Guidelines to assess the economic effects and non-commercial and environmental consequences of the entry of pests

COSAVE

STDF Standards and Trade Development Facility

IICA

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SCOPE

The scope of these Guidelines is to provide COSAVE with clear and comprehensive procedures to assess the economic effects and non-commercial and environmental consequences of the entry of pests in line with ISPM 11 of the IPPC. They are applicable at the national, regional and local level.

These Guidelines allow the assessment of different scenarios:

- The pest is not yet present in the pest risk analysis (PRA) area.
- The pest is already present in the PRA area but still meets the requirements of a quarantine pest.
- The comparison of the situation where the pest is controlled versus the situation where the pest is not controlled.
- The comparison of different control methods.

The possibility to compare the different scenarios also allows the assessment of costs and benefits regarding the different situations in order to find out whether control is appropriate.

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ACRONYMS

BTM	Benefit transfer method
CBD	Convention on Biological Diversity
CBA	Cost-Benefit Analysis
COSAVE	Southern Cone Plant Health Committee
EFSA	European Food Safety Authority
ES	Ecosystem services
FAO	Food and Agriculture Organization of the United Nations
IPPC	International Plant Protection Convention
ISPM	International Standard for Phytosanitary Measures
MEA	Millennium Ecosystem Assessment
PRA	Pest risk analysis

1. INTRODUCTION

Prevention and protection are important elements in plant health, also because eradication and containment are often much more cost intensive than prevention. A focused impact assessment methodology helps the risk assessor to conduct the assessment in a structured and reproducible way. Traditionally, decisions on management measures, ranging from measures to prevent new introductions to control measures (including eradication, containment, and adaptation of cropping systems) have been mainly based on economic arguments. However, recent outbreaks (e.g., *Halyomorpha halys, Huanglongbing*) emphasize the importance of social and environmental impacts of pests being assessed to inform decision-making. The need to consider all impacts, combined with an increase in public awareness, will help to reduce risks and improve fast and appropriate action.

The entry, establishment and spread of the pest in the territory in question (the PRA area), or, if present but not widely distributed, in the part of the territory where it is absent, should have an unacceptable economic, social and/or environmental impact on the territory or the part of the territory where it is not widely distributed.

For such a comprehensive impact assessment, new concepts are needed that are in line with ISPM 11 but that allows a better focused, more concrete or more accurate assessment. These new concepts are provided in these Guidelines and include a rating system, the use of scenarios for the impact assessment and the assessment of ecosystem services (ES).

The literature provides several definitions for ES (Costanza, 2008; Fisher and Kerry Turner, 2008; Fisher et al., 2009; Wallace, 2007). The most general was proposed by The Millennium Ecosystem Assessment (MEA, 2005): "*Ecosystem services are the benefits people obtain from ecosystems…*". Each of these definitions has different classifications. In these Guidelines we follow the one proposed by MEA (2005), which differentiates between provisioning (i.e., fresh water, food, raw material), regulating (i.e., local climate, air quality, carbon sequestration), cultural (i.e., recreation, tourism, spiritual experience), and supporting (i.e., habitat, genetic diversity) ecosystem services.

Effective management of plant health risks requires a systematic approach that balances costs and benefits and provides a justification for measures. This can be done through the Cost-Benefit Analysis (CBA). The CBA accounts for all the costs and all the benefits of a project, to assess whether this project is beneficial for society. To compare the costs and benefits, a common unit of measure is needed: in this case, money. Thus, the main challenge of any CBA analysis is the monetary representation of project impacts.

There are different methods to account for project impacts (costs and benefits), and its use will depend on the information level. Some of those impacts (costs and benefits) can be assessed using market information, for instance, the pest impact on export value can be computed as the producer's profit loss (international market price multiplied by quantity loss).

However, there are other impacts that cannot be assessed using market information, for instance, the impact on tourism activities in natural areas due to a pest

outbreak. In this case, the cost for the society cannot be computed as the area administration income lost due to a decrease in visitors' number, as the entry fee does not account for the welfare gains from visiting the area. In this case, other useful valuation methods are:

- Indirect methods using market information (revealed preferences): residual value, avoided cost, induced cost, travel cost, production function.
- Indirect methods using surveys (stated preferences): contingent valuation, choice experiment.
- Benefit transfer method.

Another important reason for having a focused impact assessment, through CBA, is to justify the use of public money and to better ensure it is appropriately used.

The results of the impact assessment should be presented in an understandable, comprehensive way and be communicated appropriately. This helps risk managers, stakeholders and the public to understand why management measures may be needed.

2. RATING SYSTEM

The risk assessment can be based on different scenarios, which should be established by the assessor when designing the assessment. These scenarios may be the current situation (with pest present), the situation where no mitigation measures are applied, or the situation where a maximum of management measures are applied.

