an enabling environment for control activities.
6. The country demonstrates transparency and commitment to participating in regional FMD control.
7. Important risk hotspots for FMD transmission are identified.

2.1 c. Phase 1 Control activities and measures

The control activities for the first phase of the Strategy are those that will contribute towards attaining the expected outcomes of PCP stage1 and equally mitigate the identified priority risk factors identified from the risk analysis.
The expected outcomes of PCP stage 1 are listed above. The priority risk factors include:

- Herd management practices;
- VSI practices;
- Livestock movement; and
- Livestock trade and market practices.

i Activities related to herd management practices.

ii-a. Organisation and Structuring of livestock farmers.

Earlier identified as a fundamental weakness in the sector and an asset where it exists, livestock farmer organizations constitute a reliable basis for control and medium for transfer of knowledge and information. Where they exist, the members cooperate towards their common benefits as seen in the fight against diseases, pooling of produce for processing, creation of pasture farms, control of market prices etc. A typical example is the proportionate practice of pasture cultivation to membership in grazers' organizations across the country as well as with regions where at individual regional level, membership in grazers' association was proportionate to good practices like pasture cultivation. Notable exceptions are the Littoral and South-west where many grazers generally exploit palm plantations or cultivate pasture without necessarily belonging to grazer associations. Farmer organizations, mostly common initiative groups (CIG) have been created for species that were subject of government projects, such as pigs and small ruminants. For cattle, the existing organizations were mostly initiated by the farmers themselves while a few in the Adamaoua were

the product of the milk processing project that was implemented there about 20 years ago. The recommended organization is the specialized cooperative, CIGs having proven very difficult to monitor. Therefore, the strategy will support the structuring grazers of susceptible livestock into Specialised Divisional Cooperatives with Board of Directors (SDC-BOD). These could be aggregates of grazers' associations of Sub-divisions or/and individual farmers.
Therefore, a maximum of 58 SDC-BODs will be expected per susceptible livestock specie.

Ii-b. Training on good livestock production practices.
The members of the SDC-BODs will be trained on good production practices in order to gradually bring them to abandon practices that hitherto exposed their herds to FMD. This will be a critical point as traditional practices are difficult to change, require tact and patience and expected change will be progressive. It will thus be necessary to win the support and adherence of community leaders who themselves ought to be members of the cooperatives. Training materials, manuals and guides will be produced for subjects like, FMD and its risk factors, animal identification, herd housing, feeding (pasture cultivation, processing, conservation and use), reproduction, empirical vaccination, FMD treatment, and FMD vaccination.
The SDC-BODs will make it mandatory for their members to identify their animals using a consensus identification tool. Herd housing will be compulsory while empirical vaccination will be proscribed. As far as reproduction is concerned, the common practice of exchange of breeding bulls will be discouraged and each SDC-BOD will constitute its gene bank for the preservation of the best genes (semen and oocytes). The cooperative will purchase the semen/oocytes from farmers and store. Interested grazers can then equally purchase desired genetic material from the cooperative.

ii-Activities related to livestock movement, trade and marketing practices
Transhumance and trade movements are two of the major causes of transmission of FMDV from wild reservoirs to domestic livestock. Most grazers declare they encounter buffaloes, antelopes and warthogs during transhumance while traders, especially those on transit equally meet these animals when they deviate from legal cattle tracks mostly in attempts to avoid control.
Practices of selling clinically infected and convalescent animals in order to curb losses during and following outbreaks should be discouraged. Buying of such animals should also be discouraged.
This aspect of risk factor mitigation will be addressed at two levels, directly to the members of the SDC- BODs and livestock traders; and legislation enforcement and review. At farmer level, the nefarious consequences of transhumance, poor transit practices and bad marketing practices will be explained to grazers and traders and they will equally be provided training sessions on good transhumance destinations, good transit practices and good marketing practices.
Training on transhumance will target the grazers; training on transit practices will target livestock traders while training on marketing practices will target both grazers and traders.
The legislation addressing livestock marketing will be reviewed to formally enforce the prohibition of the sale of FMD infected and recovering animals. Trade and transit legislation will equally be reviewed to create new livestock routes, since urbanization and human encroachment have occupied some livestock routes and tracks pushing cattle traders into FMDV niches. Another legislation will be created to progressively prohibit transit on foot where transport by train, ship or automobile is possible and available.

