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Guidelines on Pest Risk Analysis
Lignes directrices pour l'analyse du risque phytosanitaire

Decision-support scheme for quarantine pests

Specific scope

This standard is based on the ISPM N° 11 *"Pest Risk Analyses for Quarantine Pests including analysis of environmental risks and living modified organisms"*. It provides detailed instructions, for the following stages of pest risk analysis (PRA) for quarantine pests: initiation, pest categorization, probability of introduction, assessment of potential economic consequences and pest risk management. It provides a scheme based on a sequence of questions for deciding whether an organism has the characteristics of a quarantine pest, and if appropriate to identify potential management options. The scheme can also be used for PRAs initiated by the identification of a pathway or the review of a policy. Expert judgement may be used in answering the questions.

Specific approval and amendment

Version N° 05.
Approved in 2011-09.

Introduction

The EPPO decision-support scheme for quarantine pests is intended to be used to assess the potential importance of a particular pest for a clearly defined area (the PRA area). The PRA area may be the whole EPPO region or part of it or whole or part of several countries.

The scheme concentrates on the assessment of individual pests; if a risk assessment is being performed on a particular pathway, the scheme can be used once the individual pests likely to be associated with the pathway have been identified.[1]

The scheme provides detailed instructions for the following stages of pest risk analysis: initiation, pest categorization, probability of introduction, potential economic consequences and pest risk management.
Pest risk assessment is divided into two major sections. The assessment in section A is in the form of a binary decision tree, constructed from a sequence of questions based largely on decision points with two alternative options. If the scheme leads to the conclusion that an organism has the necessary characteristics of a quarantine pest, the pest is then evaluated in greater detail, in section B. From this evaluation, it should be possible to arrive at a conclusion concerning the level of 'pest risk' presented by the pest. This conclusion can then be used in the pest risk management phase to determine whether the risk is acceptable, and, to identify management options. Before beginning the pest risk management stage or at certain points throughout the process, it may be advisable to consult other interested bodies. For example, discussions may be needed with the exporters to determine what is possible, with the importers to clarify what is cost-effective, with government officials concerning international trade issues and with

[1] In the case of a detection of a pest in an imported consignment, it may be necessary first to make a rapid evaluation (i.e. within the time that the consignment can be detained) and, for this purpose, EPPO Standard PM 5/2 Pest risk analysis to decide immediate action to be taken on detection of a pest in a consignment should be followed. Such a process will only allow a decision as to what action to take with regard to the consignment in question (e.g. destruction, treatment, return to origin, no action, etc.). It may be followed by a full PRA in order to decide on permanent measures.

pest-control experts to determine which methods of control are available, their efficacy and the extent to which eradication is possible.

Information requirements
Before beginning the PRA, information should be collected on the various characteristics of the pest that will be evaluated in the procedure. EPPO Standard PM 5/1(1): "*Check-list of information required for pest risk analysis*" provides an aide mémoire to indicate which information will be of relevance. For pathway initiated risk analysis a list of the pests likely to be associated with the pathway (e.g. carried with the commodity) may be generated by any combination of official sources, databases, scientific and other literature, or expert consultation. It is preferable to prioritize the listing, based on expert judgement on pest distribution and types of pests.

A preliminary evaluation may be done using any information already available to make a clear decision immediately one way or the other. In particular, if a high risk is immediately identified for one or more important pathways or important hosts, it may be superfluous to search for information for and reply to other questions, or to consider other pathways or hosts. Expert judgement will be used to decide this, and the preliminary assessment will thus provide guidance on the information which will be needed for the full assessment. On the other hand, it can quickly be obvious in section A that a particular pest does not have all the essential characteristics for being a quarantine pest, so that there is no purpose in continuing with a full assessment.

In going through the scheme, the assessor will probably find that certain questions cannot be answered. This may be because the question is not relevant in the particular case (N/A), in which case the question can be ignored and the absence of a reply will not affect the value of the pest risk assessment. Alternatively, it may prove impossible to obtain the information, in which case its absence will to a certain degree reduce the value of the assessment depending on the importance of the question. A meaningful PRA cannot be performed without adequate information, and at the end of this scheme the assessor is asked to indicate whether the quantity and quality of the information was satisfactory.

In cases where particular information is lacking about a pest, useful information may sometimes be obtained by reference to closely related organisms. Where such indirect information is used, this should be recorded during the assessment and taken into account in the final evaluation

Documentation
It is important for any possible future re-evaluation of the PRA that all steps of the procedure should be fully documented, indicating who performed the evaluation, how each decision was reached and on what information it was based. It is also important to indicate the date on which the information was collected in case subsequent data on the pest may influence the final decision. Any uncertainties regarding data or conclusion should be noted. Templates with a table format have been developed for preparing a PRA[2]. A computerised version of the scheme is in preparation. A report of the pest risk analysis should be produced following the format for reporting PRA available on the EPPO website [2].

Special situation of pest plants
The organism undergoing PRA may be a pest plant. Pest plants may be primarily damaging to crops and managed vegetation, in which case they are generally referred to as “weeds”. Weeds do not have “host plants”, but the damage they do can be evaluated economically in similar terms to those used for pest animals or microorganisms. Apart from their effects on cultivated plants, weeds may also have effects on the environment. A few pest plants may be primarily damaging to natural or semi-natural vegetation. These are often referred to as “invasive”. Their effects are on the environment (including indirect effects on man and animals). Although they can be evaluated in economic terms, they are generally described in qualitative terms. Other pest plants are directly parasitic on a host plant; these can be assessed in the PRA in the same way as plant pathogens.

[2] http://www.eppo.org/QUARANTINE/Pest_Risk_Analysis/PRA_intro.htm

Like pest animals and microorganisms, pest plants may be introduced accidentally, especially as seeds or other propagules contaminating various imported commodities. However, it is a particular feature of plants that they are very often intentionally imported, for agricultural or horticultural purposes. In that case, the pathway of entry ceases to be of interest for PRA. Instead the analysis is concerned with the pathway from the "intended habitat" (where the plant does not necessarily establish, but may simply be sustained by human activity) to various possible "unintended habitats", where it may establish.

Pest animals and microorganisms are often known by the analyst to be pests before the start of the PRA. The same is true for many weeds and invasive plants. However, most plants are not pests, and the PRA should establish this quickly and simply. It should be noted that cases are known of plants which are not harmful in their native area, but become weedy or invasive when introduced into new areas. Newly bred or selected ornamentals may also have potential for harm.

For definitions of terms used in this decision support scheme see FAO (2010) *Glossary of phytosanitary terms*. ISPM no. 5. IPPC Secretariat, FAO, Rome (IT).
https://www.ippc.int/file_uploaded/1273490046_ISPM_05_2010_E.pdf [accessed on 01 June 2011].

Acknowledgements
This scheme has been developed over the years by the Panel on PRA development. Revised versions are based on the experience with the scheme in individual countries, in EPPO Expert Working Groups for performing PRA, as well as in training workshops for PRA. Some recent modifications result from suggestions made by the Panel on Plant Health of the European and Food Safety Authority.
This new revised version has been prepared in the framework of the European Union 7th Framework Programme project PRATIQUE (Grant Agreement No. 212459).

Computerized version of the EPPO Decision Support Scheme for PRA
In the framework of the PRATIQUE project, a computer programme named CAPRA has been developed by the EPPO Secretariat to assist pest risk analysts in running the EPPO decision-support scheme for Pest Risk Analysis (PRA), and other decision-support schemes. It presents all questions included in the decision support scheme in a user friendly interface. In order to improve consistency across risk assessors and pests, guidance and examples are provided for many questions as well as tools (e.g. matrix models for combining scores taking into account uncertainty). For some questions, link to relevant databases are included.
The software can be downloaded at the following address: http://capra.eppo.org/download.php
A manual for user can also be downloaded on this link.

Stage 1: Initiation

The aim of the initiation stage is to identify the pest(s) and pathways which are of phytosanitary concern and should be considered for risk analysis in relation to the identified PRA area.

1.01 Give the reason for performing the PRA

The PRA may be initiated for one or several reasons, the most common being:
PRA initiated by the identification of a pathway:

- international trade is initiated in a commodity not previously imported into the country, or a
- commodity from a new area or new country of origin;
- new plant species are imported for breeding or research purposes;
- a pathway other than a commodity import is identified (natural spread, packing material, mail, garbage, passenger baggage, etc).
- a Systems Approach or other management change is proposed for an international trade,

In such cases, a list of pests likely to be associated with the pathway should be generated and preferably prioritized, based on pest distribution, pest status and expert judgment. For more guidance on pathway analysis see Appendix XX (in preparation).

PRA initiated by the identification of a pest:

- an established infestation or an incursion of a pest has been discovered in the PRA area;
- a pest has been detected in an imported consignment;
- a pest has been identified as a risk by scientific research;
- a pest has invaded a new area, other than the PRA area;
- a pest is reported to be more damaging in a new area than its area of origin;
- a pest is observed to be detected more frequently in international trade;
- a request is made for the intentional import of a pest;
- a previous PRA is being re-evaluated;
- an organism has been identified as a vector for other pests.

In some cases, a PRA may be initiated as above by an organism which is not known to be a pest, but whose pest potential in the PRA area needs to be evaluated.

PRA initiated by the review or revision of a policy:

- phytosanitary regulations are being revised, e.g. following a national decision or new information on treatments or processes;
- a proposal made by another country or by an international organization (RPPO, FAO) is assessed;
- a dispute arises on phytosanitary measures.

Go to 1.02

1.02 a. Specify the pest or pests of concern and follow the scheme for each individual pest in turn. For intentionally introduced plants specify the intended habitats.

1.02 b. Specify the pathway of concern and identify the individual pests likely to be associated with the pathway and follow the scheme for each individual pest in turn.

1.02 c. If other trigger for the PRA, specify.

If no pest, pathway or trigger of concern has been identified the PRA may stop at this point.

Go to 1.03

1.03 Clearly define the PRA area.

Note: The PRA area can be a complete country, several countries or part(s) of one or several countries. These areas do not need to be contiguous. PRA performed in the EPPO framework concern EPPO member countries.

Go to 1.04

Earlier analysis

The pest, or a very similar pest, may have been subjected to the PRA process before, nationally or internationally. This may partly or entirely replace the need for a new PRA. A PRA may also have been prepared for the same pathway

1.04 Does a relevant earlier PRA exist?

Note: Note that study such as a management or contingency plan, cost-benefit analysis, may also provide useful information for performing a PRA, but can usually not be considered as relevant PRAs.

if yes **Go to 1.05**
if no **Go to 1.06**

1.05 Is the earlier PRA still entirely valid or only partly valid (out of date, applied in different circumstances, for a similar but distinct pest, for another area with similar conditions)?

if entirely valid **End**
if partly valid, proceed with the PRA but compare as much as possible with the earlier PRA **Go to 1.06**
if not valid **Go to 1.06**

1.06 Specify all host plant species (for pests directly affecting plants) or suitable habitats (for non parasitic plants). Indicate the ones which are present in the PRA area.

Note: the taxonomic level at which hosts are considered should normally be the species. The use of higher or lower taxonomic levels should be scientifically justified. The pest should be able to complete its life cycle or multiply on the hosts considered. Some other plant species might also prove to be suitable hosts in the absence of the usual host species. Additionally, it may be appropriate to distinguish between major and minor hosts when answering this question. If the PRA is conducted on a pest which is indirectly injurious to plants through effects on other organisms, these organisms should also be present in the PRA area. Habitats may be considered according to the CORINE land cover classification (see appendix I). It may be useful to consider associations with key-stone or dominant species of plants. For intentionally introduced plants, indicate the unintended habitats.

Go to 1.07

1.07 Specify the pest distribution for a pest-initiated PRA, or the distribution of the pests identified in 1.02b for pathway-initiated PRA.

Go to Stage 2

Stage 2: Pest Risk Assessment

Section A: Pest categorization

At the outset, it may not be clear which pest(s) identified in Stage 1 require(s) a PRA. The categorization process examines for each pest whether the criteria in the definition for a quarantine pest are satisfied. In the evaluation of a pathway associated with a commodity, a number of individual PRAs may be necessary for the various pests potentially associated with the pathway. The opportunity to eliminate an organism or organisms from consideration before in-depth examination is undertaken is a valuable characteristic of the categorization process.

An advantage of pest categorization is that it can be done with relatively little information; however information should be sufficient to adequately carry out the categorization.

There is no need to answer these questions in cases where it is clear from the outset that a full Pest Risk Assessment is required.

Identify the pest (or potential pest)

The identity of the pest (or potential pest) should be clearly defined to ensure that the assessment is being performed on a distinct organism, and that biological and other information used in the assessment is relevant to the organism in question. If this is not possible because the causal agent of particular symptoms has not yet been fully identified, then it should have been shown to produce consistent symptoms and to be transmissible.