The current situation with the pest present may either be the situation in which a pest is already present in the PRA area in low prevalence and under official control (i.e., certain measures are already applied, the pest still meets the requirements of a quarantine pest), or if an assessment is made for a pest that is not yet present, this would mean that the assessor projects a situation, where the pest is introduced into the PRA area, where it has a negative impact. This means that when assessing a pest that is not yet present in the PRA area, predictions need to be made based on information on areas where the pest is already present. Then it could be assessed what would happen without any management measures, with a minimum of measures, and/or with a maximum of measures. The scenarios should be chosen depending on what the risk manager wants to know.

Note also that economic consequences appear over time, and may be experienced in one year, several years or over an indeterminate period, which may be assessed in various scenarios. The choice of the scenarios depends on the questions the assessor needs to address in the risk assessment.

The questions provided in these Guidelines should be rated by using the tables provided.

The estimations are distributed between four different ratings, from Minimal to Massive. If the assessor is completely sure that the rating is moderate (5-20% of crop loss, for example), the field of moderate is filled with 100 and the remaining fields with 0. If the assessor is completely unsure, every rating is filled with 25 (see the examples in the table). The estimations that are provided need to be justified.

Question						
Rating		Scenario				
		E0	E1	E2	E3	En
Insignificant	0 - 4.9%	25	0	50	75	
Moderate	5–19.9%	25	100	25	25	
Major	20–49.9%	25	0	25	0	
Massive	50–100%	25	0	0	0	
Sum of ratings		100%	100%	100%	100%	100%

Justification: [The justification for the ratings should be based on the answers to the different questions above]

3. IMPACT ASSESSMENT

The impacts of the pest should be assessed in this section. In ISPM 11, effects are separated into direct and indirect effects. However, for these Guidelines it was appropriate convenient to carry out the impact assessment, taking into account three main dimensions: production, economic and socioecological.

The production dimension includes information about the consequences of the pest on production (i.e., expected impacts on yields); the economic dimension provides an economic meaning to impacts on production (i.e., expected impacts on production value, exports and domestic markets). Finally, the socioecological dimension complements the other two by including environmental and social impacts.

3.1. IMPACT ON PRODUCTION

In this section, the expected effects on production of each scenario should be analyzed by considering the following aspects:

- Considering the results from the section related to host plants of the COSAVE PRA Guidelines, are any of these hosts of economic importance (including those in the field, under protected cultivation or growing in the wild)? If so, provide data to show their relevance.
- Are some host species more susceptible than others?

Note: "Susceptible" is used differently from "main hosts"—see, e.g., 3.4.2 of ISPM 11, or 1.1.1 of ISPM 2, e.g., for the Asian Longhorned beetle, most or at least many deciduous tree species are susceptible, many are main hosts, but acer is most susceptible.

These Guidelines use the following definition for susceptible hosts:

Species capable of providing, increasing or accelerating invasion and development of the pest in host tissue. From a biochemical perspective, susceptible plants also resist infection, but the speed or intensity of the response is inadequate, and the pest is capable of progressively colonizing the plant. (Own elaboration based on definition of resistant species).

It may be sufficient to focus only on the most susceptible host plants and ask:

- What are the types and the level of damage caused by the pest, and how often does damage occur?
- Does the pest cause crop losses, in yield and quality? If so, how much? What revenue losses can be expected?
- Are there biotic factors (e.g., adaptability, virulence, mobility of the pest, rate of reproduction and spread, number of life cycles) that may affect damage and losses? If yes, list them.
- Are there abiotic factors (e.g., climate, crop rotation) that may affect damage and losses? If yes, list them.

Estimation of damage and crop losses						
Rating		Scenario				
		E0	E1	E2	E3	En
Insignificant	0–4.9%					
Moderate	5–19.9%					
Major	20–49.9%					
Massive	50–100%					
Sum of ratings		100%	100%	100%	100%	100%

Justification: [The justification for the ratings should be based on the answers to the different questions above]

3.2. ECONOMIC IMPACT

The economic effects refer to both the (public and private) cost to control the pest and the impacts on producers' income. In most of the cases, it would not be possible to obtain information about the specific case study, for instance, specific pest information (yield impacts) for the specific area needed (some country in COSAVE Region). As finding this information is costly, in terms of time and economic resources, the benefit transfer method (BTM) is a solution to provide a first assessment of the problem.

The BTM involves the use of existing data or information in settings other than for what it was originally collected (Rosenberger and Loomis, 2003). BTM differentiates between the study site (the original site in which the study was conducted) and the policy site (the place in which the values will be transferred). Besides, BTM considers two different ways of transferring[1]:

- Value transfer: considers the direct application of the original research result (willingness to pay, elasticities) to the policy site.
- Function transfer: considers the transfer of the statistical (behavioral) model used in the study site.