iii-Activities related to veterinary sanitary inspection.
Earlier identified as a weak link in the value chain, VSI posts have literally become virus passage posts. VSI at all levels from the frontiers, through livestock routes to abattoirs and markets is completely dysfunctional. There are no infrastructures, no equipments, unqualified poorly trained personnel, and no monitoring nor tracing facilities.
A guide will be produced for the minimum standards in VSI posts and will be used to upgrade all VSI posts in the country. Essential facilities like quarantine pens, incinerators, lairages, laboratories, veterinary crushes, recording equipment, offices and vehicles will be mandatory.
At frontiers, priority in implementation will be given to the Douala seaport, the international airports in Douala, Yaounde and Garoua, the frontier posts in Kousseri, Garoua Boulai, Djohong and Biti and other frontier posts along the borders with Chad and the Central African Republic.
At the administrative level, priority will be given to the Regional services of veterinary services (VSI

kits, laboratory diagnostic equipments and vehicles), the Divisional delegations (VSI kits, laboratory diagnostic equipments and vehicles) and the Sub-divisional delegations (VSI kits, sample collection, preservation and shipment equipments and motorbikes).
At the abattoirs, all existing abattoirs will be given priority while new abattoirs would have to comply. The VSI personnel will have to be trained and qualified and the revision, formulation and enforcement of VSI legislation will be accentuated.

iv-Other activities
Other activities prescribed for the attainment of the expected outcomes of Phase 1 which will last for two years, are presented below.

PCP related activities and training will focus on	**PVS related activities and training will focus on**
- Improving the Understanding of FMD epidemiology: FMD occurrence, virus types and virus transmission pathways; - Improving risk analyses; - The socio-economic impact of FMD;- FMD surveillance in the field; - Improvement of laboratory facilities and capabilities; - Improving the information system; - Improving effective communication with stakeholders - Preparing an FMD control strategy to enter Stage 2	- Re-assessing VS with respect to resources,staffing, funding and chain of command; - Reinforcing VS capacities to develop legislation and regulations; - Assessing and revising the legislation as appropriate; - Reinforcing cooperation with all stakeholders- Reinforcing communication capacity and a team of specialists; - Reinforcing reporting capacity / WAHIS notification; - Strengthening basic laboratory diagnostic capacities, preferably with bilateral support from a reference laboratory;

2.2 PHASE 2
2.2 a. Objective
Phase two of the control strategy which corresponds to the next three years following phase 1, has as objective to implement risk based control measures such that the impact of FMD is reduced in one or more livestock sectors and/or in one or more zones.

2.2 b. Expected outcomes of phase 2
1. On-going monitoring of circulating strains and risk in different husbandry systems;
2. Risk-based control measures are implemented for the sector or zone targeted; and
3. Develop a revised, more aggressive control strategy that has the objective of eliminating FMD from at least a zone of the country.

2.2 c. Phase 2 control activities and measures
These activities and measures will be implemented in priority zones as defined by the revised strategy document of phase 1. However, based on the forecasted epidemiological situation and the prescriptions of the global strategy, the following activities are proposed for stage 2 of the strategy:

a. Continuation of the activities listed for Stage;
b. Control of FMD in target areas/zones or farming systems;
c. In targeted areas/sectors, active (i.e. investigating FMD outbreaks) and passive surveillance;
d. Raising the participation of producers and stakeholders by means of joint programmes, communication and operational funding;
e. Raising biosecurity awareness;
f. Vaccination based on vaccine matching information, respecting the cold chain and followed by post- vaccination monitoring; and
g. Establishing a zoning approach with a national animal identification system.

2.3 PHASE 3
2.3 a. Objectives

Phase 3 of the control strategy, which corresponds to the next five years following completion of stage 2, will have as objective the progressive reduction in outbreak incidence followed by elimination of FMDV circulation in domestic animals in at least one zone of the country.