In cases where a vector is involved, the vector may also be considered a pest to the extent that it is associated with the causal organism and is required for transmission of the pest.

1.08 Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?

if yes indicate the correct scientific name and taxonomic position — Go to 1.10

if no — Go to 1.09

Note: The taxonomic unit for the pest is generally the species. The use of a higher or lower taxonomic level should be supported by a scientifically sound rationale. In the case of levels below the species, this should include evidence demonstrating that factors such as differences in virulence, host range or vector relationships are significant enough to affect phytosanitary status.

1.09 Even if the causal agent of particular symptoms has not yet been fully identified, has it been shown to produce consistent symptoms and to be transmissible?

if yes — Go to 1.10

if no — Go to 1.19

Determining whether the organism is a pest

1.10 Is the organism in its area of current distribution a known pest (or vector of a pest) of plants or plant products?

if yes, the organism is considered to be a pest — Go to 1.12

if no — Go to 1.11

1.11 Does the organism have intrinsic attributes that indicate that it could cause significant harm to plants?

Note: Some organisms may not be known to be harmful in their area of current distribution, but may nevertheless have the potential to become pests in the PRA area. This possibility may have to be considered in certain circumstances.

if yes or uncertain, the organism may become a pest of plants in the PRA area — Go to 1.12

if no — Go to 1.19

Presence or absence in the PRA area and regulatory status (pest status)

1.12 Does the pest occur in the PRA area?

Note: occurrence: the presence in an area of a pest officially recognized to be indigenous or introduced and/or not officially reported to have been eradicated [FAO, 1990; revised FAO, 1995; formerly occur]. This includes organisms which have been introduced intentionally and which are not subject to containment (notably cultivated plants). Organisms present for scientific purposes under adequate confinement (e.g. in botanic gardens) are not included.

if yes **Go to 1.13**
if no **Go to 1.14**

1.13 Is the pest widely distributed in the PRA area?

Note: a quarantine pest may be 'present but not widely distributed'. This means that the pest has not reached the limits of its potential area of distribution either in the field or in protected conditions; it is not limited to its present distribution by climatic conditions or host-plant distribution. There should be evidence that, without phytosanitary measures, the pest would be capable of additional spread. If the pest is present but not widely distributed in the PRA area, it may already be under official control, with the aim of eradication or containment. If it is not already under official control and if the conclusion of this PRA is that it should be regulated as a quarantine pest, then the pest should also be placed under official control.

if not widely distributed **Go to 1.14**
if widely distributed **Go to 1.19**

Potential for establishment and spread in the PRA area

For a pest to establish, it should find host plants or suitable habitat in the PRA area. Natural hosts should be of primary concern but, if such information is lacking, plants which are recorded as hosts only under experimental conditions or accidental/very occasional hosts may also be considered. The pest should also find environmental conditions suitable for its survival, multiplication and spread, either in natural or in protected conditions.

1.14 Does at least one host-plant species (for pests directly affecting plants) or one suitable habitat (for non parasitic plants) occur in the PRA area (outdoors, in protected cultivation or both)?

Note: if the PRA is conducted on a pest which indirectly affects plants through effects on other organisms, these organisms should also be present in the PRA area. Some pests require more than one host plant species to complete their life cycle and this should be taken into account when answering this question.

if yes **Go to 1.15**
if no **Go to 1.19**

1.15 If a vector is the only means by which the pest can spread, is a vector present in the PRA area?
(if a vector is not needed or is not the only means by which the pest can spread go to 16)

Note: if a vector is the only natural means by which the pest can spread and when it is absent from the PRA area, a separate PRA to determine the risk of introduction of the vector may be needed.

if yes **Go to 1.16**
if no **Go to 1.19**

1.16 Does the known area of current distribution of the pest include ecoclimatic conditions comparable with those of the PRA area or sufficiently similar for the pest to survive and thrive (consider also protected conditions)?

if yes or uncertain **Go to 1.17**
if no **Go to 1.19**

Potential for economic consequences in PRA area

There should be clear indications that the pest is likely to have an unacceptable economic impact in the PRA area. Unacceptable economic impact is described in ISPM No. 5 Glossary of phytosanitary terms, Supplement No. 2: Guidelines on the understanding of potential economic importance and related terms. Climatic and cultural conditions in the PRA area should be considered to decide whether important economic (including environmental or social) damage or loss to plants may occur in the PRA area. The

effect of the presence of the pest on exports from the PRA area should also be allowed for. In some cases, the pest may only be potentially harmful, as suggested by its intrinsic attributes.

1.17 With specific reference to the plant(s) or habitats which occur(s) in the PRA area, and the damage or loss caused by the pest in its area of current distribution, could the pest by itself, or acting as a vector, cause significant damage or loss to plants or other negative economic impacts (on the environment, on society, on export markets) through the effect on plant health in the PRA area?

Note: "through the effect on plant health" means that the organism should have a direct or indirect effect on plants. ISPM n° 11 states that "*Environmental effects and consequences considered should result from effects on plants. Such effects, however, on plants may be less significant than the effects and/or consequences on other organisms or systems. For example, a minor weed may be significantly allergenic for humans or a minor plant pathogen may produce toxins that seriously affect livestock. However, the regulation of plants solely on the basis of their effects on other organisms or systems (e.g. on human or animal health) is outside the scope of this standard. If the PRA process reveals evidence of a potential hazard to other organisms or systems, this should be communicated to the appropriate authorities which have the legal responsibility to deal with the issue.*"

if yes or uncertain	**Go to 1.18**
if no	**Go to 1.19**

<u>Conclusion of pest categorization</u>

1.18 This pest could present a phytosanitary risk to the PRA area (Summarize the main elements leading to this conclusion)

Go to section B

1.19 The pest does not qualify as a quarantine pest for the PRA area and the assessment for this pest can stop (summarize the main reason for stopping the analysis).

For a pathway analysis, go to 1.02b and proceed with the next pest. If no further pests have been identified the PRA may stop at this point.

Section B: Assessment of the probability of introduction and spread and of potential economic consequences

Note

During pest categorization (Section A), the assessor may have identified factors which have a major influence on the overall evaluation (e.g. the climatic conditions for establishment appear to be critical). In such situations it is recommended that the assessor first considers the questions in section B that are relevant to these factors. Based on the evaluation of such questions, and if the conclusion is that the risk is very low or low, it may not be necessary to answer other parts of the scheme.

This part of the risk assessment process firstly estimates the probability of the pest being introduced into the PRA area (its entry and establishment) and secondly makes an assessment of the likely economic impact if that should happen. From these assessments, it should be possible to estimate the level of risk associated with the pest, which can then be used in the pest risk management phase to determine whether it is necessary to take phytosanitary measures to prevent the introduction of the pest, and if the measures chosen are appropriate for the level of risk.

The evaluation is based on the replies to a series of questions, mostly expressed in the first instance as the choice of an appropriate phrase out of a set of five alternatives (e.g. very unlikely, unlikely, moderately likely, likely, very likely). It is important to identify especially high or especially low risks. The user of the scheme should add to all replies any details which appear relevant indicating the source of information used. In addition the level of uncertainty attached to each answer should be given.

Answer as many of the following questions as possible. If any question does not appear to be relevant for the pest concerned, it should be noted as "irrelevant". If any question appears difficult to answer no judgement should be given but the user should note whether this is because of lack of information or uncertainty.

Probability of introduction and spread

Introduction, as defined by the FAO Glossary of Phytosanitary Terms, is the entry of a pest resulting in its establishment.

Probability of entry of a pest

Identification of pathways

Pathway is defined in the Glossary as "any means that allows the entry or spread of a pest" [FAO, 1990; revised FAO, 1995].

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

Closed pathways may also be considered, as the pests identified may support existing phytosanitary measures. Furthermore, some pathways may be closed by phytosanitary measures which might be withdrawn at a future date. In such cases, the risk assessment may need to be continued. Data on detections in imported consignments may indicate the ability of a pest to be associated with a pathway. For a PRA initiated by the identification of a pathway, this is the main pathway to be considered.

If the PRA is being conducted on a pest that is intentionally imported, e.g. a plant for planting or a biological control agent, and this is the only pathway of entry, an assessment of its entry potential is not required. However, it is still important to record the volume, frequency and distribution of imports (the assessor should answer the following questions of the scheme: 2.05, 2.06 and 2.11). If other pathways of entry also exist, these should be assessed following standard procedures. Spread from the intended habitat to the unintended habitat which is an important judgement for intentionally imported plants is covered by questions 4.01 to 4.03.

2.01 List the relevant pathways.

Note: Relevant pathways are those with which the pest has a possibility of being associated (in a suitable life stage), on which it has the possibility of survival, and from which it has the possibility of transfer to a suitable host. Make a note of any obvious pathways that are impossible and record the reasons.

Examples of pathways are:

- **Plants for planting**
  - plants for planting (except seeds bulbs and tubers)
  - bulbs or tubers
  - seeds
- **Plant parts and plant products**
  - cut flowers or branches
  - fruits or vegetables
  - grain
  - pollen
  - stored plant products
- **Wood and wood products**
  - non-squared wood
  - squared wood
  - bark
  - wood packaging material

Other possible pathways

- soil/growing medium
- agricultural machinery
- passengers
- hitchhiking
- plant waste
- natural spread
- manufactured plant products

It is common practice when performing PRAs to group pathways of similar commodities (e.g. seeds of host plants) except if there is a very good reason to do otherwise (e.g. clear difference in host status of different genus or species, i.e. minor or major hosts).

Go to 2.02

2.02 Select from the relevant pathways, using expert judgement, those which appear most important. If these pathways involve different origins and end uses, it is sufficient to consider only the realistic worst-case pathways. The following group of questions on pathways is then considered for each relevant pathway in turn, as appropriate, starting with the most important.

Go to 2.03

Probability of the pest being associated with the individual pathway at origin.

2.03 How likely is the pest to be associated with the pathway at the point(s) of origin taking into account the biology of the pest?

Note: This question is about the likelihood that the pest may be able to enter the pathway at the point(s) of origin. In order to answer the question, consider the following criteria:
- Is the pest in a life stage that would be associated with commodities, containers, or conveyances?
- For plants do seeds or other propagules have access to commodities,
- Is seasonal timing appropriate for the pest to be associated with the pathway at origin?

very unlikely, unlikely, moderately likely, likely, very likely.

Level of uncertainty:	**Low**	**Medium**	**High**

Go to 2.04

2.04 How likely is the pest to be associated with the pathway at the point(s) of origin taking into account *current management* conditions?

Note: Consider the concentration of the pest on the pathway in the country of origin and the influence of practices), such as plant protection product application (including herbicides for plants), use of specific cultivars, removal of substandard produce, kiln-drying of wood, cultural methods, sorting and cleaning of commodities. Pre-shipment phytosanitary measures already in place that may be efficient against the pest should be considered. Note that practices may change over time.

very unlikely, unlikely, moderately likely, likely, very likely.

Level of uncertainty:	**Low**	**Medium**	**High**

Go to 2.05

2.05 Consider the volume of movement along the pathway (for periods when the pest is likely to be associated with it): how likely is it that this volume will support entry?

Note: This should be estimated on the basis of quantities of the traded commodity, packing materials, persons, baggage, mail and conveyances, on a yearly basis. For natural spread, movement of the pest should be estimated as far as possible (usually little information is available).

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

Go to 2.06

2.06 Consider the frequency of movement along the pathway (for periods when the pest is likely to be associated with it): how likely is it that this frequency will support entry?

Note: This should be estimated on the basis of movements of the traded commodity, packing materials, persons, baggage, mail and conveyances, on a yearly basis. For natural spread, movement of the pest should be estimated as far as possible (usually little information is available).

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

Go to 2.07

Probability of survival during transport or storage

2.07 How likely is the pest to survive during transport or storage?

Note: Consideration should be given to: speed and conditions of transport (including treatments performed during transport); vulnerability of the life-stages likely to be transported (for plants viability of seeds or other propagules, for all pests tolerance of low or elevated temperatures); whether the life cycle is of sufficient duration to extend beyond time in transit. Detection data can be used to indicate the ability of a pest to survive in transit.

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

Go to 2.08

2.08 How likely is the pest to multiply/increase in prevalence during transport or storage?

Note: Some pests do not multiply/increase in prevalence during transport or storage, in this case it should be rated very unlikely.

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

Go to 2.09

Probability of the pest surviving existing pest management procedures

2.09 Under current inspection procedures how likely is the pest to enter the PRA area undetected?

Note: The likelihood of detecting the organism during inspection or testing will depend on a number of factors including:

- ease of detection of the life stages that are likely to be present. Some stages are more readily detected than others, for example insect adults may be more obvious than eggs, growing plants may be more obvious than seeds or bulbs, etc.;
- location of the organism on the commodity - surface feeders may be more readily detected than internal feeders;
- symptom expression - many diseases may be latent for long periods, at certain times of the year, or may be without symptoms in some hosts or cultivars and virulent in others;
- distinctiveness of symptoms - the symptoms might resemble those of other organisms or sources of damage such as mechanical or cold injury;
- the intensity of the sampling and inspection regimes;
- accessibility of the consignment for inspection
- distinguishing the organism from similar organisms

The assessor should bear in mind that such measures could be removed in the future if the other pests were to be re-evaluated.

very unlikely, unlikely, moderately likely, likely, very likely.