The analysis should be conducted considering the following topics for pest control:

- What measures exist for control of the pest, would eradication or containment of the pest be feasible? What is their efficacy and cost?
- What effect might the pest have on existing production practices and on costs that could arise from additional practices in the PRA area? Consider changes in production methods and associated costs.
- Would resources be needed for additional research and advice? If yes, estimate how much. Take into account, e.g., salaries for researchers, material.

1 The different steps needed for each case are summarized by Rosenberger and Loomis (2003).

Estimation of costs caused by the pest if present or introduced						
Rating		Scenario				
		E0	E1	E2	E3	En
Insignificant	0 - 4.9%					
Moderate	5–19.9%					
Major	20–49.9%					
Massive	50–100%					
Sum of ratings		100%	100%	100%	100%	100%

Justification: [The justification for the ratings should be based on the answers to the different questions above]

As stated above, other economic impacts are related to changes (positive or negative) on producers' income. In this case, the assessment should consider the following topics:

- How likely is an introduction of the pest to cause effects on domestic markets?

Estimation of effects on domestic markets caused by the pest if present or introduced						
Rating		Scenario				
		E0	E1	E2	E3	En
Insignificant	0 - 4.9%					
Moderate	5–19.9%					
Major	20–49.9%					
Massive	50–100%					
Sum of ratings		100%	100%	100%	100%	100%

- How likely is an introduction of the pest to cause effects export markets, including in particular export market access? The potential consequences for market access which may result if the pest becomes established should be estimated, including the extent of any phytosanitary regulations imposed (or likely to be imposed) by trading partners.

Estimation of effects on export markets caused by the pest if present or introduced						
Rating		Scenario				
		E0	E1	E2	E3	En
Insignificant	0 - 4.9%					
Moderate	5–19.9%					
Major	20–49.9%					
Massive	50–100%					
Sum of ratings		100%	100%	100%	100%	100%

Justification: [The justification for the ratings should be based on the answers to the different questions above]

- Could introduction of the pest cause changes to domestic or foreign consumer demand for a product resulting from quality changes, loss of marketability, and/or diversion of the product to a lower value end-use?

Estimation of effects on consumer demand caused by the pest if present or introduced						
Rating		Scenario				
		E0	E1	E2	E3	En
Insignificant	0 - 4.9%					
Moderate	5–19.9%					
Major	20–49.9%					
Massive	50–100%					
Sum of ratings		100%	100%	100%	100%	100%

Justification: [The justification for the ratings should be based on the answers to the different questions above]

3.3. SOCIOECOLOGICAL IMPACT

The socioecological impact assessment will focus on the environmental and the social consequences of the pest. For the environmental impact, it is important that these should result from effects on plants, whether direct or indirect. Such effects may be less significant than pest effects on other organisms or systems, but the regulation of pests solely on the basis of effects on other (non-plant) organisms or systems (e.g., human or animal health) is beyond the scope of ISPM No. 11. In this case, the assessment should consider the following aspects:

- Could the pest cause reduction, displacement or elimination of important or native plant species, or key components in an ecosystem (in terms of abundance, size or economic importance)?

Estimation of effects on native plant species or key components in an ecosystem caused by the pest if present or introduced						
Rating		Scenario				
		E0	E1	E2	E3	En
Insignificant	0 - 4.9%					
Moderate	5–19.9%					
Major	20–49.9%					
Massive	50–100%					
Sum of ratings		100%	100%	100%	100%	100%

Justification: [The justification for the ratings should be based on the answers to the different questions above]

- How likely is the pest to have significant effects on plant communities through competition for resources?
- How likely is the pest to have significant effects on environmentally protected areas?
- How likely is the pest to have significant environmental and other undesired effects due to control measures?

Note: these could be effects on other, non-target species, impacts on animal health, etc.

- How likely is the pest to create costs associated with environmental restoration?

Use the table below to estimate such effects—either summarize the effects (and explain in the justification what you have rated) or use different tables for different aspects if deemed necessary.

Estimation of other environmental effects caused by the pest if present or introduced						
Rating		Scenario				
		E0	E1	E2	E3	En
Insignificant	0 - 4.9%					
Moderate	5–19.9%					
Major	20–49.9%					
Massive	50–100%					
Sum of ratings		100%	100%	100%	100%	100%

Justification: [The justification for the ratings should be based on the answers to the different questions above]

- Does the pest have significant impacts on ecosystem services? If yes, on which ones? List them and identify those that are most affected.