2.3 b. Expected Outcomes

1. On-going monitoring of circulating strains and risk in different husbandry systems;
2. The disease control plan developed at the end of Stage 2 is implemented, resulting in rapid detection of, and response to, all FMD outbreaks in at least one zone in the country;
3. The incidence of clinical FMD is progressively eliminated in domestic animals in at least a zone in the country; and
4. There is further development of an enabling environment for control activities. In this Stage, Cameroon will request formal OIE endorsement of its national FMD control programme.

2.3 c. Activities

PCP activities and training will focus on:

1. Extension of FMD control measures to all FMD- susceptible domestic species;
2. Prompt response mechanisms (emergency plan, upgraded surveillance, implementation of emergency response measures, including culling);
3. Intensive targeted vaccination;
4. Up-dating and implementing the legal framework to effectively combatFMD and control outbreaks;
5. Developing public/private partnerships; and
6. Application to OIE for endorsement of the National FMD Control Plan.

Endorsement of this strategy document by the Government of Cameroon indicates Cameroon's completion of prerequisites for admission into stage 1 and implementation of measures targeting passage into stage 2 of the PCP.

3 VACCINATION

The vaccination protocol, prioritization of zoning, vaccines and methodology here proposed are based on the FAO prescriptions contained in the document 'vaccination campaigns in endemic situation', which in itself complies with OIE and EMPRES recommendations. Hence, as a control tool, vaccination will be done in a step-by-step progression, moving from one zone to the next, supported by strong disease surveillance network that will monitor the effectiveness of the campaign. Measures will be taken to ensure that prior secured zones will not be re-infected. Hence, geographic barriers will be employed in the zoning process. Epidemiological, livestock production, livestock movement and livestock marketing patterns that influence disease spread have also been taken into consideration. The Government of Cameroon officially launched the FMD vaccination campaign with priority objective being the revamping of the dairy sector; hence, the major dairy production zones of the country are equally given priority.

Vaccination against FMD in Cameroon will continue from the ongoing pilot phase in the first year of PCP stage 1 in six of the ten regions of the country, constituting approximately 60% coverage of the national territory.

Priority will also be given to the major state-owned ranches and livestock stations where a higher compliance and success rate is expected and which furthermore would serve as sources of disease-free animals for restocking other areas.

For optimal efficiency, and with respect to livestock movement patterns this plan prescribes vaccination of animals "upstream" beyond the primary control zone where the virus is present in its ecological niche, as well as the bovine population in the primarily targeted zone "downstream".

Vaccination will be done at times of the year before movements are likely to occur, e.g. before departure on transhumance. This will be to avoid extreme perturbation of local pastoralist practices and enhance adherence.

Based on the preceding facts, the North-west, West, East, Adamaoua, North and Far-north regions have been selected for vaccination for the first five years.

3.1 PRESCRIBED ACTIONS IN CONFIRMED SECURED ZONES.

In regions eventually confirmed FMD-free, action will be directed away from routine vaccination to increased early warning and early response activities. Active disease surveillance activities will be enhanced and a high-level preparedness against the disease will be maintained. In this way, any disease breakdowns will be detected and eliminated quickly by either a short, sharp, targeted vaccination campaign or by limited stamping out.

4 CHAPTER 2.
OPERATIONAL PLAN 2.1. ORGANISATION OF FMD MANAGEMENT

The strategy will be under the overall responsibility of the Minister of Livestock, Fisheries and Animal Industries, while technical implementation of the Strategy will be supervised by the Director of Veterinary Services (DVS), and coordinated by a National Coordinator appointed by the Minister of Livestock, Fisheries and Animal Industries. Because of the multitude of stakeholders and administrations necessary for a successful implementation of a control strategy, a National Consultative Committee for the Control of FMD will be created by Order of the Prime Minister.
The NCCC-FMD will comprise representatives of stakeholders and implementation partners such as:

- The Minister of Livestock, Fisheries and Animal Industries (Chairperson)
- The Director of Veterinary Services (Vice-Chairperson)
- The National Coordinator of the Control Strategy(Scribe)
- The General Manager of the National Veterinary Laboratory
- The President of the National Veterinary Council
- A representative of the Ministry of Defence
- A representative of the General Delegation for National Security
- A representative of the Ministry of the Economy, Planning and Regional Development
- A representative of one State faculty of Veterinary Medicine.
- A representative of the Ministry of Scientific Research
- A representative of the Ministry in charge of Wildlife
- Senior representatives of farmer groups or organizations
- Other technical experts, as required (with observer status).