Level of uncertainty:	**Low**	**Medium**	**High**

Go to 2.10

Probability of transfer to a suitable host or habitat

2.10 How likely is the pest to be able to transfer from the pathway to a suitable host or habitat?

Note: Factors to consider include:

a) innate dispersal mechanisms or the need for vectors
b) the likelihood that the pest might find suitable hosts and habitats, considering the distribution of the commodity throughout the PRA area. The more scattered the destinations, the more likely it is that the pest might find suitable hosts and habitats.
c) the likelihood that the pest will arrive during the months of the year most appropriate for establishment. Introduction at many different times of the year will increase the probability that entry of the pest will occur at a life stage of the organism or the host suitable for establishment.
d) the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) and how it can affect the transfer of the pest to a suitable host or habitat Some uses are associated with much higher probability of introduction (e.g. planting) than others (e.g. processing). Consider whether the intended use of the commodity would destroy the pest or whether the processing, planting or disposal might be done in the vicinity of suitable hosts or habitats.

Very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

Go to 2.11

2.11 The probability of entry for the pathway should be evaluated

Very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

Go to 2.12

Consideration of further pathways

In principle, all the relevant pathways selected at point 2.01 may in turn be considered. However, the replies given for the pathway(s) so far considered may indicate that it is not necessary to consider any more.

2.12 Do other pathways need to be considered?

if yes **Go back to 2.02 for the next pathway**
if no **Go to 2.13 and then to 3.01**

Conclusion on the probability of entry

2.13 Describe the overall probability of entry taking into account the risk presented by different pathways and estimate the overall likelihood of entry into the PRA area for this pest (comment on the key issues that lead to this conclusion).

Note: The overall likelihood rating for entry should combine the assessments of the individual pathways.

Very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

go to 3.01

Probability of Establishment

For plants which are intentionally imported, the assessment of the probability of establishment concerns the unintended habitat.

Selecting the ecological factors that influence the potential for establishment

Seven factors may influence the limits to the area of potential establishment and the suitability for establishment within this area:

1. Host plants and suitable habitats
2. Alternate hosts and other essential species
3. Climatic suitability
4. Other abiotic factors
5. Competition and natural enemies
6. The managed environment
7. Protected cultivation

Host plants (and suitable habitats) and climate are always influencing the potential of establishment, and will therefore always be taken into account. For the other factors listed here, there is often little or no information available for use by risk assessors and so they cannot be evaluated. In order to identify, which factors need to be considered, use the table to select which of the questions you will answer in detail.

The following table is designed to select only those factors that need to be assessed:

(i) to delimit the area where there is a potential for establishment
- answer YES or NO to the questions in column A

(ii) to determine the suitability of this area for establishment
- answer YES or NO to the questions in column B

No.	Factor	Column A **Is the factor likely to have an influence on the limits to the area of potential establishment?**	Column B **Is the factor likely to have an influence on the suitability of the area of potential establishment?**
1	Host plants and suitable habitats (*see note for Q3.01*)	Answer Q3.01.	Answer Q3.09.
2	Alternate hosts and other essential species (*see note for Q3.02*)	Only if relevant, answer YES OR NO. If YES answer Q3.02. If NO provide a justification.	Only if relevant, answer YES OR NO. If YES answer Q3.10. If NO provide a justification.
3	Climatic suitability (*see note for Q3.03*)	Answer Q3.03.	Answer Q3.11.
4	Other abiotic factors (*see note for Q3.04*)	Answer YES OR NO. If YES provide a justification. If NO provide a justification answer Q3.04.	Answer YES OR NO. If YES answer Q3.12. If NO provide a justification.
5	Competition and natural enemies (*see note for Q3.05*)	Answer YES OR NO. If YES answer Q3.05. If NO provide a justification.	Answer YES OR NO. If YES answer Q3.13. If NO provide a justification.
6	The managed environment (*see note for Q3.06*)	Answer YES OR NO. If YES answer Q3.06. If NO provide a justification.	Answer Q3.14 and 3.15.
7	Protected Cultivation (*see note for Q3.07*)	Answer YES OR NO. If YES answer Q3.07. If NO provide a justification.	Answer YES OR NO. If YES answer Q 3.16. If NO provide a justification.

Summarise the table to list the questions in column A (where you have responded YES) that will now need to be answered to delimit the area of potential establishment and go to question 3.01. Answer only these questions and question 3.08 to identify the area.

Summarise the table to list the questions in column B (where you have responded YES) that will now need to be answered to assess the suitability of the area of potential establishment. Once you have completed Question 3.08, go to question 3.09 and only answer these questions.

In the first sub-section entitled ***Identification of the area of potential establishment***, the questions act cumulatively to delimit the area.
In the second sub-section called ***Suitability of the area of potential establishment***, the suitability of this area is assessed.

Identification of the area of potential establishment

Factor 1 host plants and suitable habitats

3.01 Identify and describe the area where the host plants or suitable habitats are present in the PRA area outside protected cultivation.

Note: For EU cultivated plant hosts consult country production data from FAOSTAT and EUROSTAT. For more detailed crop distribution data use JRC, SEAMLESS and McGill University crop distribution maps and country datasets. For uncultivated plant distributions explore global (e.g. GBIF), European (e.g. Florae Europaeae), regional and country flora. For habitat distributions consult maps prepared by the European Environment Agency, CORINE, EUNIS, etc. The distribution can be described by national region, country, by continental region (e.g. south-western Europe) or by environmental zone (e.g. the Mediterranean).

Factor 2 alternate hosts and other essential species

3.02 Does all the area identified in 3.01 have alternate hosts or other essential species if these are required to complete the pest's life cycle?

Note: The pest needs more than one host or another essential species to complete its life cycle or for a critical stage of its life cycle such as transmission (e.g. vectors), growth (e.g. root symbionts), reproduction (e.g. pollinators) or spread (e.g. seed dispersers).

If Not Required: Record this information.
If Yes: Record this information and provide justification.
If No: Based on the area assessed as being suitable for establishment in question 3.01, identify and describe the area where alternate hosts or other essential species are present. Describe how this affects the area where hosts and suitable habitats are present.

Go to the next question.

Factor 3 climatic suitability

3.03 Does all the area identified as being suitable for establishment in previous questions have a suitable climate for establishment?

Note: When comparing climates in a pest's current distribution with those in the PRA area, it is important to ensure that, as far as possible, the variables selected are relevant to the pest's ability to exploit conditions when these are favourable for growth and reproduction and to survive unfavourable periods, such as those of extreme cold, heat, wetness or drought. It may be helpful to compare the global distribution of the pest and its hosts. If they have similar climatic responses, all the hosts in the PRA area might be considered to be at risk and a Yes response may be appropriate. In situations where this question is difficult to answer it may be useful to consult the maps provided in the appendices to the guidance for question 3.11.

If Yes: Record this information and provide justification,
If No: Based on the area assessed as being suitable for establishment in previous questions, identify and describe the area where the climate is similar to that in the pest's current area of distribution. Describe how this affects the area identified where hosts, suitable habitats and other essential species are present.

Go to the next question.

Factor 4 other abiotic factors

3.04 Does all the area identified as being suitable for establishment in previous questions have other suitable abiotic factors for establishment?

Note: the major abiotic factors to be considered are the physical and chemical characteristics of the soil; others include, for example, environmental pollution and topography/orography. For organisms having an aquatic stage, pH, salinity, current and temperature are important factors to consider.

If Yes: Record this information and provide justification,

If No: Based on the area assessed as being suitable for establishment in previous questions, identify and describe the area that is not under protected cultivation where additional abiotic factors that can affect establishment are favourable. Describe how this affects the area identified where hosts, suitable habitats and other essential species are present.

Go to the next question.

Factor 5 competition and natural enemies

3.05 Is all the area identified as being suitable for establishment in previous questions likely to remain unchanged despite the presence of competitors and natural enemies?

Note: For pest plants, how likely is the pest plant to build up monospecific stands? Is the species a freshwater macrophyte? Is the species allelopathic? Is the species able to fix nitrogen? Natural enemies include antagonists (herbivores, predators and parasites). Is an organism already present in the PRA area occupying the same niche as the pest? The assessor should also consider if the species is unpalatable to grazing animals or toxic.

If Yes: Record this information and provide justification,

If No: Identify and describe any locations where the area suitable for establishment based on previous questions is likely to be altered due to competition and natural enemies. Provide justification.

Go to the next question.

Factor 6: the managed environment

3.06 Is all the area identified as being suitable for establishment in previous questions likely to remain unchanged despite the management of the environment?

Note: factors that should be considered include cultivation practices such as the time of year that the crop is grown, soil preparation, method of planting, irrigation, surrounding crops, time of harvest, method of harvest, soil water balance, fire regimes, disturbance, etc. Factors to consider for pest plants are for instance the regular mowing of road sides, cleaning of water courses, etc. Existing pest management practice should also be considered.

If Yes: Record this information and provide justification,

If No: Identify and describe any locations where the area suitable for establishment based on previous questions is likely to be altered due to the management of the environment. Provide justification.

Go to the next question.

Factor 7: protected cultivation

3.07 Are the hosts grown in protected cultivation in the PRA area? If the pest is a plant, has it been recorded as a weed in protected cultivation elsewhere?

Note: "Protected cultivation" in the context of this scheme means synthetic or glass structures (e.g. glasshouses) which provide suitable conditions for host growth, protecting them from adverse environmental extremes.

The pest may already have been recorded in protected cultivation elsewhere, but it may also happen that the host is grown outside in the area where the pest is present and the possibility that hosts under protected cultivation can be infected/infested has to be considered.

If No: Record this information and provide justification.

If Yes: Identify and describe the areas where the hosts are grown in protected cultivation or – if the pest is a plant - where similar protected cultivation occurs in the PRA area. Provide justification.

Go to the next question.

Area of potential establishment

3.08 By combining the cumulative responses to those questions 3.01 to 3.06 that have been answered with the response to question 3.07, identify the part of the PRA area where the presence of host plants or suitable habitats and other factors favour the establishment of the pest.

Note: The area of potential establishment may be the whole of the PRA area, or part or parts of the area (i.e. the whole EPPO region or whole or part of several countries of the EPPO region). It can be defined ecoclimatically, geographically, by crop or by production system (e.g. protected cultivation such as glasshouses) or by types of

ecosystems.

Suitability of the area of potential establishment

Questions 3.09-3.16 should be answered following the summarising table above. Questions 3.17-3.20 should always be answered.

Availability of suitable hosts or suitable habitats, alternate hosts and vectors in the PRA area

3.09 How likely is the distribution of hosts or suitable habitats in the area of potential establishment to favour establishment?

Note: In question 3.01 the area where host plants or suitable habitats are present in the PRA area was identified but here we are assessing the abundance and patchiness of the distribution of host plant species or suitable habitats in the area of potential establishment defined in question 3.08. See also the note for question 3.01.

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

3.10 How likely is the distribution of alternate hosts or other species critical to the pest's life cycle in the area of potential establishment to favour establishment?

Note: Although this is based on the answer to question 3.02, in this question the abundance and patchiness of the distribution of alternate hosts and other species critical for the life cycle in the area of potential establishment (defined in question 3.08) is evaluated. For examples, see note for question 3.02.

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

Suitability of the environment

3.11 Based on the area of potential establishment already identified, how similar are the climatic conditions that would affect pest establishment to those in the current area of distribution?

Note: In question 3.03 the area where climate is suitable for establishment in the PRA area was determined but here the extent to which the climate is suitable in the area for potential establishment (defined in question 3.08) is assessed. Using pest distribution maps and maps of world climate zones (e.g. the Köppen-Geiger zones), identify the climates where the pest is currently present. Then, compare these with the climates in the area for potential establishment (defined in question 3.08). The relative distributions of the hosts and the pest in areas where the pest is not still spreading may help indicate whether both the hosts and the pest have similar climatic responses. It is important to take into account the fact that the relationship between the current pest distribution and climate may not be clear because (a) the current pest distribution is poorly known, (b) the species is still spreading, (c) the limits to its distribution depend on factors such as the presence of hosts or geographical barriers e.g the sea or mountains, rather than climate and (d) climate, as measured at weather stations, is unrelated to the microclimate inhabited by the species because it completes much of its life cycle in protected or irrigated cultivation, submerged aquatic habitats, the soil, thick woody plant tissue or in vectors.

not similar, slightly similar, moderately similar, largely similar, completely similar

Level of uncertainty:	**Low**	**Medium**	**High**

3.12 Based on the area of potential establishment, how similar are other abiotic factors that would affect pest establishment to those in the current area of distribution?