Note: Ecosystem services are the benefits that human beings obtain from the natural environment and from well-functioning ecosystems. They can be grouped into four different categories: provisioning services, such as the production of food, fiber and clean water; regulating, such as the control of climate, erosion and diseases; supporting, such as nutrient cycles and pollination; and cultural, such as spiritual and recreational benefits.

Estimation of effects on ecosystem services in an ecosystem						
Rating		Scenario				
Insignificant	0 - 4.9%					
Moderate	5–19.9%					
Major	20–49.9%					
Massive	50–100%					
Sum of ratings		100%	100%	100%	100%	100%

Justification: [The justification for the ratings should be based on the answers to the different questions above]

When assessing the social impacts, you may take into consideration the following aspects:

- Loss of employment.
- Effects on migration.
- Loss of real estate.
- Effects on tourism, loss of income in hotels
- Effects on cultural events for specific crops (e.g., vineyard celebrations).
- Risks for human health and adverse effects on human well-beings (e.g., for *Halyomorpha halys*, bad smell).
- Reduction or loss of available plants with cultural purposes, cultural heritage.
- Impact on consumption habits–healthy food, vegetables, adverse effects on diets.
- Need of education syllabus of schools for certain crops (e.g., HLB included in the school syllabus to teach about the pest).
- Negative effects on organic farming.
- Loss of confidence (e.g., for an NPPO, effects on credibility of an organization).

Estimation of social impacts						
Rating		Scenario				
		E0	E1	E2	E3	En
Insignificant	0 - 4.9%					
Moderate	5–19.9%					
Major	20–49.9%					
Massive	50–100%					
Sum of ratings		100%	100%	100%	100%	100%

Justification: [The justification for the ratings should be based on the answers to the different questions above]

4. CONCLUSION OF THE IMPACT ASSESSMENT

If appropriate, the output of the assessment of economic, environmental and social impacts described in these Guidelines should be expressed as monetary values. If not appropriate or not feasible, the economic consequences can also be expressed in qualitative or quantitative terms without monetary values. Sources of information, assumptions and methods of analysis should be documented thoroughly.

4.1. OVERALL ASSESSMENT OF IMPACTS

Based on the ratings given under section 3, provide an overall assessment of impacts. Where are the highest, where the lowest ratings? Compare also the impacts estimated for the different scenarios. Furthermore, consider what additional information would be useful for completing this section and where it might be obtained.

4.2. OVERALL ASSESSMENT OF UNCERTAINTY

The level of uncertainty can be identified based on the distribution of ratings over the four scores.

For every question, you can make a conclusion about the uncertainty. From this, the global uncertainty can then be deduced, whether it is high, medium, or low, depending on how many times questions were rated as having a high, medium or low uncertainty.

E.g.,	**25**	**25**	**25**	**25**	**high**
	10	**70**	**10**	**10**	**medium**
	50	**50**	**0**	**0**	**medium**
	0	**0**	**50**	**50**	**medium**
	0	**100**	**0**	**0**	**insignificant/no uncertainty**

The uncertainties should be commented and recommendations may be provided on how to reduce them (e.g., through research or further data collection).

4.3. CONCLUSION REGARDING ENDANGERED AREAS

The endangered area is the part of the PRA area in which ecological and other conditions favor the establishment of a pest whose presence will result in economically important losses. To define the endangered area, the results of the assessments of potential distribution and potential impacts need to be taken into account. The endangered area may be all or part of the PRA area.

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GLOSSARY

Biodiversity: the variety of living organisms and the ecological complexes of which they are part (Harrington et al., 2010).

Cultural service: non-material benefits obtained from ecosystems (Harrington et al., 2010).

Ecosystem: a dynamic complex of plant, animal and microorganism communities and their nonliving environment interacting as a functional unit (MEA, 2003).

Ecosystem services: benefits that humans recognise as obtained from ecosystems that support, directly or indirectly, their survival and quality of life; ecosystem services include provisioning, regulating, supporting and cultural services (EFSA, 2010).

Environmental risk assessment: a process of predicting whether there may be a risk of adverse effects on the environment caused by the presence of a pest (EFSA, 2010).

Genetic diversity: genetic variation between and within species. This can be characterised by the proportion of polymorphic loci (different genes whose product performs the same function within the organism), or by the heterozygous individuals in a population. (Frankham et al., 2002)

Impact/consequence: a measure of whether the changes in the state variables have a negative or positive effect on individuals, society and/or environmental resources. The state variables are the collection of variables that describe the whole of the social-ecological system, including the attributes of ecosystem service beneficiaries (ESBs) and the attributes of ecosystem service providers. There is an impact if the state no longer equates to service provision (Harrington et al., 2010).

Pest: any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products (FAO, 2009).

Provisioning services: products obtained from ecosystems (Harrington et al., 2010).

Regulating services: benefits obtained from regulation of ecosystem processes (Harrington et al., 2010).

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