The national coordination for the implementation of the strategy will comprise;

- A national coordinator
- A disease control specialist
- An epidemiologist
- An administrative and finance expert
- An accountant.

The national coordination for the control of FMD will have the following functions:

- implementing the disease control policies decided by the DVS and the NCCC-FMD;
- directing and monitoring the operations of regional coordinations;
- maintaining up-to-date lists of available personnel and other resources, and details of where further resources may be obtained;
- deploying staff and other resources to the regional coordinations;
- ordering and dispersing essential supplies, including vaccines if they are to be used;
- monitoring the progress of the campaign and providing technical advice to the DVS;
- advising the DVS on the definition and proclamation of the various FMD control zones;
- maintaining up-to-date lists and contact details of risk hot spots;
- liaising with other groups involved in the emergency response, including those that may be activated as part of the National Disaster Plan;
- preparing international disease reports and, at the appropriate times, cases for recognition of zonal or national freedom from the disease;
- managing farmer awareness and general publicity programmes, including press releases, and creating a public relations centre to liaise with the media;
- General and financial administration, including record-keeping.

2.1. LEGISLATION

The Cameroonian legislation already has provisions which:

- make FMD and other proclaimed animal diseases compulsorily notifiable;
- allow the entry of officials (or other designated persons) on to a farm or other livestock enterprise for disease surveillance purposes (including the collection of diagnostic specimens) and to carry out any other approved disease control actions;
- authorize the proclamation of infected and disease control zones;
- authorize the quarantining of farms or other livestock enterprises;
- authorize bans on the movement of livestock, livestock products or other potentially contaminated materials, or the issue of permits to move these only under specified animal health conditions;
- authorize the compulsory destruction and safe disposal of infected or potentially infected animals and contaminated or potentially contaminated products and materials, subject to fair compensation and cleaning and disinfection of properties;
- authorize the destruction of feral animals and uncontrolled/ poorly controlled livestock.

Specific legislation should be adopted and enforced to:

- provide for compensation to be paid to owners of livestock and property destroyed as part of disease control programmes and define standards for such compensation;
- allow zoosanitary codes of practice to be mandated for risk enterprises and activities (e.g. livestock markets, abattoirs and dairy factories) and authorize any necessary disease control actions;
- authorize the compulsory vaccination of animals; authorize the compulsory identification of animals, where appropriate; authorize other justifiable and necessary disease control actions.

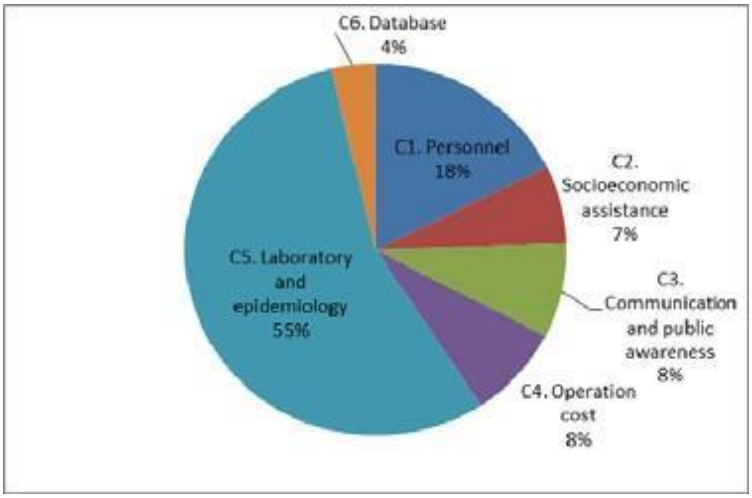
Due to the near-unrestricted exchange of livestock and animal products under free trade pacts within the ECCAS, efforts will be made to bring the other member states to prepare and implement same measures. This could be done through CEBEVIRHA, which could adequately and efficiently coordinate a sub-regional FMD control strategy/programme.