Note: This question evaluates the extent to which the abiotic factors are suitable in the area of potential establishment.

The major abiotic factors to be considered are the physical and chemical characteristics of the soil; others are, for example, environmental pollution, topography/orography. For organisms having an aquatic stage, pH, salinity, current and temperature are important factors to consider.

not similar, slightly similar, moderately similar, largely similar, completely similar

Level of uncertainty:	**Low**	**Medium**	**High**

3.13 Based on the area of potential establishment, how likely is it that establishment will occur despite competition from existing species, and/or despite natural enemies already present?
Note: See question 3.05

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

Cultural practices and control measures

3.14 How favourable for establishment is the managed environment in the area of potential establishment?
Note: see question 3.06. This question refers to the situation outdoors, i.e. not in protected crops.

Not at all favourable, slightly favourable, moderately favourable, highly favourable, very highly favourable

Level of uncertainty:	**Low**	**Medium**	**High**

3.15 How likely is the pest to establish despite existing pest management practice?

very unlikely, unlikely, moderately likely, likely, very likely.

Level of uncertainty:	**Low**	**Medium**	**High**

3.16 Is the pest likely to establish in protected cultivation in the PRA area?
Note: For crops in Northern/Central Europe and pests from warmer climates: is the relevant crop grown under protected conditions? This sub-question is only relevant for pests that cannot establish outdoors in the PRA area.

Yes
No

Level of uncertainty:	**Low**	**Medium**	**High**

Other characteristics of the pest affecting the probability of establishment

3.17 How likely are the reproductive strategy of the pest and the duration of its life cycle to aid establishment?

Note: consider characteristics which would enable the pest to reproduce effectively in a new environment and answer the following sub questions either yes or no (some may not be appropriate for the pest taxon studied, these should be identified and do not need to be answered)

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

3.18 Is the pest highly adaptable?
Note: Evidence of variability may indicate that the pest has a greater capacity to withstand environmental fluctuations, to adapt to a wider range of habitats or hosts, to develop resistance to plant protection products and to overcome host resistance. If the answer to this question is yes, this is an important indication that this species is likely to have a greater potential for establishment. In addition, the magnitude of future impacts may increase. High adaptability also indicates that data from the native range, e.g. on climatic responses and host range, may not continue to be representative of the population in the PRA area so that the PRA itself may need revision at a shorter interval. Furthermore, if adaptability is high, this needs to be kept in mind with regard to effective management measures. Examples of high adaptability include *Bemisia tabaci* which clearly seems to be able to evolve quickly to produce new biotypes, to develop insecticide resistance and to expand its host range and *Phytophthora ramorum*, which also appears to be rapidly increasing its host range.

If the pest is highly or very highly adaptable, this should be mentioned in the section degree of uncertainty.

YES, highly or very highly adaptable
NO, moderately adaptable or less
Not relevant

Level of uncertainty:	**Low**	**Medium**	**High**

3.19 How widely has the pest established in new areas outside its original area of distribution? (specify the instances, if possible; note that if the original area is not known, answer the question only based on the countries/continents where it is known to occur)

Not established in new areas, not widely, moderately widely, widely, very widely

Level of uncertainty:	**Low**	**Medium**	**High**

Conclusion on the probability of establishment

3.20 The overall probability of establishment should be described.

Very low, low, medium, high, very high

Level of uncertainty:	**Low**	**Medium**	**High**

Probability of spread

Spread is defined as the expansion of the geographical distribution of a pest within an area. Spread potential is an important element in determining how quickly impact is expressed and how readily a pest can be contained. In the case of intentionally imported plants, the assessment of spread concerns spread from the intended habitat or the intended use to an unintended habitat, where the pest may establish. Further spread may then occur to other unintended habitats. The nature and extent of the intended habitat and the nature and amount of the intended use in that habitat will also influence the probability of spread. Some pests may not have injurious effects on plants immediately after they establish, and in particular may only spread after a certain time. In assessing the probability of spread, this should be considered, based on evidence of such behaviour.

4.01 What is the most likely rate of spread by natural means (in the PRA area)?

Note: Natural population spread, increasing the infested area, can result from the movement of the pest by flight (of an insect), wind or water dispersal (except irrigation), transport by vectors such as insects, birds or other animals (internally through the gut or externally on the fur), natural migration, rhizomial growth.

Consider potential vectors of the pest in the PRA area, the presence of natural barriers, and the suitability of the environment. In this question the mean rate of spread should be taken into account to decide on the rating. The maximum spread capacity should be described in the justification text and the corresponding rating may also be given when the assessors considers it important to describe different scenarios.

Spread can be described as distance covered per unit time (e.g. 50 m /year) or in increasing area occupied (e.g. km^2) over time.

Very low rate of spread, low rate of spread, moderate rate of spread, high rate of spread, very high rate of spread

Level of uncertainty:	**Low**	**Medium**	**High**

4.02 What is the most likely rate of spread by human assistance (in the PRA area)?

Note: consider the potential for movement with commodities, packing materials, baggage, mail or conveyances, the fact that the species is intentionally dispersed by people and the ability of the pest to be unintentionally dispersed along major transport routes. For intentionally introduced plants consider spread to the unintended habitat.

Mechanical transmission through human activities (by grafting or budding and contamination of hands, clothing and tools used for pruning, cutting, thinning and preparing the soil) commonly occurs over short distances within the place of production. However, since employees often travel long distances to work and contract workers (that

visit many production sites) are commonly employed, it is considered that evidence of mechanical transmission indicates the potential for at least moderate spread.

Very low rate of spread, moderate rate of spread, high rate of spread, very high rate of spread

Level of uncertainty:	**Low**	**Medium**	**High**

Conclusion on the probability of spread

4.03 Describe the overall rate of spread

Note: The overall rate for spread should combine the assessments of the rate for natural spread and human spread. In most situations the overall rate of spread equals the highest rate of spread given to either question 4.01 or 4.02.

very low rate of spread, low rate of spread, moderate rate of spread, high rate of spread, very high rate of spread

Level of uncertainty:	**Low**	**Medium**	**High**

The assessor should also give his/her best estimate for the following questions:

4.04 What is your best estimate of the time needed for the pest to reach its maximum extent in the PRA area?

Note: In this question, ignore any containment measures that may be taken to prevent or contain the spread of the pest. The maximum extent can be considered to be the area of potential establishment defined in question 3.08.
The factors to be taken into account in deciding on the time to reach its maximum extent include:

- The rate of spread,
- The survival and reproductive rate
- The relationship between population density and impact thresholds
- The time taken for impacts to be observed, e.g. through a lag phase
- Climate and land use change

Level of uncertainty:	**Low**	**Medium**	**High**

4.05 Based on your responses to questions 4.01, 4.02, and 4.04 while taking into account any current presence of the pest, what proportion of the area of potential establishment do you expect to have been invaded by the organism after 5 years?

Level of uncertainty:	**Low**	**Medium**	**High**

Eradication, containment of the pest and transient populations

This section evaluates the likelihood that the pest could survive eradication programmes or be contained in case of an outbreak within the PRA area. It also considers if transient populations are likely to occur in the PRA area through natural migration or entry through man's activities.

5.01 Based on its biological characteristics, how likely is it that the pest could survive eradication programmes in the area of potential establishment?

Note: Some pests can be eradicated at any time (survival is very unlikely), others at an early stage (moderately likely) and others are very difficult to eradicate (very likely). Similarly, incursions of some pests may be difficult to find and/or delimit (very likely). Intentionally imported plants may need to be eradicated from the intended habitat as well as from the unintended habitat. Some plants should be eradicated before fructification.

very unlikely, unlikely, moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

5.02 Based on its biological characteristics, how likely is it that the pest will not be contained in case of an outbreak within the PRA area?

Note: consider the biological characteristics of the pest that might allow it to be contained in part of the PRA area. For intentionally introduced plants consider spread to the unintended habitat.

very unlikely, unlikely moderately likely, likely, very likely

Level of uncertainty:	**Low**	**Medium**	**High**

5.03 Are transient populations likely to occur in the PRA area through natural migration or entry through man's activities (including intentional release into the environment) or spread from established populations?

Note: Transience is defined as the presence of a pest that is not expected to lead to establishment. The likelihood of transience should be assessed by considering the same factors taken into account when assessing establishment potential (e.g. climatic conditions). Damaging transient populations may occur outside the area of potential establishment, particularly in areas where climatic conditions are suitable during some period of the year (e.g. summer). In Southern Europe populations of *Bactrocera invadens* may enter through man's activities but are not expected to overwinter. Moth pests such as *Plusia gamma* and *Ostrinia nubilalis*, may enter through natural migration but summer populations are unable to survive low winter temperatures.

Yes
No

Level of uncertainty:	**Low**	**Medium**	**High**

6. Assessment of potential economic consequences

The main purpose of this section is to determine whether the introduction of the pest will have unacceptable economic consequences. It may be possible to do this very simply, if sufficient evidence is already available or the risk presented by the pest is widely agreed. Start by answering Questions 6.01 – 6.11. If the responses to question 6.04 and 6.05 are "major" or "massive" or any of the responses to questions 6.06, 6.09, and 6.11 is "major" or "massive" the evaluation of the other questions in this section may not be necessary and you can go to 6.15 unless a detailed study is required or the answers given to these questions have a high level of uncertainty. In cases where the organism has already entered and is established in part of the PRA area, responses to questions 6.01, 6.08 and 6.10, which refer to impacts in its area of current distribution, should be based on an assessment of current impacts in the PRA area in addition to impacts elsewhere.

Expert judgement is used to provide an evaluation of the likely scale of impact. If precise economic evaluations are available for certain pest/host plant combinations, it will be useful to provide details.

The replies should take account of both short-term and long-term effects of all aspects of agricultural, environmental and social impact. When a qualitative impact assessment is conducted, there is no need to take the time constraint into account. An option is to evaluate the impact for different scenarios where different proportions of the area of potential establishment are considered to be invaded (e.g. 10 %, 25%).

In any case, providing replies for all hosts (or all habitats) and all situations may be laborious, and it is desirable to focus the assessment as much as possible. The study of a single case may be sufficient, e.g. if the effect on one host exceeds the effect on all other hosts together. It may be appropriate to consider all hosts/habitats together in answering the questions once, if effects on these hosts are comparable. If a selection is made, it should be justified. Only in certain circumstances will it be necessary to answer the questions separately for specific hosts or habitats. This is the case if the majority of the affected producers suffer minor or moderate impacts, but a small group suffers major or massive impacts. Differences can be caused by different host plants; differences between crops and amenity plants or differences between cropping system: conventional and organic production.

When the PRA is performed on a pest proposed for deregulation, the current impact noted in the area may be linked to the implementation of phytosanitary measures. The assessor should evaluate the possible impact for a scenario where these measures targeting the pest are withdrawn.

ECONOMIC IMPACT "SENSUS-STRICTO"

6.01 How great a negative effect does the pest have on crop yield and/or quality of cultivated plants or on control costs within its current area of distribution?

Note: Effect on crop yield and/or quality are usually expressed as a relative decrease (%) per crop per ha or relative increase in total control costs. When following the rating guidance, it is important to take into account the annual variation in crop yield and quality that normally occurs in different crops. For some crops, e.g. those grown in protected conditions, such as tomatoes, cut flowers and pot plants, the annual yield fluctuations are normally very small and a yield loss greater than 10% can be considered as a massive impact. For crops with high yearly fluctuations, e.g. fruit and arable products and a loss of more than 50% would be needed before it can be considered to be a massive impact. Other crops, such as nursery stock, outdoor vegetables and forestry, take an intermediate position. The main causes of the fluctuation are due to the weather and the lower amount of protection provided, the higher the annual variation in yield. Other aspects to be taken into account include biennial bearing (e.g. fruit) which increases yield variation, whether the product is a bulk product (maize) or a high quality product (e.g. roses) and whether the product is harvested annually (e.g. vegetables). The more quality is an important product feature, the lower the yield variation is. If product the production cycle takes more than one year (e.g. forestry), yield variation due to weather conditions are levelled.

minimal, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

6.02 How great a negative effect is the pest likely to have on crop yield and/or quality of cultivated plants in the PRA area without any control measures?

Note: This information can be derived from trials where no measures are taken on some plots. Consider the note and the answer to question 6.01. The ecological conditions in the PRA area may be adequate for pest survival but may not be suitable for pest populations to build up to levels at which significant damage is caused to the host plant(s). Rates of pest growth, reproduction, longevity and mortality may all need to be taken into account to determine whether these levels are exceeded despite the presence of natural enemies. Consider also the effects on non-commercial crops, e.g. private gardens, amenity plantings.

minimal, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

6.03 How great a negative effect is the pest likely to have on yield and/or quality of cultivated plants in the PRA area without any additional control measures?

Note: Consider the note and answer to question 6.01 and consider the pest survival and population growth when producers only apply current crop protection measures.

minimal, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

6.04 How great a negative effect is the pest likely to have on yield and/or quality of cultivated plants in the PRA area when all potential measures legally available to the producer are applied, without phytosanitary measures?

Note: Consider the note and answer to question 6.01. Take into account the existing and potential control measures and their efficacy against the pest. Difficulty of control can result from such factors as lack of effective plant protection products against this pest, resistance to plant protection products, difficulty to change cultural practices, occurrence of the pest in natural habitats, private gardens or amenity land, simultaneous presence of more than one stage in the life cycle, absence of resistant cultivars.

Include both normal farm practice costs and costs of control of measures which are additional to the common agricultural practice and which are assumed to be taken from a sound managerial perspective, in particular:

- ease of detection of the pest: species that are difficult to detect will require a greater surveillance and monitoring effort which will indirectly result in higher production costs.
- treatment: treatment options may vary (plant protection products, physical removal, etc.) Treatment costs may be divided into operating (e.g. chemical, fuel, equipment) and labour (i. e. hours per ha).

minimal, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

6.05 How great an increase in production costs (including control costs) is likely to be caused by the pest in the PRA area in the absence of phytosanitary measures?

Note: This is evaluated on the basis of the relative increase (%) in total costs (e.g. €). Include the costs of all additional measures which are considered in question 6.04 and costs incurred to prevent environmental impacts. Consider also the answer to question 6.02.

minimal, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

6.06 Based on the total market, i.e. the size of the domestic market plus any export market, for the plants and plant product(s) at risk, what will be the likely impact of a loss in export markets, e.g. as a result of trading partners imposing export bans from the PRA area?

Note: consider whether plant products potentially affected by the pest are exported from the PRA area and how important such exports are, for example by estimating the proportion of production that is exported. Take into account the major existing (or potential) export markets and how likely each is to impose an export ban from the PRA area. This is expressed as a relative decrease in market size.

minimal, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

6.07 To what extent will direct impacts be borne by producers?

Note: This is evaluated as the proportion (%) of total economic impact (the sum of the questions 6.04, 6.05 and 6.06) borne by the producers. Producers can try to transfer economic losses to consumers and to other producers in order to decrease impacts on themselves.

Factors that enable producers to decrease impacts include:

- the alternative use of the product, e.g. a shift from human consumption to use for animal feed
- the negotiation power of the producer to change the price of the product,
- the potential to grow other crops.

The ease with which production can be adjusted depends on:

- the time needed for new crops to reach full production, e.g. one season for potatoes and several years for apples,
- the availability of factors such as labour, land and the investments which may have to be made to increase production (investment in plants for planting, buildings such as glasshouses, etc.),
- factors such as market expectations and the potential for storage of the product until prices rise.

Factors that limit producers capacity to decrease impacts include:

- consumer responsiveness (can consumers postpone consumption or shift to substitutes?),
- reductions in market share due to loss of image or dependency on the harmed products, such as wood which is used as packaging material. This can also affect the sale of products which are not infested.

A producer will almost never be able to pass on all costs.

When no judgment is chosen, the assessor should specify in the PRA that the impact may be overestimated**.**

no judgment possible/ ask an economist, minimal, minor, moderate, major, massive

Level of uncertainty:	Low	Medium	High

ENVIRONMENTAL IMPACT

Questions to be answered to assess environmental impact are different for pests and for plants. Choose the relevant set of questions below (A or B respectively).

- ***A. Questions for pests which are not plants***

6.08. How important is the environmental impact caused by the pest within its current area of invasion? *(Answer the sub-questions below)*

N/A, Minimal, minor, moderate, major, massive

6.08.0A Based on the elements explained in the note, do you consider that the question on the environmental impact caused by the pest within its current area of invasion can be answered?

Note: in this question we rate the current environmental impact in other invaded regions that can be used as indicator for determining the potential environmental impact in the PRA area (Q. 6.09).

If the species has not invaded any other area, or if the invasion is too recent and too little is known about its ecology in the invaded areas, this question cannot be answered properly (assuming that no additional investigations can be undertaken during the time available for producing the PRA). The assessor may choose to go directly to Q 6.09. He/she may also choose to answer these questions based on well-studied closely-related species or data for the target species from the region of origin. Although the concept of "environmental impact" of an indigenous species on native biodiversity and ecosystem is debatable, in some cases native species clearly have an environmental impact, usually resulting either from climate change or ecological mismanagement (e.g. *Dendroctonus ponderosae* presently causing serious outbreaks and extending its range in Canada, various weeds now invasive in their native range, etc.). Nevertheless, the assessor should take into account the fact that the environmental impact of a pest in its region of origin is often a very poor predictor of potential impact in regions where it has been introduced. In particular, the absence of any obvious environmental impact in a region of origin should not be considered as a predictor for a low impact in a new area.

When data on impact are available in several invaded regions, priority should be given to impact observed in regions that are most closely related, geographically and eco-climatologically, to the PRA region. However, data from other regions should not be excluded. For example, when performing a PRA on an invasive pest for the entire Europe, data on impact already observed in Europe should be given priority, but information from other regions should also be provided. In any case, the assessor should specify the region where the information on impact has been gathered.

If Yes: Go to 6.08.01 (see Appendix 2 part A)

If No, but information is available for the native area of the pest, Go to 6.08.01 (see Appendix 2 part A)

If No, **but there is some evidence that the environmental impact may be significant in the PRA area**: answer N/A for 6.08 and Go to 6.09.0C

If No, and the assessor is certain that, in any case, the environmental impact will be lower than the economic impact (e.g. a purely agricultural pest not known to occur in other environments): answer N/A for 6.08 and 6.09 (the assessor will have to justify this decision).

Q 6.09. How important is the environmental impact likely to be in the PRA area?

Minimal, minor, moderate, major, massive

Verify that, based on Q 6.08, an environmental impact is also likely to occur in the PRA area, and, if yes, at a comparable level, using the following questions. For this, answers to the section in the "likelihood of establishment" section should be taken into account:

To answer this question, begin at 6.09.0A

6.09.0A Taking into account the responses to the relevant questions (on hosts and habitats, climatic conditions, abiotic factors and management methods) in the establishment section, are the conditions in the PRA area sufficiently similar to those in the area of invasion to expect a similar level of impact?

If No: the situation regarding environmental impact may be different, Go to 6.09.0C

If Yes: go to next question (6.09.0B)

Note: If Q 6.08 has been answered for the native area only, it is highly advisable to go to 6.09.0C.

Level of uncertainty:	Low	Medium	High

6.09.0B Does the same native species or community, or the same threatened ecosystem services, occur in the PRA area and, if not, is it known whether the native species or communities, or ecosystem service in the PRA area are similarly susceptible?

If No: the situation regarding environmental impact may be different, Go to 6.09.0C

If Yes: The situation regarding environmental impact is likely to be similar between the invaded and the PRA areas, the score of Q 6.08 can be given in Q 6.09 **as the impact elsewhere will be the most reliable criterion to predict impact in the PRA area.**

Level of uncertainty:	Low	Medium	High

6.09.0C If the assessor considered that Q6.08 could not be answered, or if answered only for a native region, or if answered for another invaded region but the situation in the PRA area is likely to be different: use another, simpler rating system based on simpler impact predictors (see Appendix 2 part B).

- ***B. Questions for plants***

Q6.08: How important is the environmental impact caused by the plant within its current area of invasion? *(Answer the sub-questions below)*

N/A, Minimal, minor, moderate, major, massive

6.08.0A Based on the elements explained in the note, do you consider that the question on the environmental impact caused by the pest within its current area of invasion can be answered?

Note: In this question we rate the current environmental impact in other invaded regions that can be used as an indicator for determining the potential environmental impact in the PRA area (Q. 6.09). If the species has not invaded any other area, or if the invasion is too recent and too little is known about its ecology in the invaded areas, this question cannot be answered properly, assuming that no additional investigations can be undertaken during the time available for producing the PRA. The assessor may also choose to answer these questions based on well-studied closely-related species or on data for the target species from the region of origin. Although the concept of the "environmental impact" of a native species on native biodiversity and ecosystems is debatable, in some cases recently expanding native species clearly have an environmental impact, resulting from climate change, habitat change, change in disturbance regime or ecological mismanagement (e.g. various weeds such as Canada thistle are now expanding in their native range, etc.). Nevertheless, the assessor should take into account that the environmental impact of a pest in its region of origin is often a very poor predictor of potential impact in regions where it has been introduced. In particular, the absence of any obvious environmental impact in the region of origin should not be considered as a predictor for a low impact in a new area.

When data on impact are available in several invaded regions, priority should be given to impact observed in regions that are most closely related, geographically and eco-climatologically, to the PRA region. However, data from other regions should not be excluded. For example, when performing a PRA on an invasive plant for the entire Europe, data on impact already observed in Europe should be given priority, but information from other regions should also be provided. In any case, the assessor should specify the region where the information on impact has been gathered.

If Yes: Go to 6.08.01 (see Appendix 3)

If No, but information is available for the native area of the plant, Go to 6.08.01(see Appendix 3).

If No: answer N/A for 6.08 and Go to 6.09.0C.

Q6.09: How important is the environmental impact likely to be in the PRA area?

Minimal, minor, moderate, major, massive

Verify that, based on Q6.08, an environmental impact is also likely to occur in the PRA area, and, if yes, at a comparable level, using the following questions. For this, answers to the section in the "likelihood of establishment" section should be taken into account:

6.09.0A Taking into account the responses to the relevant questions (on hosts and habitats, climatic conditions, abiotic factors, management methods) in the establishment section, are the conditions in the PRA area sufficiently similar to those in the area of invasion to expect a similar level of impact?

If No: the situation regarding environmental impact may be different, **the assessor should use the subquestions in Q6.08 and reassess those subquestions concerned by the differences identified between the invaded and the PRA areas.**

If Yes: Go to next question (6.09.0B)

Level of uncertainty:	**Low**	**Medium**	**High**

6.09.0B Does the same native species or community, or the same threatened ecosystem services, occur in the PRA area and, if not, is it known whether the native species or communities, or ecosystem service in the PRA area are similarly susceptible?

If No: the situation regarding environmental impact is likely to be different between the invaded and the PRA areas, **the assessor should use the subquestions in Q6.08 and reassess those subquestions concerned by the differences identified between the invaded and the PRA areas.**

If Yes: The situation regarding environmental impact is likely to be similar between the invaded and the PRA areas, the score of Q 6.08 can be given in Q 6.09 **as impact elsewhere will be the most reliable criterion to predict the impact in the PRA area.**

Level of uncertainty:	**Low**	**Medium**	**High**

6.09.0C If the assessor considered that Q6.08 could not be answered, i.e. the species has not invaded any other area, or if the invasion is too recent and too little is known on its ecology in the invaded areas, and assuming that no additional investigations can be undertaken during the time available for producing the PRA, an environmental impact assessment cannot be properly made using this scheme. Nevertheless, in any case, the assessor should be able to provide his/her opinion on the potential environmental impact in the PRA area.

SOCIAL IMPACT

6.10 How important is social damage caused by the pest within its current area of distribution?

Note: Social effects are impacts on human well-being, other than economic impacts. The main social effects are:

- Landscape effects. To assess the impacts on the landscape two elements need to be involved:
  - Land use function (agriculture, living area)
  - Contribution to wellbeing (aesthetic value, (cultural-) historic value)
- Loss of employment
- Effects on human health (in addition to effects on plant health)
- Products and services such as water quality, animal grazing, hunting and fishing (in addition to effects on plant health).

Effects on human or animal health, the water table and tourism could be considered, as appropriate, by other agencies/authorities.

minimal, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

6.11 How important is social damage likely to be in the PRA area?

minimal, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

OTHER ECONOMIC IMPACTS

As noted in the introduction, the evaluation of the following questions may not be necessary if the responses to question 6.04 and 6.05 are "major" or "massive" or any of the responses to questions 6.06, 6.09 and 6.11 is "major" or "massive" or "very likely" or "certain", and you can go to 6.15 unless a detailed study is required or the answers given to these questions have a high level of uncertainty.

6.12 To what extent is the pest likely to disrupt existing biological or integrated systems for control of other pests be?