2.2. BUDGET

The cost of the activities foreseen under the Global FMD Control Strategy has been comprehensively calculated with the support of experts from the World Bank. The cost of the Global Strategy for the initial five years of the programme would be US $ 820 million, of which US $ 762 million (93%), US $ 47 million (6%) and US $ 11 million (1%) are attributable to the country, regional and global levels respectively. The vaccination cost of US $ 694 million is by far the largest component of the cost.

The global strategy further carried out a comprehensive analysis taking into consideration the experiences of 79 PCP 0-2 countries. The figure 8.4 depicts the prioritization of activities excluding vaccination and distribution of allocated funds.

Figure A8.4: Prioritization of activities besides vaccination and distribution of allocated funds. (FAO and OIE, 2012)



2.2.1. INITIAL 5 YEAR COST OF FMD CONTROL WITHOUT VACCINATION AT COUNTRY LEVEL

The average initial 5 year cost of FMD control without vaccination, equivalent to PCP levels 0-2 is estimated at 68 million US $, while the average cost for Africa is placed 34 million US $. Based on these estimates and the activities prescribed in this strategy, the figure below presents a comprehensive estimate of the cost of FMD control without vaccination, equivalent to PCP levels 0 to 2 and transition to PCP level 3 (see table A8.1)

Table A8.1: Cost of the first five years of the Cameroon strategic plan.

No	Category	Sub-category	Estimated cost (FCFA)
1	Personnel	Salary for a national coordinator Salary for a disease control specialist Salary for a epidemiologist Salary for a administrative and finance expert Salary for an M&E expert Salary for auxiliary staff	90 000 000 60 000 000 60 000 000 48 000 000 48 000 000 60 000 000
2	Socioeconomic assistance	Description of animal husbandry systems value chains analysis, socioeconomic studies, and analysis of FMD impacts.	142 380 000
3	Communications and public awareness	Communication and public awareness	162 720 000
4	Operations costs	Office equipments Vehicles Unforseen	46 490 000 90 000 000 26 230 000
5	Laboratory and epidemiology	Purchase/Replacement of machine, equipment and warranty Annual cost for equipment, quality assurance and training Local labour for sample collection Local labour for sample laboratory testing Cost of laboratory testing Sampling material In-country training for field staff	132 006 600 327 779 100 48 104 100 29 086 200 97 326 900 54 816 300 274 081 500

		Travel expenses to participate in regional wet laboratory trainings Travel expenses to participate in regional calibration trainings Proficiency panel and shipping costs Database including user training and maintenance	30 204 900 26 848 800 26 848 800 71 596 800
	TOTAL		2 034 000 000

2.2.2. THE COST OF VACCINATION

As with the global strategy, the Cameroon strategy assumes vaccination will begin in the first year of PCP stage 2, targeting ruminants at critical points and high risk groups. It also assumes that Cameroon will identify a reiable good quality vaccine source with average price of $1 per dose and that each animal will be vaccinated twice per year. The money includes cost for PVM. The global strategy estimates the average cost in Africa at $138 million, with $0 at stage 0, 23,3% at stage1, 10% at stage 2 and 66,7% at stage 3. The global strategy estimates the average vaccination cost per country at $15 million. The table below presents the average vaccination cost as proposed for Cameroon.

Table A8.2: Cost of vaccination including PVM

PCP Stage	Cost of vaccination (FCFA)
1	1.747.500.000
2	750.000.000
3	5.002.500.000

Therefore the total cost of the first five years of the strategy including vaccination is estimated at 4.531.500.000 (Four Billion five hundred and thirty-one million five hundred thousand) FCFA.