Minimal extent, minor extent, moderate extent, major extent, massive extent

Level of uncertainty:	**Low**	**Medium**	**High**

6.13 How great an increase in other costs resulting from introduction is likely to occur?

Note: This is evaluated in comparison with total production costs, see q. 6.05. Other costs include costs to the government, such as project management and administration, enforcement, research, extension/education, advice, publicity, certification schemes; costs to the crop protection industry.

minimal, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

6.14 How great an increase in the economic impact of other pests is likely to occur if the pest can act as a vector or host for these pests or if genetic traits can be carried to other species, modifying their genetic nature?

minimal, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

Conclusion of the assessment of economic consequences

6.15 With reference area of potential establishment identified in Q 3.08, identify the areas which are at highest risk from economic, environmental and social impacts. Summarize the impacts and indicate how these may change in future.

minimal, minor, moderate, major, massive

Level of uncertainty:	**Low**	**Medium**	**High**

Degree of uncertainty
Estimation of the probability of introduction of a pest and of its economic consequences involves many uncertainties. In particular, this estimation is an extrapolation from the situation where the pest occurs to the hypothetical situation in the PRA area. It is important to document the areas of uncertainty (including identifying and prioritizing of additional data to be collected and research to be conducted) and the degree of uncertainty in the assessment, and to indicate where expert judgement has been used. This is necessary for transparency and may also be useful for identifying and prioritizing research needs.

It should be noted that the assessment of the probability and consequences of environmental hazards of pests of uncultivated plants often involves greater uncertainty than for pests of cultivated plants. This is due to the lack of information, additional complexity associated with ecosystems, and variability associated with pests, hosts or habitats.

For Pest-Initiated Risk Assessments:	**Go to conclusion of the risk assessment**
For Pathway-Initiated Risk Assessments:	**Go to back to 2.03 to evaluate the next pest, if all pests have been evaluated go to conclusion of the risk assessment**

Conclusion of the pest risk assessment

Entry Evaluate the probability of entry and indicate the elements which make entry most likely or those that make it least likely. Identify the pathways in order of risk and compare their importance in practice.

Establishment
Evaluate the probability of establishment, and indicate the elements which make establishment most likely or those that make it least likely. Specify which part of the PRA area presents the greatest risk of establishment.

Spread
Evaluate the probability of spread, and indicate the elements which make spread most likely or those that make it least likely.

Economic importance
List the most important potential economic impacts, and estimate how likely they are to arise in the PRA area. Specify which part of the PRA area is economically most at risk.

Overall conclusion of the pest risk assessment
The risk assessor should give an overall conclusion on the pest risk assessment and an opinion as to whether the pest or pathway assessed is an appropriate candidate for stage 3 of the PRA: the selection of risk management options, and an estimation of the associated pest risk.

Stage 3: Pest risk management

The pest risk management stage is the third stage in pest risk analysis. It provides a structured analysis of the measures that can be recommended to minimize the risks posed by a pest or pathway. The pest risk management part may be used to consider measures to prevent entry, establishment or spread of a pest. It explores options that can be implemented (i) at origin or in the exporting country, (ii) at the point of entry or (iii) within the importing country or invaded area.

Before beginning the pest risk management stage or at certain points throughout the process, it may be advisable to consult other interested bodies. For example, discussions may be needed with the exporters to determine what is possible, with the importers to clarify what is cost-effective, with government officials concerning international trade issues and with pest-control experts to determine which methods of control are available, their efficacy and the extent to which eradication is possible.

Before considering the available risk management options, a judgement on the acceptability of the risk posed by the pest or pathway is required. In this scheme, the methods whereby risk management options are selected differ according to whether the introduction is intentional or unintentional, whether the organism is absent or already present in the PRA area and the type of entry pathway. Options to prevent unintentional entry on commodities are distinguished from options to prevent natural spread/movement or entry with other pathways such as passenger luggage. It should be noted that measures recommended for intentional introductions are often restricted to prohibiting imports and to actions that can be taken in the importing country.

The scheme requires a judgement on the reliability of each potential measure identified and an assessment of uncertainty. A reliable measure is understood to mean one that it is efficient, feasible and reproducible. Limitations of application in practice should be noted. Once all potential measures have been identified, the extent to which they are cost-effective and can be combined with other measures is evaluated. A pest may enter by many different pathways and a pathway may transport many pests. It is therefore important to repeat the process for all relevant pests and pathways of concern.

Risk associated with major pathways

Acceptability of the risk

A decision has to be made to determine whether the risk from any pest/pathway combination is an acceptable risk. This decision will be based on the relationship between the level of risk identified in the pest risk assessment stage (i.e. the combination of the probability of introduction and the potential economic impact) and the importance/desirability of the trade that carries the risk of introduction of the pest.

7.01 Is the risk identified in the Pest Risk Assessment stage for all pest/pathway combinations an acceptable risk?

If yes	**STOP**
If no	**Proceed through the risk management scheme following the instructions below**

Types of pathways

In most cases, the pathways to be studied will be particular commodities of plants and plant products, of stated species, moving in international trade and coming from countries where the pest is known to occur, and the questions are intended primarily for these situations. However, the pathways identified in the pest risk assessment may also include other types of pathways, e.g. natural pathway (pest spread), transport by human travellers, conveyances packing material and traded commodities other than plants and plant products, and these also need to be assessed for suitable measures. Therefore, this section explains how to analyze the other types of pathways. For pest plants, it is particularly important to prioritize the pathways

and to identify their relative importance, as some important pathways may not currently be regulated (grain, wool, hides, sand, gravel, etc.).

Instructions for working through the Risk Management stage

Pest-Initiated Analysis

In the case of an analysis concerning an unintentional introduction of a pest, go to question 7.02 and proceed through steps 7.02-7.09, which relate to different pathways on which the pest being analyzed may be carried. Thereafter continue with the questions concerned with the measures that might be applied to each pathway. Repeat the process for every major pathway.

For the intentional import of pest plants, the focus should be on measures preventing the establishment and spread of the organism in unintended habitats within the PRA area. The main pathway for these plants is usually the trade with ornamental plants intended for planting. For such cases go directly to question 7.29 (measures that can be taken in the importing country). This still allows the option of prohibiting import (7.37) to be considered. However, if the organism is also entering the area unintentionally, then measures may be required to prevent introduction through unintentional pathways and steps 7.02-7.29 should also be followed. Options for managing the unintentional introduction of pest plants are covered by following the procedures for pathway-initiated analysis.

Pathway-Initiated Analysis for a commodity of plants and plant products

In the case of a pathway-initiated analysis for a commodity of plants and plant products, since the precise pathway is already known, begin with question 7.09 to consider possible measures for this pathway and repeat the process as far as question 7.39 for each of the pests identified in the pest risk assessment as presenting a risk to the PRA area. When all the pests have been considered, go to 7.40 to integrate the measures for the commodity. (Note that the probabilities for entry of a particular pest with other pathways, including existing pathways, may also need to be investigated).

In considering your responses to the following questions, please note that helpful information may be obtained from the pest risk assessment stage, particularly from the section concerning entry (2.01-2.11). References to the relevant sections of the risk assessment stage have been added.

7.02 Is natural spread one of the pathways (see answer to question 2.01)**?**

Note: Natural spread includes movement of the pest by flight (of an insect), wind or water dispersal, transport by vectors such as insects or birds, natural migration, rhizomial growth.

If yes **go to 7.03**
If no **go to 7.06**

7.03 Is the pest already entering the PRA area by natural spread or likely to enter in the immediate future? (see answer to question 2.01 & 4.01)

If yes **go to 7.04**
If no **go to 7.38**

7.04 Is natural spread the major pathway?

If yes **go to 7.29**
If no **go to 7.05**

7.05 Could entry by natural spread be reduced or eliminated by control measures applied in the area of origin?

Note: the uncertainty relates to the efficacy of the control measures in the country of origin

If yes **possible measures: control measures in the area of origin in collaboration with the NPPO concerned**
Go to 7.30
If no **Go to 7.29**

Level of uncertainty:	**Low**	**Medium**	**High**

7.06 Is the pathway that is being considered a commodity of plants and plant products?

If yes **Go to 7.09**
If no **Go to 7.07**

7.07 Is the pathway that is being considered the entry with human travellers?

If yes **possible measures: inspection of human travellers, their luggage, publicity to enhance public awareness on pest risks, fines or incentives. Treatments may also be possible.**
Go to 7.29
If no **Go to 7.08**

7.08 Is the pathway being considered contaminated machinery or means of transport?

If yes **possible measures: cleaning or disinfection of machinery/vehicles**
Go to 7.29
If no **Go to 7.09**

For other types of pathways (e.g. commodities other than plants or plant products, exchange of scientific material, packing material, grain, wool, hides, sand, gravel ...), not all of the following questions may be relevant; adapt the questions to the type of pathway.

Existing phytosanitary measures

7.09 If the pest is a plant, is it the commodity itself?

If yes **go to 7.30**
If no (the pest is not a plant or the pest is a plant but is not the commodity itself) **go to 7.10**

Existing phytosanitary measures

7.10 Are there any existing phytosanitary measures applied on the pathway that could prevent the introduction of the pest?

Note: Phytosanitary measures may already be required as a protection against other (quarantine) pests (see stage 2: questions 2.04, 2.09 & 2.10) or may already be implemented in the country of origin for the same pest for the export to other countries. These measures include inspection, testing or treatments, official control in the country of origin for the pest concerned, pathway originating only from pest free areas, pest free places of production or areas of low pest prevalence for the pest concerned.

Note that this question is particularly relevant in the framework of a pathway analysis when the country of origin of the pathway and the pathway are well defined and information from the exporting country is available.

The assessor should list these measures and identify their efficacy against the pest of concern. He/she should nevertheless bear in mind that some measures could be removed in the future.

If yes **if appropriate, list the measures and identify their**

efficacy against the pest of concern and go to 7.11

If no **go to 7.13**

Level of uncertainty:	Low	Medium	High

7.11 Are the measures likely to change in the foreseeable future?

Note that this question is particularly relevant in the framework of a pathway analysis when the country of origin of the pathway and the pathway itself are well defined and information from the exporting country is available.

If yes **go to 7.13**
If no or no judgement **go to 7.12**

Level of uncertainty:	Low	Medium	High

7.12 Do you conclude that other measures should be considered?

If yes **go to 7.13**
If no **go to 7.30**

Identification of appropriate risk management options

This section (questions 7.13 to 7.29) analyses the pathway from the place of production to the place of destination in the importing countries. Characteristics of the pest are examined to determine if it can be reliably detected in consignments by inspection or testing, if it can be removed from consignments by treatment or other methods, if limitation of the use of the commodity would prevent introduction, or if the pest can be prevented from infecting/infesting consignments by treatment, production methods, inspection or isolation. **In the individual questions, "Reliably" should be understood to mean that a measure is efficient, feasible and reproducible. Measures can be reliable without being sufficient to reduce the risk to an acceptable level. When a measure is considered reliable but not sufficient, the assessor should indicate this. In such cases their combination with other measures to reach the desired level of protection against the pest should be envisaged (see question 7.32).** The efficiency, feasibility and reproducibility of the measures should be evaluated by the assessor for each potential management option identified. Limitations of application of measures in practice should be noted. **Cost effectiveness and impact on trade are considered in the section "evaluation of risk management options" (questions 7.34 to 7.36).**

Options at the place of production

Detection of the pest at the place of production by inspection or testing

7.13 Can the pest be reliably detected by visual inspection at the place of production?

Note: if the answer is yes specify the period and if possible appropriate frequency if only certain stages of the pest can be detected answer yes as the measure could be considered in combination with other measures in a Systems Approach

If yes or could be considered in a Systems Approach **possible measure: visual inspection at the place of production**

Level of uncertainty:	Low	Medium	High

Go to next question

7.14 Can the pest be reliably detected by testing at the place of production?

Note: if only certain stages of the pest can be detected by testing answer yes as the measure could be considered in combination with other measures in a Systems Approach

If yes or could be considered in a Systems Approach **possible measure: specified testing at the place of production**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Prevention of infestation of the commodity at the place of production

7.15 Can infestation of the commodity be reliably prevented by treatment of the crop

If yes or could be considered in a Systems Approach **possible measure: specified treatment of the crop**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

7.16 Can infestation of the commodity be reliably prevented by growing resistant cultivars*? (This question is not relevant for pest plants)*

If yes or could be considered in a Systems Approach **possible measure: consignment should be composed of specified cultivars**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

7.17 Can infestation of the commodity be reliably prevented by growing the crop in specified conditions (e.g. protected conditions such as screened greenhouses, physical isolation, sterilized growing medium, exclusion of running water, etc.)**?**

If yes or could be considered in a Systems Approach **possible measure: specified growing conditions of the crop**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

7.18 Can infestation of the commodity be reliably prevented by harvesting only at certain times of the year, at specific crop ages or growth stages?

If yes or could be considered in a Systems Approach **possible measure: specified age of plant, growth stage or time of year of harvest**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

7.19 Can infestation of the commodity be reliably prevented by production in a certification scheme (i.e. official scheme for the production of healthy plants for planting)?

If yes or could be considered in a Systems Approach **possible measure: certification scheme**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Establishment and maintenance of pest freedom of a crop, place of production or area

Note that in this question pest spread capacity is considered without prejudice to any other measure that can be recommended. For some pests, growing the plant in specific conditions can prevent natural spread (e.g. production in a glasshouse may provide protection against pest with high capacity for natural spread). These measures should have been identified in question 7.17.

7.20 Based on your answer to question 4.01 select the possible measures based on the capacity for natural spread.

Very low rate of natural spread	**pest freedom of the crop, or pest-free place of production or pest-free area**
Low to moderate rate of natural spread	**pest-free place of production or pest free area**
High to very high rate of natural spread	**pest-free area**

Level of uncertainty:	**Low**	**Medium**	**High**

7.21 Can pest freedom of the crop, place of production or an area be reliably guaranteed?

Note: In order to guarantee freedom of a crop, place of production, place of production and buffer zone, or area, it should be possible to fulfil the requirements outlined in ISPM No. 4 and ISPM No. 10. Consider in particular the degree to which unintentional movement of the pest by human assistance could be prevented (see answer to question 4.02).

If no **Possible measure identified in question 7.20 would not be suitable.**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Options after harvest, at pre-clearance or during transport

Detection of the pest in consignments by inspection or testing

7.22 Can the pest be reliably detected by a visual inspection of a consignment at the time of export, during transport/storage?

Note: if only certain stages of the pest can be detected answer yes as the measure could be considered in combination with other measures in a Systems Approach)

If yes or could be considered in a Systems Approach **possible measure: visual inspection of the consignment**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

7.23 Can the pest be reliably detected by testing of the commodity (e.g. for pest plant, seeds in a consignment)?

Note: if only certain stages of the pest can be detected by testing answer yes as the measure could be considered in combination with other measures in a Systems Approach

If yes or could be considered in a Systems Approach **possible measure: specified testing of the consignment**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Removal of the pest from the consignment by treatment or other phytosanitary procedures

7.24 Can the pest be effectively destroyed in the consignment by treatment (chemical, thermal, irradiation, physical)?

If yes or could be considered in a Systems Approach **possible measure: specified treatment**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

7.25 Does the pest occur only on certain parts of the plant or plant products (e.g. bark, flowers), which can be removed without reducing the value of the consignment? *(This question is not relevant for pest plants)*

If yes **possible measure: removal of parts of plants from the consignment**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

7.26 Can infestation of the consignment be reliably prevented by handling and packing methods?

If yes or could be considered in a Systems Approach **Possible measure : specific handling/packing methods of the consignment**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Options that can be implemented after entry of consignments

7.27 Can the pest be reliably detected during post-entry quarantine?

Note: ISPM no. 5 *"Glossary of Phytosanitary Terms*" defines quarantine as *"official confinement for observation and research or for further inspection, testing and/or treatment of a consignment after entry".*

If yes **possible measure: import of the consignment under special licence/permit and post-entry quarantine**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

7.28 Could consignments that may be infested be accepted without risk for certain end uses, limited distribution in the PRA area, or limited periods of entry, and can such limitations be applied in practice?

If yes **possible measure: import under special licence/permit and specified restrictions**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

7.29 Are there effective actions that could be taken in the importing country (surveillance, eradication, containment) to prevent establishment and/or economic or other impacts?

Note: For intentionally imported plants, see the EPPO Standard PM3/67 on *Guidelines for the management of invasive alien plants or potentially invasive alien plants which are intended for import or have been intentionally imported*. When natural spread is the major pathway, international measures are not justified and risk should be accepted because it is not manageable.

If yes **Possible measures: internal surveillance and/or eradication or containment campaign**

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

Evaluation of risk management options

This section evaluates the risk management options selected and considers in particular their cost effectiveness and potential impact on international trade.

7.30 Have any measures been identified during the present analysis that will reduce the risk of introduction of the pest? List them.

If yes **Go to next question**
If no **Go to 7.37**

7.31 Does each of the individual measures identified reduce the risk to an acceptable level?

If yes **Go to 7.34**
If no **Go to next question**

Level of uncertainty:	**Low**	**Medium**	**High**

7.32 For those measures that do not reduce the risk to an acceptable level, can two or more measures be combined to reduce the risk to an acceptable level?

Note: The integration of different phytosanitary measures at least two of which act independently and which cumulatively achieve the Appropriate Level of Protection against regulated pests are known as Systems Approaches (see ISPM 14 *The use of integrated measures in a systems approach for Pest Risk Management*). It should be noted that Pest free places of production identified as phytosanitary measures in questions 7.22 to 7.24 may correspond to a System Approach.

If yes **Go to 7.34**
If no **Go to next question**

Level of uncertainty:	**Low**	**Medium**	**High**

7.33 If the only measures available reduce the risk but not down to an acceptable level, such measures may still be applied, as they may at least delay the introduction or spread of the pest. In this case, a combination of phytosanitary measures at or before export and internal measures (see question 7.29) should be considered.

Go to next question

7.34 Estimate to what extent the measures (or combination of measures) being considered interfere with international trade.

Note: If this analysis concerns a pest already established in the PRA area but under official control, measures that are applied for international trade should not be more stringent than those applied domestically/internally.

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

7.35 Estimate to what extent the measures (or combination of measures) being considered are cost-effective, or have undesirable social or environmental consequences.

Level of uncertainty:	**Low**	**Medium**	**High**

Go to next question

7.36 Have measures (or combination of measures) been identified that reduce the risk for this pathway, and do not unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences?

If yes **For pathway-initiated analysis, go to 7.39**
For pest-initiated analysis, go to 7.38
If no **Go to next question**

7.37 Envisage prohibiting the pathway.

Note: Prohibition should be viewed as a measure of last resort. If prohibition of the pathway is the only measure identified for a pathway-initiated analysis, there may be no need to analyze any other pests that may be carried on the pathway. If later information shows that prohibition is not the only measure for this pest, analysis of the other pests associated with the pathway will become necessary.

For pathway-initiated analysis, go to 7.39
For pest-initiated analysis go to 7.38

7.38 Have all major pathways been analyzed (for a pest-initiated analysis)?

If yes **Go to 7.41**
If no **Analyze the next major pathway**

Note: if natural spread is considered as the major pathway (see question 7.04) and possible measures have not been identified there is no need to consider further pathways

7.39 Have all the pests been analyzed (for a pathway-initiated analysis)?

If yes **Go to 7.40**
If no **Go to 7.01 (to analyze next pest)**

7.40 For a pathway-initiated analysis, compare the measures appropriate for all the pests identified for the pathway that would qualify as quarantine pests, and select only those that provide phytosanitary security against all the pests.

Note: the minimum effective measures against one particular pest may reduce the risk from other pests far more than necessary, but these measures would be the only ones appropriate for the pathway as a whole.

Go to 7.42

7.41 Consider the relative importance of the pathways identified in the conclusion to the entry section of the pest risk assessment

Note: the relative importance of the pathways is an important element to consider in formulating phytosanitary regulation. Regulation of pathways presenting similar risks should be consistent.

Go to next question

7.42 All the measures or combination of measures identified as being appropriate for each pathway or for the commodity can be considered for inclusion in phytosanitary regulations in order to offer a choice of different measures to trading partners. Data requirements for surveillance and monitoring to be provided by the exporting country should be specified

Note: only the least stringent measure (or measures) capable of performing the task should be selected. Thus, if inspection is truly reliable, it should not be necessary to consider treatment or testing. Note also that some measures may counteract each other; for example the requirement for resistant cultivars may make detection more difficult. It may be that some or all of these measures are already being applied to protect against one or more other pests, in which case such measures need only be applied if the other pest(s) is/are later withdrawn from the legislation.
The minimum phytosanitary measure applied to any pest is the declaration in phytosanitary regulations that it is a quarantine pest. This declaration prohibits both the entry of the pest in an isolated state, and the import of consignments infested by the pest. If other phytosanitary measures are decided upon, they should accompany the declaration as a quarantine pest. Such declaration may occasionally be applied alone, especially: (1) when the pest concerned may be easily detected by phytosanitary inspection at import (see question 7.13), (2) where the risk of the pest's introduction is low because it occurs infrequently in international trade or its biological capacity for establishment is low, or (3) if it is not possible or desirable to regulate all trade on which the pest is likely to be found. The measure has the effect of providing the legal basis for the NPPO to take action on detection of the pest (or also for eradication and other internal measures), informing trading partners that the pest is not acceptable, alerting phytosanitary inspectors to its possible presence in imported consignments, and sometimes also of requiring farmers, horticulturists, foresters and the general public to report any outbreaks.

Go to next question

7.43 In addition to the measure(s) selected to be applied by the exporting country, a phytosanitary certificate (PC) may be required for certain commodities. The PC is an attestation by the exporting country that the requirements of the importing country have been fulfilled. In certain circumstances, an additional declaration on the PC may be needed (see EPPO Standard PM 1/1(2) *Use of phytosanitary certificates*).

Go to next question

7.44 If there are no measures that reduce the risk for a pathway, or if the only effective measures unduly interfere with international trade (e.g. prohibition), are not cost-effective or have undesirable social or environmental consequences, the conclusion of the pest risk management stage may be that introduction cannot be prevented. In the case of pest with a high natural spread capacity, regional communication and collaboration is important.

Conclusion of Pest Risk Management

Summarize the conclusions of the Pest Risk Management stage. List all potential management options and indicate their effectiveness. Uncertainties should be identified.

Monitoring and review

Performance of measure(s) should be monitored to ensure that the aim is being achieved. This is often carried out by inspection of the commodity on arrival, noting any detection in consignments or any entries of the pest to the PRA area.

Information supporting the pest risk analyses should be reviewed periodically by the pest risk analysts to ensure that any new information that becomes available does not invalidate the decision taken. The analysts should in particular be aware that new international trade may be initiated, host plants may newly be grown in the PRA area which were not grown at the time the PRA was conducted, climate may change, new policy decisions may influence the result of a previous analysis.

Appendix I
Categories of habitat (adapted from Corine Land Cover nomenclature)

Arable land
Protected agriculture (e.g. glasshouses)
Permanents crops (e.g. vineyards, fruit tree and berry plantations, olive)
Pastures
Natural grassland
Mixed forests
Conifer forests
Broad-leaved forests
Deserts (sparsely vegetated areas)
Cold lands (e.g. tundra, ice, high altitudes)
Moors and heathland
Sclerophyllous vegetation (e.g. garrigue, maquis)
Inland wetlands (marshes, peat bogs)
Coastal wetlands
Marine waters (coastal lagoons, estuaries)
Continental waters (water courses, water bodies)
Banks of continental water, Riverbanks / canalsides (dry river beds)
Road and rail networks and associated land
Other artificial surfaces (wastelands)
Green urban areas, including parks, gardens, sport and leisure facilities
Scrub

Appendix 2 Environmental sub-questions for plant pests *(note that matrices have been developed within CAPRA to combine the answers to the subquestions into a rating for questions 6.08 and 6.09)*

Part A

The pest has to be assessed for three categories of impact using several indicators that need to be rated. The precise region (and whether invaded or native) and the species (target species or closely-related species) for which the question is answered should be clearly described by the assessors.

The subquestions to be answered are organized as follows:

Negative impact on native biodiversity

6.08.01. To what extent does the pest cause a decline in native species?

6.08.02. To what extent does the pest cause changes in the composition and structure of native species communities?

6.08.03. To what extent does the pest hybridize with native species?

Alteration of ecosystem processes and patterns

6.08.04. To what extent does the pest cause physical modifications of habitats?

6.08.05. To what extent does the pest cause changes in nutrient cycling and availability?

6.08.06. To what extent does the pest cause modifications of natural successions?

6.08.07. To what extent does the pest disrupt trophic and mutualistic interactions?

Conservation impacts

6.08.08. To what extent does the pest occur in habitats of high conservation value?

6.08.09. To what extent does the pest cause harm to rare or vulnerable species?

For each of the indicators, a rating is given based on three choices: *Low*, *Medium* or *High*. Information is provided for each indicator on the meaning of these scores.

For each answer, the associated uncertainty should also be assessed, the possible options are *Low*, *Medium* or *High*.

Negative impact on native biodiversity

Note 1: The word "native" in "native species" or "native biodiversity" throughout Questions 6.08 and 6.09 should be understood in a broad sense, i.e. it should also include species that have been naturalised for centuries and that play an important role in the ecosystems or local cultural heritage, such as walnut (*Juglans*) or chestnut (*Castanea*) in Europe. The assessor may also include other, more recently introduced beneficial organisms such as biological control agents or exotic plants that play a role in ecosystem services, e.g. plants used against erosion.

Note 2: If possible, all mechanisms of impact on native biodiversity should be considered, but only the mechanism providing the highest score and lowest uncertainty is kept for the scoring of the indicators. Mechanisms of impact may include, among others:

Herbivory: Most impacts by plant pests occur through direct feeding on native plants. E.g., the emerald ash borer *Agrilus planipennis* feeds on, and kills native *Fraxinus* spp. in North America. The hemlock woolly adelgid, *Adelges tsugae*, severely affects natural stands of *Tsuga* spp. in Eastern North America.

Plant pathology: A pathogen directly impacts its host plant by causing disease, e.g. *Ophiostoma novo-ulmi* decimated *Ulmus* spp. by causing Dutch elm disease in Europe and North America. Nematodes may also cause plant disease, e.g. *Bursaphelenchus xylophilus* causes pine wilt, which devastates native pine stands in East Asia.

Disease transmission: Alien pests can affect native plants through disease transmission, e.g. *Scolytus multistriatus*, a European bark beetle, is a vector of the Dutch elm disease in North America. This can also include pests that facilitate the attack of a pathogen, without being vectors themselves. For example, the European beech scale, *Cryptococcus fagisuga*, increases the susceptibility of the fungus *Neonectria faginata*, causal agents of the beech bark disease in North America.

Hybridization: Hybridization between an alien and a native species or sub-species may affect the genetic identity of native species or sub-species, although well documented examples are rare for plant pests. The Australian lycaenid butterfly *Zizina labradus* has apparently locally displaced the endemic *Z. oxleyi* in New Zealand. In insects, examples are most common between alien and native honey-bee and bumble-bee sub-species.

Competition for resources: Alien herbivores may affect native biodiversity by competing for food or by affecting the quality and availability of food. For example, the scale insect *Icerya purchasi*, by killing endangered plants in the Galapagos, has also caused local extinction of host specific Lepidoptera. In North America, the Asian adelgid *Pineus boerneri*, is displacing *P. coloradensis* in red pine plantations, by reducing host plant quality and forcing the native species to move to other hosts.

Predation: Plant pests may also affect native species through predation on other animals. For example, the ladybird *Harmonia axyridis*, a pest of vineyards in North America also affects native ladybird populations through predation.

Apparent competition: Apparent competition occurs when the presence of one species indirectly decreases the fitness of another through the increased presence of a shared enemy. An example is the variegated leafhopper, *Erythroneura variabilis*, which, when introduced into California, affected populations of the native *E. elegantula* by enhancing populations of a shared egg parasitoid.

Pesticide use: An intensive use of non-specific pesticides (including biopesticides) over wide areas may affect native biodiversity, in particular when used in natural or semi-natural habitats (e.g. forests, swamps, etc.) . For example, the use of Bt over wide areas in North America to control *Lymantria dispar* locally affects the Lepidopteran fauna; the chemical control of alien mosquitoes over wide areas worldwide has a negative impact on the aquatic fauna.

6.08.01. To what extent does the pest cause a decline in native species?

Low extent, Medium extent, High extent

Level of uncertainty:	**Low**	**Medium**	**High**

6.08.02. To what extent does the pest cause changes in the composition and structure of native species communities?

Low extent, Medium extent, High extent

Level of uncertainty:	**Low**	**Medium**	**High**

6.08.03. To what extent does the pest hybridize with native species?

Low extent, Medium extent, High extent

Level of uncertainty:	**Low**	**Medium**	**High**

Alteration of ecosystem processes and patterns

Note : Only the impact on natural or semi-natural habitats should be considered when assessing the impact on ecosystem processes and patterns. However, natural and semi-natural habitats have to be considered in a broad sense, i.e. every habitat that is not under constant human management. It includes all EUNIS habitat types 1 (http://eunis.eea.europa.eu/habitats-code-browser.jsp), except I (Regularly or recently cultivated agricultural, horticultural and domestic habitats) and J (Constructed, industrial and other artificial habitats). For example, grasslands that are regularly mown are included as well, but not those that are repeatedly re-seeded.

6.08.04. To what extent does the pest cause physical modifications of habitats (e.g. changes to the hydrology, significant increase of water turbidity, light interception, alteration of river banks, changes in fire regime, etc.)?

Low extent, Medium extent, High extent

Level of uncertainty:	**Low**	**Medium**	**High**

6.08.05. To what extent does the pest cause changes in nutrient cycling and availability (e.g. significant changes in nutrient pools in topsoils or in water)?

Low extent, Medium extent, High extent

Level of uncertainty:	**Low**	**Medium**	**High**

6.08.06. To what extent does the pest cause modifications of natural successions (e.g. acceleration or temporary freezing of successions)?

Low extent, Medium extent, High extent

Level of uncertainty:	Low	Medium	High

6.08.07. To what extent does the pest disrupt trophic and mutualistic interactions (e.g. disruption of food web, pollination or plant-mycorrhiza webs leading to ecosystem imbalance)?

Low extent, Medium extent, High extent

Level of uncertainty:	Low	Medium	High

Conservation impacts

6.08.08. To what extent does the pest occur in habitats of high conservation value (includes all officially protected nature conservation habitats)?

Low extent, Medium extent, High extent

Level of uncertainty:	Low	Medium	High

6.08.09. To what extent does the pest cause harm to rare or vulnerable species (includes all species classified as rare, vulnerable or endangered in official national or regional lists within the PRA area)?

Low extent, Medium extent, High extent

Level of uncertainty:	Low	Medium	High

Part B

Impact on native plants:

6.09.01. What is the risk that the host range of the pest includes native plants in the PRA area?

Low risk, Medium risk, High risk

Level of uncertainty:	Low	Medium	High

6.09.02. What is the level of damage likely to be caused by the organism on its major native host plants in the PRA area? (If possible, this question should be answered by taking account the impacts on its major host plants in the PRA area. If the effects on the host plants in the PRA area are not well known, then the answer should be based on damage levels in other areas, but with a higher level of uncertainty).

Low level, Medium level, High level

Level of uncertainty:	Low	Medium	High

Impact on ecosystem patterns and processes

6.09.03. What is the ecological importance of the host plants in the PRA area?

Low importance, Medium importance, High importance

Level of uncertainty:	Low	Medium	High

Conservation impacts

6.09.04. To what extent do the host plants occur in ecologically sensitive habitats (includes all officially protected nature conservation habitats)?

Low extent, Medium extent, High extent

Level of uncertainty:	Low	Medium	High

6.09.05. What is the risk that the pest would harm rare or vulnerable species? (includes all species classified as rare, vulnerable or endangered in official national or regional lists within the PRA area)

Low risk, Medium risk, High risk

Level of uncertainty:	Low	Medium	High

Impact of pesticides

6.09.06. What is the risk that the presence of the pest would result in an increased and intensive use of pesticides?

Low risk, Medium risk, High risk

Level of uncertainty:	Low	Medium	High

Appendix 3. Environmental sub-questions for plants *(note that matrices have been developed within CAPRA to combine the answers to the subquestions into a rating for questions 6.08)*

The plant has to be assessed for three categories of impact using several indicators that need to be rated. The precise region (and whether invaded or native) and the species (target species or closely-related species) for which the question is answered should be clearly described by the assessors.

The subquestions to be answered are organized as follows:
Negative impact on native biodiversity
6.08.01. To what extent does the plant cause a decline in native species populations and changes in communities of native species?
6.08.02. To what extent does the plant hybridize with native species?
Alteration of ecosystem processes and patterns
6.08.03. To what extent does the plant cause physical modifications of habitats?
6.08.04. To what extent does the plant cause changes to nutrient cycling and availability?
6.08.05. To what extent does the plant cause modifications of natural successions?
6.08.06. To what extent does the plant disrupt trophic and mutualistic interactions?
Conservation impacts
6.08.07. To what extent does the plant occur in habitats of high conservation value?
6.08.08. To what extent does the plant threaten rare or vulnerable species?

For each of the indicators, a rating is given based three choices: *Low*, *Medium* or *High*. Information is provided for each indicator on the meaning of these scores.

For each answer, the associated uncertainty should also be assessed, the possible options are *Low*, *Medium* or *High*:

Negative impact on native biodiversity
Note 1: The word "native" in "native species" or "native biodiversity" throughout Questions 6.08 and 6.09 should be understood in a broad sense, i.e. it should also include species that have been naturalised for centuries and that play an important role in the ecosystems or local cultural heritage, such as walnut (Juglans) or chestnut (Castanea) in Europe. The assessor may also include other, more recently introduced beneficial organisms such as exotic plants that play a role in ecosystem services, e.g. plants used against erosion.

Note 2: If possible, all mechanisms of impact on native biodiversity should be considered, but only the mechanism providing the highest score and lowest uncertainty is kept for the scoring of the indicators. Mechanisms of impact may include, among others:

Competition with native vegetation for limiting resources: Invasive plants are, simply by occupying a large amount of space in invaded habitats, expected to impose a significant impact on the native vegetation through competition for space, light, water and nutrients. For example, the tall and densely growing alien *Fallopia* species shade out native plant species.

Allelopathy: Allelopathy is defined here as a chemically mediated interference competition between co-occurring plant species, including both direct effects of the chemicals and indirect effects of the chemicals that are mediated by the soil microbial community or other biota. Allelopathy is considered as an important mechanism for the invasion success of various alien invasive species, including *Ailanthus altissima, Solidago canadensis* or exotic *Fallopia* species.

Impact of vegetation changes on higher trophic levels: Changes in plant communities also alter communities at higher trophic levels. For example, because alien *Fallopia* species are poorly colonized by resident invertebrate herbivores, invasion by *Fallopia* species reduces diversity and productivity of

invertebrate communities, and, as a consequence, the fitness and density of vertebrates that rely on invertebrates as food source.

Changes of ecosystem processes: Change of ecosystem patterns and processes (as described in subquestions 6.08.03 to 6.08.06 below) may indirectly affect native vegetation. For example, increased nitrogen availability caused by nitrogen-fixing alien species such as *Robinia pseudoacacia* and Acacia may reduce the competitive performance of local plants and favour others. Also, changes in fire regime and pollination services may have serious impacts on native community structures. Physical and chemical modifications of habitats may also have an impact on invertebrate and microbial soil communities.

Disease vector: Alien plants can act as a vector of plant diseases affecting native vegetation. For example, in Europe, the sudden oak death *Phythophtora ramorum* is spread mainly by the trade of exotic ornamentals such as *Viburnum* spp. and *Rhododendron* spp.

Pesticide use: An intensive use of non-specific pesticides over wide areas may affect native biodiversity, in particular when used in natural or semi-natural habitats (e.g. forests, wetlands). For example, herbicides used to control invasive *Fallopia spp*. have lethal effects on amphibians.

Hybridization: Hybridization between an alien and a native species or sub-species may affect the genetic integrity of native species or sub-species. For example, the Spanish Bluebell *Hyacinthoides hispanicus* successfully hybridizes with the native bluebell *Hyacinthoides non-scripta* in the UK

6.08.01. To what extent does the plant cause a decline in native species populations and changes in communities of native species?

Low extent, Medium extent, High extent

Level of uncertainty:	**Low**	**Medium**	**High**

6.08.02. To what extent does the plant hybridize with native species?

Low extent, Medium extent, High extent

Level of uncertainty:	**Low**	**Medium**	**High**

Alteration of ecosystem patterns and processes

Note: Only the impact on natural or semi-natural habitats should be considered when assessing the impact on ecosystem processes and patterns. However, natural and semi-natural habitats have to be considered in a broad sense, i.e. every habitat that is not under constant human management. It includes all EUNIS habitat types 1 (http://eunis.eea.europa.eu/habitats-code-browser.jsp), except I (Regularly or recently cultivated agricultural, horticultural and domestic habitats) and J (Constructed, industrial and other artificial habitats). For example, grasslands that are regularly mown are included as well, but not those that are repeatedly re-seeded.

6.08.03. To what extent does the plant cause physical modifications of habitats (e.g. changes to the hydrology, significant increase of water turbidity, light interception, alteration of river banks, changes in fire regime, etc.)?

Low extent, Medium extent, High extent

Level of uncertainty:	**Low**	**Medium**	**High**

6.08.04. To what extent does the plant cause changes to nutrient cycling and availability (e.g. significant changes in nutrient pools in topsoils or in water)?

Low extent, Medium extent, High extent

Level of uncertainty:	**Low**	**Medium**	**High**

6.08.05. To what extent does the plant cause modifications of natural successions (e.g. acceleration or temporary freezing of successions)?

Low extent, Medium extent, High extent

Level of uncertainty:	**Low**	**Medium**	**High**

6.08.06. To what extent does the plant disrupt trophic and mutualistic interactions (e.g. through the alteration of pollinator visitations - leading to a decrease in the reproductive success of native species-, allelopathic interactions, strong reduction of phytophagous or saprophagous communities, etc.)?

Low extent, Medium extent, High extent

Level of uncertainty:	**Low**	**Medium**	**High**

Conservation impacts

6.08.07. To what extent does the plant occur in habitats of high conservation value (includes all officially protected nature conservation habitats)?

Low extent, Medium extent, High extent

Level of uncertainty:	**Low**	**Medium**	**High**

6.08.08. To what extent does the plant threaten rare or vulnerable species (includes all species classified as rare, vulnerable or endangered in official national or regional lists within the PRA area)?

Low extent, Medium extent, High extent

Level of uncertainty:	**Low**	**Medium**	**High**